FEDERAL ENERGY REGULATORY COMMISSION
Routing Code: PJ-11.1, 2, 3, or 4
Washington, DC 20426

Official Business
Penalty for Private Use

Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Volume I

Oregon LNG and Washington Expansion Projects

Draft Environmental Impact Statement

FERC/DEIS-0261D

Docket Nos.
CP09-6-000, 001
CP09-7-000, 001
CP13-507-000

DOE Docket No.
FE 12-48-LNG

August 2015

Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Oregon LNG and Washington Expansion Projects

Draft Environmental Impact Statement

Volume I



LNG Development Company, LLC
Docket Nos. CP09-6-000,
CP09-6-001

Oregon Pipeline Company, LLC
Docket Nos. CP09-7-000,
CP09-7-001

Northwest Pipeline LLC
Docket No. CP13-507-000

FERC/DEIS-0261D
DOE Docket No. FE 12-48-LNG

Cooperating Agencies:

August 2015

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 2
LNG Development Company, LLC and
Oregon Pipeline Company, LLC
Docket Nos. CP09-6-001, CP09-7-001
Northwest Pipeline LLC
Docket No. CP13-507-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a draft environmental impact statement (EIS) for the Oregon LNG Terminal and Pipeline Project (Oregon LNG Project) proposed by LNG Development Company, LLC and Oregon Pipeline Company, LLC (collectively referred to as Oregon LNG) and the Washington Expansion Project proposed by Northwest Pipeline LLC (Northwest) in the above-referenced dockets. Oregon LNG requests authorization under Section 3 of the Natural Gas Act (NGA) to site, construct, and operate an import/export bidirectional liquefied natural gas (LNG) terminal in Warrenton, Oregon. Oregon LNG also requests a Certificate of Public Convenience and Necessity (Certificate) pursuant to Section 7(c) of the NGA to construct and operate a natural gas pipeline from the proposed LNG terminal to an interconnect with the interstate transmission system of Northwest near Woodland, Washington. Northwest requests a Certificate pursuant to Section 7(c) of the NGA to expand the capacity of its existing natural gas transmission facilities between Woodland and Sumas, Washington. The primary purpose of the projects is to export an equivalent of about 456.3 billion cubic feet per year of natural gas to foreign markets.

The draft EIS assesses the potential environmental effects of the construction and operation of the Oregon LNG and Washington Expansion Projects in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed projects would result in some adverse environmental impacts; however, most of these impacts would be reduced to less-than-significant levels with the implementation of Oregon LNG's and Northwest's proposed mitigation and the additional measures recommended in the draft EIS.

The U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Coast Guard, U.S. Department of Energy, and U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration participated as cooperating agencies in the preparation of the EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis. Although the cooperating agencies provided input to the conclusions and recommendations presented in the draft EIS, the agencies will present their own conclusions and recommendations in their respective records of decision or determinations for the projects.

The draft EIS addresses the potential environmental effects of the construction and operation of the following facilities for the Oregon LNG Project:

- one marine terminal with a ship berth for one LNG marine carrier;
- two full-containment storage tanks, each designed to store 160,000 cubic meters of LNG;
- natural gas pretreatment facilities;
- two liquefaction process trains, regasification facilities, and other related terminal support structures and systems;
- an 86.8-mile-long, 36-inch-diameter bidirectional pipeline; and
- one 40-megawatt (MW), 48,000-horsepower (hp) electrically driven gas compressor station.

For the Washington Expansion Project, the draft EIS addresses the potential environmental effects of the construction and operation of:

- 140.6 miles of 36-inch-diameter pipeline loop[1] along Northwest's existing pipeline in 10 noncontiguous segments;
- ancillary pipeline facilities; and
- 96,000 hp of additional compression at five existing compressor stations.

Northwest's project would also include abandonment and removal of existing pipeline and aboveground facilities.

The FERC staff mailed copies of the draft EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and groups; newspapers and libraries in the project area; and parties to these proceedings. Paper copy versions of this EIS were mailed to those specifically requesting them; all others received a CD version. In addition, the draft EIS is available for public viewing on the FERC's website (www.ferc.gov) using the eLibrary link. A limited number of copies are available for distribution and public inspection at:

[1] A pipeline loop is a segment of pipe constructed parallel to an existing pipeline to increase capacity.

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Any person wishing to comment on the draft EIS may do so. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments on or before **October 6, 2015**.

For your convenience, there are four methods you can use to submit your comments to the Commission. In all instances, please reference the project docket numbers (CP09-6-001, CP09-7-001, and CP13-507-000) with your submission. The Commission encourages electronic filing of comments and has expert staff available to assist you at (202) 502-8258 or efiling@ferc.gov.

1. You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on a project;

2. You can file your comments electronically by using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." If you are filing a comment on a particular project, please select "Comment on a Filing" as the filing type; or

3. You can file a paper copy of your comments by mailing them to the following address:

   Kimberly D. Bose, Secretary
   Federal Energy Regulatory Commission
   888 First Street NE, Room 1A
   Washington, DC 20426

4. In lieu of sending written or electronic comments, the Commission invites you to attend one of the public comment meetings its staff will conduct in the project area to receive comments on the draft EIS. We encourage interested groups and individuals to attend and present oral comments on the draft EIS. Transcripts of the meetings will be available for review in eLibrary under the project docket numbers. A notice of meeting times and locations will be sent to the environmental mailing list and posted on the FERC eLibrary.

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (Title 18 Code of Federal Regulations Part 385.214).[2] Only intervenors have the right to seek rehearing of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding that no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

Questions?

Additional information about the project is available from the Commission's Office of External Affairs, at **(866) 208-FERC,** or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number, excluding the last three digits in the Docket Number field (i.e., CP09-6-001, CP09-7-001, and CP13-507-000). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676; for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

[2] See the previous discussion on the methods for filing comments.

TABLE OF CONTENTS: VOLUME I

EXECUTIVE SUMMARY ES-1

INTRODUCTION ES-1

PROPOSED ACTION ES-1

PUBLIC INVOLVEMENT ES-2

ENVIRONMENTAL IMPACTS AND MITIGATION ES-3

ALTERNATIVES CONSIDERED ES-14

MAJOR CONCLUSIONS ES-15

1.0 INTRODUCTION 1-1

1.1 OREGON LNG 1-3

1.2 WASHINGTON EXPANSION PROJECT 1-6

1.3 PROJECT PURPOSE AND NEED 1-8

1.4 PURPOSE AND SCOPE OF THIS EIS 1-8

1.4.1 Federal Energy Regulatory Commission 1-8

1.4.2 U.S. Army Corps of Engineers 1-9

1.4.3 U.S. Coast Guard 1-9

1.4.4 U.S. Environmental Protection Agency 1-10

1.4.5 U.S. Fish and Wildlife Service 1-11

1.4.6 U.S. Department of Transportation 1-11

1.4.7 U.S. Department of Energy 1-11

1.4.8 Topics Outside the Scope of this EIS 1-12

1.5 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS 1-13

1.5.1 Federal 1-13

1.5.1.1 Clean Water Act and River and Harbors Act 1-14

1.5.1.2 Clean Air Act 1-14

1.5.1.3 Endangered Species Act 1-15

1.5.1.4 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act 1-15

1.5.1.5 Magnuson-Stevens Fishery Conservation and Management Act 1-15

1.5.1.6 Marine Mammal Protection Act 1-16

1.5.1.7 Marine Protection, Research and Sanctuaries Act 1-16

1.5.1.8 National Historic Preservation Act 1-17

1.5.1.9 Coastal Zone Management Act 1-17

1.5.1.10 U.S. Department of Defense Consultation 1-18

1.5.2 Oregon Laws and Regulations 1-18
1.5.2.1 Safety Advisory and Agency Coordination 1-18
1.5.2.2 State-Listed Endangered and Threatened Species 1-19
1.5.2.3 Oregon Removal-Fill Law 1-19
1.5.2.4 Fish and Wildlife Habitat Mitigation Policy 1-19
1.5.2.5 Forest Practices Act 1-20
1.5.2.6 Oregon State Historic Preservation Office 1-20
1.5.3 Washington Laws and Regulations 1-20
1.5.3.1 State Environmental Policy Act 1-20
1.5.3.2 Growth Management Act 1-21
1.5.3.3 Shoreline Management Act and Hydraulic Project Approval 1-21
1.5.3.4 Washington State Historic Preservation Office 1-21
1.5.4 Permit Summary Tables 1-21
1.5.4.1 Oregon LNG Project 1-21
1.5.4.2 Washington Expansion Project 1-27
1.6 PUBLIC REVIEW AND COMMENT 1-30
1.6.1 Notices and Meetings 1-30
1.6.2 Scoping Comments 1-33
2.0 DESCRIPTION OF PROPOSED ACTIONS 2-1
2.1 OREGON LNG PROJECT 2-1
2.1.1 Project Components 2-1
2.1.1.1 Terminal Facilities 2-1
2.1.1.2 Pipeline and Associated Aboveground Facilities 2-10
2.1.1.3 Wetland and Habitat Mitigation Sites 2-12
2.1.2 Nonjurisdictional Facilities 2-17
2.1.2.1 LNG Marine Carriers and Waterway for LNG Marine Traffic 2-17
2.1.2.2 Terminal Electrical Power Supply 2-19
2.1.2.3 Terminal Wastewater and Water Lines 2-22
2.1.2.4 Compressor Station Electrical Substation and Transmission Line 2-25
2.1.3 Land Requirements 2-25
2.1.3.1 Terminal Facilities 2-26
2.1.3.2 Pipeline and Associated Aboveground Facilities 2-26

2.1.4 Construction Procedures....2-27
2.1.4.1 Terminal Facilities....2-28
2.1.4.2 Pipeline and Associated Aboveground Facilities....2-32
2.1.5 Construction Schedule....2-45
2.1.6 Environmental Compliance Inspection and Mitigation Monitoring....2-45
2.1.7 Operation and Maintenance Procedures....2-46
2.1.7.1 Terminal Facilities....2-46
2.1.7.2 Pipeline and Associated Aboveground Facilities....2-47
2.1.8 Future Plans and Abandonment....2-47
2.2 WASHINGTON EXPANSION PROJECT....2-48
2.2.1 Project Components....2-48
2.2.1.1 Pipeline Facilities....2-48
2.2.1.2 Aboveground Facilities....2-52
2.2.2 Land Requirements....2-56
2.2.3 Construction Procedures....2-59
2.2.3.1 General Pipeline Construction Procedures....2-59
2.2.3.2 Special Pipeline Construction Procedures....2-62
2.2.3.3 Aboveground Facilities Construction Procedures....2-69
2.2.4 Construction Schedule....2-70
2.2.5 Environmental Compliance Inspection and Mitigation Monitoring....2-70
2.2.6 Operation, Maintenance, and Safety Controls....2-71
2.2.6.1 Pipeline Facilities....2-71
2.2.6.2 Compressor Stations....2-72
3.0 ALTERNATIVES....3-1
3.1 NO ACTION....3-2
3.2 SYSTEM ALTERNATIVES....3-3
3.2.1 Existing Pipelines....3-3
3.2.1.1 Replace Northwest's Existing Pipeline with Larger Diameter Pipeline....3-6
3.2.1.2 Return Northwest's Abandoned Pipeline to Service....3-6
3.2.1.3 Remove the Abandoned Pipeline and Place the New Pipeline in the Same Trench for the Entire Length of the WEP....3-7
3.2.2 Existing and Proposed LNG Facilities....3-7
3.2.2.1 Existing LNG Terminals....3-7
3.2.2.2 Existing LNG Storage Facilities in the Pacific Northwest....3-8

3.2.2.3 Proposed LNG Export Terminals on the West Coast of North America 3-9
3.3 LNG TERMINAL ALTERNATIVES 3-10
3.3.1 Offshore LNG Terminal Alternatives 3-10
3.3.2 Onshore Terminal Site Alternatives 3-12
3.3.2.1 Initial Screening 3-12
3.3.2.2 Lower Columbia River Site Evaluation 3-13
3.3.2.3 Terminal Design Alternatives 3-33
3.3.3 Dredging Alternatives 3-35
3.3.3.1 Dredged Material Placement Sites 3-35
3.3.3.2 Dredging Methods 3-40
3.3.3.3 Dredging Alternatives Conclusions 3-41
3.4 PIPELINE ALTERNATIVES 3-41
3.4.1 Oregon LNG Project 3-41
3.4.1.1 Pipeline Route Alternatives Eliminated from Detailed Analyses 3-42
3.4.1.2 Major Route Alternatives 3-42
3.4.1.3 Minor Route Alternatives 3-45
3.4.1.4 Minor Route Variations 3-49
3.4.1.5 Compressor Station Alternatives 3-52
3.4.2 Washington Expansion Project 3-55
3.4.2.1 Major Route Alternatives 3-55
3.4.2.2 Minor Route Variations 3-55
4.0 ENVIRONMENTAL ANALYSIS 4-1
4.0 ENVIRONMENTAL ANALYSIS 4-1
4.1 OREGON LNG PROJECT 4-2
4.1.1 Geological Resources 4-2
4.1.1.1 Terminal 4-2
4.1.1.2 Pipeline 4-16
4.1.1.3 Compressor Station 4-28
4.1.2 Soils and Sediments 4-28
4.1.2.1 Terminal 4-29
4.1.2.2 Pipeline and Associated Facilities 4-33

4.1.3 Water Resources....4-39
4.1.3.1 Groundwater....4-39
4.1.3.2 Surface Waters....4-44
4.1.4 Wetlands....4-62
4.1.4.1 Terminal....4-64
4.1.4.2 Pipeline and Associated Facilities....4-65
4.1.4.3 Compensatory Mitigation....4-72
4.1.5 Aquatic Resources....4-73
4.1.5.1 Existing Aquatic Resources....4-73
4.1.5.2 Aquatic Resources Impacts and Mitigation....4-79
4.1.5.3 Essential Fish Habitat....4-112
4.1.6 Vegetation....4-118
4.1.6.1 Terminal....4-120
4.1.6.2 Pipeline and Associated Facilities....4-121
4.1.7 Terrestrial Wildlife....4-129
4.1.7.1 Terminal....4-132
4.1.7.2 Pipeline Facilities....4-138
4.1.7.3 Habitat Mitigation Policy....4-143
4.1.7.4 Big Game Habitat....4-145
4.1.7.5 Migratory Birds....4-146
4.1.8 Threatened, Endangered, and Other Special Status Species....4-152
4.1.8.1 Federally Listed Threatened and Endangered Species....4-153
4.1.8.2 State Listed Threatened and Endangered Species....4-223
4.1.8.3 Other Special Status Species....4-228
4.1.9 Land Use, Recreation, and Visual Resources....4-229
4.1.9.1 Terminal and Waterway....4-229
4.1.9.2 Pipeline and Associated Facilities....4-256
4.1.10 Socioeconomics....4-284
4.1.10.1 Terminal....4-284
4.1.10.2 Pipeline and Associated Facilities....4-299
4.1.11 Cultural Resources....4-314
4.1.11.1 Consultations....4-314
4.1.11.2 Results of Literature Reviews and Cultural Resources Surveys....4-319
4.1.11.3 Unanticipated Discovery Plan....4-321

4.1.11.4 Compliance with the NHPA 4-322
4.1.12 Air Quality and Noise 4-323
4.1.12.1 Air Quality 4-323
4.1.12.2 Noise 4-349
4.1.13 Reliability and Safety 4-369
4.1.13.1 LNG Facility Regulatory Oversight 4-369
4.1.13.2 LNG Facility Hazards 4-370
4.1.13.3 Past Incidents at LNG Plants 4-375
4.1.13.4 Technical Review of the Preliminary Engineering Designs 4-376
4.1.13.5 Siting Requirements 4-387
4.1.13.6 Siting Analysis for Facilities at the Terminal 4-390
4.1.13.7 LNG Marine Carriers 4-413
4.1.13.8 Regulatory Requirements for LNG Marine Carrier Operations 4-424
4.1.13.9 Emergency Response and Evacuation 4-430
4.1.13.10 Facility Security and LNG Vessel Safety 4-431
4.1.13.11 Conclusions on Facility Reliability and Safety 4-432
4.1.13.12 ODE Safety Advisory Report 4-432
4.1.13.13 Pipeline Facilities 4-432
4.2 WASHINGTON EXPANSION PROJECT 4-441
4.2.1 Geological Resources 4-440
4.2.1.1 Geologic Setting 4-440
4.2.1.2 Mineral Resources 4-441
4.2.1.3 Seismic Related Hazards and Mitigation 4-444
4.2.1.4 Other Geologic and Natural Hazards 4-449
4.2.1.5 Paleontological Resources 4-454
4.2.2 Soils 4-455
4.2.2.1 Existing Environment 4-455
4.2.2.2 Soil Characteristics and Limitations 4-459
4.2.2.3 Soil Contamination 4-462
4.2.2.4 Alternative Measures to Our Plan 4-462
4.2.3 Water Resources 4-462
4.2.3.1 Groundwater 4-462
4.2.3.2 Surface Waters 4-472

4.2.4 Wetlands 4-483
4.2.4.1 Existing Environment 4-485
4.2.4.2 Wetland Impacts and Mitigation 4-487
4.2.4.3 Compensatory Wetland Mitigation 4-490
4.2.4.4 Alternative Measures to Our Procedures 4-490
4.2.5 Aquatic Resources 4-495
4.2.5.1 Existing Aquatic Resources 4-495
4.2.5.2 Aquatic Resources Impacts and Mitigation 4-497
4.2.5.3 Essential Fish Habitat 4-504
4.2.6 Vegetation 4-506
4.2.6.1 Existing Environment 4-506
4.2.6.2 Impacts and Mitigation 4-508
4.2.6.3 Forest Practices 4-511
4.2.7 Terrestrial Wildlife 4-512
4.2.7.1 Existing Environment 4-512
4.2.7.2 Unique or Sensitive Habitats 4-514
4.2.7.3 Impacts and Mitigation 4-516
4.2.7.4 Migratory Birds 4-519
4.2.8 Threatened, Endangered, and Other Special Status Species 4-520
4.2.8.1 Federally Listed Threatened and Endangered Species 4-520
4.2.8.2 State Listed and Other Special Status Species 4-547
4.2.9 Land Use, Recreation, and Visual Resources 4-551
4.2.9.1 Land Use 4-551
4.2.9.2 New and Planned Developments 4-568
4.2.9.3 Schools 4-571
4.2.9.4 Zoning 4-573
4.2.9.5 Coastal Zone Management Act 4-573
4.2.9.6 Washington Shoreline Management Act 4-574
4.2.9.7 Land Ownership 4-574
4.2.9.8 Scenic Highways 4-575
4.2.9.9 Wild and Scenic Rivers 4-576
4.2.9.10 Recreation and Public Interest Areas 4-576
4.2.9.11 Special Land Use Areas 4-584
4.2.9.12 Visual Resources 4-587

4.2.10 Socioeconomics 4-589
4.2.10.1 Population 4-589
4.2.10.2 Economy and Employment 4-590
4.2.10.3 Tax Revenues 4-591
4.2.10.4 Housing 4-592
4.2.10.5 Property Values 4-593
4.2.10.6 Public Services 4-594
4.2.10.7 Transportation and Traffic 4-601
4.2.10.8 Native American Treaty Fishing 4-603
4.2.10.9 Environmental Justice 4-603
4.2.11 Cultural Resources 4-608
4.2.11.1 Consultations 4-608
4.2.11.2 Results of Literature Reviews and Cultural Resources Surveys 4-611
4.2.11.3 Unanticipated Discovery Plan 4-613
4.2.11.4 Compliance with the NHPA 4-613
4.2.12 Air Quality and Noise 4-615
4.2.12.1 Air Quality 4-615
4.2.12.2 Noise 4-637
4.2.13 Reliability and Safety 4-658
4.2.13.1 Safety Standards 4-658
4.2.13.2 Pipeline Accident Data 4-660
4.2.13.3 Impact on Public Safety 4-660
4.3 CUMULATIVE EFFECTS 4-661
4.3.1 Cumulative Effects on Resources 4-666
4.3.2 Cumulative Effects from Other Proposed LNG Actions in Oregon 4-681
4.3.3 Cumulative Effects Conclusions 4-682
5.0 CONCLUSIONS AND RECOMMENDATIONS 5-1
5.1 SUMMARY OF THE ENVIRONMENTAL ANALYSIS 5-1
5.1.1 Geological Resources 5-1
5.1.1.1 Oregon LNG Project 5-1
5.1.1.2 WEP 5-3
5.1.2 Soils and Sediments 5-4
5.1.2.1 Oregon LNG Project 5-4
5.1.2.2 WEP 5-5

5.1.3 Water Resources 5-5
5.1.3.1 Oregon LNG Project 5-5
5.1.3.2 WEP 5-7
5.1.4 Wetlands 5-8
5.1.4.1 Oregon LNG Project 5-8
5.1.4.2 WEP 5-9
5.1.5 Aquatic Resources 5-10
5.1.5.1 Oregon LNG Project 5-10
5.1.5.2 WEP 5-12
5.1.6 Vegetation 5-13
5.1.6.1 Oregon LNG Project 5-13
5.1.6.2 WEP 5-14
5.1.7 Wildlife 5-15
5.1.7.1 Oregon LNG Project 5-15
5.1.7.2 WEP 5-16
5.1.8 Threatened, Endangered, and Other Special Status Species 5-17
5.1.8.1 Oregon LNG Project 5-17
5.1.8.2 WEP 5-18
5.1.9 Land Use, Recreation, and Visual Resources 5-19
5.1.9.1 Oregon LNG Project 5-19
5.1.9.2 WEP 5-21
5.1.10 Socioeconomics 5-22
5.1.10.1 Oregon LNG Project 5-22
5.1.10.2 WEP 5-24
5.1.11 Cultural Resources 5-25
5.1.11.1 Oregon LNG Project 5-25
5.1.11.2 WEP 5-26
5.1.12 Air Quality and Noise 5-26
5.1.12.1 Oregon LNG Project 5-26
5.1.12.2 WEP 5-28
5.1.13 Reliability and Safety 5-29
5.1.13.1 Oregon LNG Project 5-29
5.1.13.2 WEP 5-29
5.1.14 Cumulative Effects 5-29

5.1.15 Alternatives 5-31
5.2 FERC STAFF'S RECOMMENDED MITIGATION 5-33
5.2.1 Oregon LNG Project 5-33
5.2.2 Washington Expansion Project 5-51

LIST OF TABLES

Table 4.1.1-1 Terminal Site Stratigraphy 4-3
Table 4.1.1-2 Site-specific Probabilistic Seismic Hazard Analysis Values for the Oregon LNG Terminal 4-11
Table 4.1.1-3 Mineral Resources Within 0.25 Mile of Oregon LNG Pipeline 4-18
Table 4.1.1-4 Peak Ground Accelerations along Oregon LNG Pipeline Route 4-20
Table 4.1.1-5 Portions of the Oregon LNG Pipeline Route Within the 100-Year Floodplain 4-27
Table 4.1.2-1 Soil Units at Terminal 4-29
Table 4.1.2-2 Characteristics of Soils Affected by Construction at the Terminal 4-30
Table 4.1.2-3 Soil Units Crossed by the Oregon LNG Pipeline 4-33
Table 4.1.2-4 Soil Units at Oregon LNG Pipeline Aboveground Facilities and Contractor/Pipe Storage Yards 4-35
Table 4.1.2-5 Characteristics and Limitations of Soils Affected by Construction of the Oregon LNG Pipeline Facilities 4-36
Table 4.1.3-1 Critical Aquifer Recharge Areas Crossed by the Oregon LNG Pipeline, Cowlitz County, Washington 4-41
Table 4.1.3-2 Water Wells Within 150 Feet of Oregon LNG Pipeline Construction Right-of-way 4-42
Table 4.1.3-3 Water Needs for Construction of the Terminal 4-47
Table 4.1.3-4 LNG Marine Carrier Ballast and Cooling Water Requirements 4-50
Table 4.1.3-5 303(d) Waterbodies Crossed by the Oregon LNG Pipeline 4-52
Table 4.1.3-6 Flood Control Dikes Crossed by the Oregon LNG Pipeline 4-53
Table 4.1.3-7 Vertical Scour and Lateral Channel Migration Potential at Waterbody Crossings that Support Federally Listed Fish 4-55
Table 4.1.3-8 Water Demand for Hydrostatic Testing of Oregon LNG Pipeline 4-59
Table 4.1.3-9 Projected Water Needs for Horizontal Directional Drilling 4-61
Table 4.1.4-1 Cowardin Classifications of Wetlands in the Oregon LNG Project Area 4-63
Table 4.1.4-2 Wetlands Affected by the Terminal 4-64
Table 4.1.4-3 Typical Wetland Plant Species Along the Proposed Oregon LNG Pipeline 4-66
Table 4.1.4-4 Wetlands Impacted by Oregon LNG Pipeline Construction and Operation 4-67
Table 4.1.4-5 Differences Between Oregon LNG's Procedures and Our Procedures 4-72
Table 4.1.5-1 Fish Species Commonly Found in Terminal Area 4-74

Table 4.1.5-2 Representative Fish Species in Waterbodies Crossed by the Oregon LNG Pipeline 4-77
Table 4.1.5-3 Waterbodies with Anadromous and Resident Salmonid Species Crossed by the Oregon LNG Pipeline 4-78
Table 4.1.5-4 Distances to Noise Impact Thresholds for Impact Pile Driving 4-87
Table 4.1.5-5 Potential Impacts on Essential Fish Habitat from Terminal Construction and Operation 4-114
Table 4.1.5-6 Potential Impacts on EFH from Oregon LNG Pipeline Construction 4-117
Table 4.1.6-1 Ecoregions Crossed by the Oregon LNG Project 4-119
Table 4.1.6-2 Upland Vegetation Affected by Construction and Operation of the Terminal 4-120
Table 4.1.6-3 Noxious Weeds and Invasive Plant Species Along the Proposed Oregon LNG Pipeline Route 4-122
Table 4.1.6-4 Upland Vegetation Types Affected by the Oregon LNG Pipeline 4-122
Table 4.1.7-1 Wildlife Species Occurring Within the Vegetative Communities in the Vicinity of the Project 4-130
Table 4.1.7-2 ODFW Habitat Mitigation Goals and Implementation Standards 4-131
Table 4.1.7-3 Terminal Wildlife Habitat Impacts 4-133
Table 4.1.7-4 Oregon LNG Pipeline Wildlife Habitat Impacts for Oregon a 4-139
Table 4.1.7-5 Avoidance, Minimization, and Mitigation Measures for Affected Habitat Categories 4-144
Table 4.1.8-1 Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project 4-154
Table 4.1.8-2 Estimated Whale Strikes from LNG Marine Carriers in Oregon and Washington EEZ 4-165
Table 4.1.8-3 Estimated LNG Marine Carrier Strikes on Whales Over 50 Years 4-166
Table 4.1.8-4 Typical and Approximate Timing of Federally Listed Fish in the Vicinity of the Terminal 4-188
Table 4.1.8-5 Timing of Peak Green Sturgeon, Eulachon and Juvenile Salmonid Abundance 4-199
Table 4.1.8-6 Juvenile Salmonids Potentially Affected by Pile Driving Noise 4-204
Table 4.1.8-7 Waterbody Crossings Where Federally Listed Fish May Be Present and Associated In-Water Work Periods 4-211
Table 4.1.8-8 Potential Oregon LNG Pipeline Effects on Salmonid Critical Habitat 4-214
Table 4.1.8-9 Length of Riparian Effect Within Basins 4-216
Table 4.1.8-10 Federally Listed Fish Species and Critical Habitat Potentially Occurring in Project Area and Effect Determination 4-217
Table 4.1.8-11 State Listed or Candidate Species Potentially Occurring in the Vicinity of the Oregon LNG Project 4-223
Table 4.1.9-1 Land Use Impacts Associated with the Terminal 4-230

Table 4.1.9-2 Marinas and Boat Launches along the LNG Waterway 4-237
Table 4.1.9-3 Key Observation Points 4-242
Table 4.1.9-4 Land Use Associated with the Proposed Oregon LNG Pipeline Facilities Construction 4-258
Table 4.1.9-5 Land Use Associated with the Proposed Oregon LNG Pipeline Facilities Operation 4-260
Table 4.1.9-6 Comprehensive Plan Designations and Zoning Districts Crossed, City of Warrenton 4-264
Table 4.1.9-7 Comprehensive Plan Designations and Zoning Districts Crossed, Clatsop County 4-265
Table 4.1.9-8 Land Ownership Crossed by the Oregon LNG Pipeline 4-266
Table 4.1.9-9 Structures Within 50 Feet of the Oregon LNG Pipeline Construction Work Areas 4-267
Table 4.1.9-10 Planned Developments within 0.25 Mile of the Oregon LNG Pipeline Construction Right-of-way 4-272
Table 4.1.9-11 National or State Scenic Highways Crossed by the Oregon LNG Pipeline 4-273
Table 4.1.9-12 Recreational and Public Interest Areas Crossed or Within 0.25 Mile of the Oregon LNG Pipeline 4-276
Table 4.1.9-13 Impacts of Oregon LNG Pipeline Within State Forests 4-279
Table 4.1.10-1 Populations in Terminal Area 4-285
Table 4.1.10-2 Economic Conditions in the Terminal Area 4-286
Table 4.1.10-3 Housing Characteristics in the Waterway and Terminal Area 4-288
Table 4.1.10-4 Existing Public Services in the Vicinity of the Terminal and Waterway 4-290
Table 4.1.10-5 Existing Intersection Conditions (2012) 4-295
Table 4.1.10-6 Background Traffic Growth Intersection Conditions (2016) 4-295
Table 4.1.10-7 Total Traffic Intersection Conditions (2016) 4-296
Table 4.1.10-8 Demographics in the Vicinity of the Terminal 4-298
Table 4.1.10-9 Income Distribution in the Vicinity of the Terminal 4-299
Table 4.1.10-10 Populations in Counties Crossed by the Oregon LNG Pipeline Route (2010) 4-300
Table 4.1.10-11 Selected Socioeconomic Characteristics in Counties Crossed by the Oregon LNG Pipeline Route 4-301
Table 4.1.10-12 Forecast of Assessed Value and Property Tax 4-302
Table 4.1.10-13 Forecast of Assessed Value and Property Tax Imposed Within State Forests 4-302
Table 4.1.10-14 Housing Characteristics in Counties Crossed by the Oregon LNG Pipeline Route 4-303
Table 4.1.10-15 Major Utilities Crossed by the Pipeline 4-305
Table 4.1.10-16 Emergency Services in Counties Crossed by the Oregon LNG Pipeline Route 4-305
Table 4.1.10-17 Fire Districts Crossed by the Oregon LNG Pipeline Route 4-306
Table 4.1.10-18 Hospitals in Counties Crossed by the Oregon LNG Pipeline Route 4-306
Table 4.1.10-19 Number of School Districts and Enrollment in the Oregon LNG Pipeline Area 4-307

Table 4.1.10-20 Major Roads Crossed by the Oregon LNG Pipeline Route 4-309
Table 4.1.10-21 Demographics of Counties Crossed by the Oregon LNG Pipeline Route 4-311
Table 4.1.10-22 Demographics of Census Tracts Crossed by the Oregon LNG Pipeline Route 4-312
Table 4.1.10-23 Income Distribution of Counties Crossed by the Oregon LNG Pipeline Route 4-313
Table 4.1.10-24 Poverty Status by Census Tract for Area Crossed by the Oregon LNG Pipeline Route 4-313
Table 4.1.11-1 Cultural Resources Identified During Oregon LNG Surveys of the Direct APE Along the Pipeline Route 4-321
Table 4.1.12-1 National Ambient Air Quality Standards and Background Levels 4-326
Table 4.1.12-2 SO2 Ambient Air Quality Standards 4-327
Table 4.1.12-3 Stationary Source Information 4-330
Table 4.1.12-4 Summary of Air Pollutant Emissions from Terminal Construction Activities 4-335
Table 4.1.12-5 Summary of Construction Emissions from the Oregon LNG Compressor Station 4-336
Table 4.1.12-6 Summary of Construction Air Pollutant Emissions from the Project 4-337
Table 4.1.12-7 Summary of Potential Emissions from the Terminal During Operation 4-339
Table 4.1.12-8 Summary of Indirect Emissions from Terminal Operation 4-340
Table 4.1.12-9 Marine Vessel Emissions Comparison 4-340
Table 4.1.12-10 Air Quality Modeling Results Compared to National Ambient Air Quality Standards 4-344
Table 4.1.12-11 Class I Modeling Results for the Terminal 4-345
Table 4.1.12-12 Emissions used in Class I AQRV Screening Analysis of Terminal 4-346
Table 4.1.12-13 New Industrial and Commercial Noise Source Standards 4-350
Table 4.1.12-14 Maximum Permissible Noise Levels from a Class C EDNA 4-351
Table 4.1.12-15 Maximum Permissible Sound Pressure Levels in Woodland, Washington 4-352
Table 4.1.12-16 Monitoring Site Locations—Description and Summary 4-353
Table 4.1.12-17 Typical Equipment Noise Levels for Heavy Construction Projects 4-354
Table 4.1.12-18 Noise-Producing Equipment at the Terminal 4-357
Table 4.1.12-19 Summary of Regulatory Noise Limits for the Oregon LNG Terminal 4-358
Table 4.1.12-20 Predicted Unmitigated Noise Levels During HDD Activities 4-365
Table 4.1.12-21 Site-specific Horizontal Directional Drilling Noise Levels 4-366
Table 4.1.12-22 Summary of Regulatory Noise Limits for the Compressor Station—Previously Unused Site 4-367
Table 4.1.12-23 Noise Analysis Results for the Compressor Station 4-367
Table 4.1.13-1 Toxicity Levels 4-374
Table 4.1.13-2 Process Impoundment Sizing Spills 4-392

Table 4.1.13-3 Design Spills 4-392
Table 4.1.13-4 H_2S Vapor Dispersion Distances 4-407
Table 4.1.13-5 Benzene Vapor Dispersion Distances 4-408
Table 4.1.13-6 Thermal Radiation from Design Spill Impoundments 4-411
Table 4.1.13-7 Thermal Radiation from the LNG Storage Tank Outer Concrete Wall Impoundment 4-411
Table 4.1.13-8 Natural Gas Transmission Pipeline Significant Incidents by Cause (1994-2013) 4-437
Table 4.1.13-9 Outside Forces Incidents by Cause (1994-2013) 4-438
Table 4.1.13-10 Injuries and Fatalities - Natural Gas Transmission Pipelines 4-439
Table 4.1.13-11 Nationwide Accidental Deaths 4-439
Table 4.2.1-1 Mineral Resources Within 0.25 Mile of the WEP 4-442
Table 4.2.1-2 Peak Ground Accelerations Along the WEP 4-445
Table 4.2.1-3 Locations with Moderate to High Liquefaction Hazard Along the WEP 4-448
Table 4.2.1-4 Volcanic Hazards in Proximity of the WEP 4-450
Table 4.2.1-5 Portions of the WEP Within the 100-year Floodplain 4-453
Table 4.2.1-6 Location of Potentially Fossiliferous Geologic Units 4-454
Table 4.2.2-1 Soil Associations Along the WEP Pipeline 4-456
Table 4.2.2-2 Characteristics and Limitations of Soils Affected by Construction 4-459
Table 4.2.2-3 Alternative Measures to Our Plan 4-462
Table 4.2.3-1 CARAs Crossed by the Woodland Loop in Cowlitz County 4-464
Table 4.2.3-2 CARAs Crossed by the Woodland and Chehalis Loops in Lewis County 4-465
Table 4.2.3-3 CARAs Crossed by the Chehalis Loop in Thurston County 4-466
Table 4.2.3-4 CARAs Crossed by the Sumner South Loop in Pierce County 4-467
Table 4.2.3-5 CARAs Crossed by the Sumner North A and B Loops in King County 4-467
Table 4.2.3-6 Group A Public Water Supply Wells within 400 Feet of the Construction Right-of-Way 4-469
Table 4.2.3-7 Group B Public Water Supply Wells within 400 Feet of the Construction Right-of-Way 4-470
Table 4.2.3-8 Surface Waterbody Classifications 4-472
Table 4.2.3-9 Water Quality Impaired and Water-Quality-Limited Streams Crossed by the WEP 4-474
Table 4.2.3-10 Surface Waterbodies Crossed by Each Loop 4-475
Table 4.2.3-11 Hydrostatic Test Water Source and Discharge Locations 4-482
Table 4.2.4-1 Typical Wetland Plant Species Along the WEP Pipeline 4-486
Table 4.2.4-2 Construction Wetlands Impacts Along the WEP Pipeline 4-487

Table 4.2.4-3 Areas Where Northwest Requested a Construction Right-of-Way Width Greater than 75 Feet in Category I and II Wetlands 4-491
Table 4.2.4-4 ATWS Less than 50 Feet from Wetlands and Waterbodies 4-493
Table 4.2.5-1 Fish-bearing Waterbodies by Water Resource Inventory Area Crossed by the WEP 4-496
Table 4.2.6-1 Ecoregions Affected by the WEP Pipeline 4-506
Table 4.2.6-2 Upland Vegetation Types Affected by the WEP Pipeline 4-509
Table 4.2.6-3 Miles of Merchantable Timber Crossed within the WEP 4-511
Table 4.2.7-1 Wildlife Species Occurring Within the Land Cover Types in the Vicinity of the WEP 4-512
Table 4.2.7-2 Sensitive Habitat Features Crossed by the WEP 4-515
Table 4.2.8-1 Federally and State Listed Species Potentially Occurring in the Vicinity of the WEP 4-521
Table 4.2.8-2 WEP Waterbody Crossings Where Federally Listed Fish May be Present and Associated In-water Work Periods 4-539
Table 4.2.8-3 Federally Listed Fish Species and Critical Habitat Potentially Crossed by the WEP and Effect Determinations 4-542
Table 4.2.9-1 WEP Pipeline Collocation within Existing Northwest Pipeline Right-of-way 4-552
Table 4.2.9-2 Land Requirements Associated with the WEP Construction 4-555
Table 4.2.9-3 Land Requirements Associated with the WEP Operation 4-557
Table 4.2.9-4 Land Uses Associated with the WEP Aboveground Facilities 4-558
Table 4.2.9-5 Residences within 50 Feet of Construction Right-of-way 4-564
Table 4.2.9-6 New and Planned Developments within 0.25 Mile of the WEP Construction Right-of-Way 4-568
Table 4.2.9-7 Schools, Colleges, and Learning Institutions Near or Adjacent to the WEP Pipeline 4-571
Table 4.2.9-8 Land Ownership Crossed by the WEP Pipeline 4-574
Table 4.2.9-9 Scenic and Memorial Highways Crossed or Within 0.25 mile of the WEP Pipeline 4-576
Table 4.2.9-10 Recreation and Public Interest Areas Crossed or Within 0.25 mile of the WEP-Pipeline 4-577
Table 4.2.9-11 Potential Contaminant Sources within 250 feet of the WEP Pipeline 4-586
Table 4.2.10-1 Socioeconomic Conditions in the Areas Crossed by the WEP 4-589
Table 4.2.10-2 Economic Characteristics of Counties Crossed by the WEP 4-590
Table 4.2.10-3 Projected Annual Property Tax by County 4-592
Table 4.2.10-4 Existing Housing Characteristics in Counties Crossed by the WEP (2010) 4-592
Table 4.2.10-5 Emergency Services in Larger Cities Near the WEP 4-594
Table 4.2.10-6 Fire Districts Crossed by the WEP 4-594
Table 4.2.10-7 Fire Districts and Stations within 5 Miles of the Pipeline Loops 4-596

Table 4.2.10-8 Police and Sheriff Stations within 5 Miles of the Pipeline Loops 4-597
Table 4.2.10-9 Hospitals in Larger Cities Near the WEP 4-598
Table 4.2.10-10 School Districts Crossed by the WEP 4-599
Table 4.2.10-11 Demographics and Income Distribution of Census Tracts Crossed by the WEP 4-604
Table 4.2.11-1 Previously Recorded Cultural Resources within the APE 4-611
Table 4.2.11-2 Historic GLO Survey Plat Features Within 0.25 Mile of the Pipeline 4-612
Table 4.2.11-3 Cultural Resources Identified During 2012 Northwest Surveys of the APE for the WEP 4-613
Table 4.2.11-4 Areas That Still Require Archaeological Surveys 4-614
Table 4.2.12-1 Summary of Potential-to-Emit from Existing Compressor Stations 4-617
Table 4.2.12-2 National and State Ambient Air Quality Standards and Background Levels 4-618
Table 4.2.12-3 Compressor Station PSD Applicability 4-620
Table 4.2.12-4 Summary of Emissions Increase 4-621
Table 4.2.12-5 Screening for Class I Areas within 100 Kilometers of the WEP Compressor Stations 4-624
Table 4.2.12-6 Conformity Applicability for Construction of Chehalis, Sumner South, Sumner North A, and Sumner North B Loops 4-625
Table 4.2.12-7 Conformity Applicability for Construction of Sumner North B and Snohomish Loops 4-625
Table 4.2.12-8 Conformity Applicability for Sumner South Loop Construction 4-625
Table 4.2.12-9 Conformity Applicability for Sumner Compressor Station Construction 4-626
Table 4.2.12-10 Conformity Applicability for Snohomish Compressor Station Construction 4-626
Table 4.2.12-11 Summary of Estimated Construction Emissions from the WEP Pipeline Modifications 4-632
Table 4.2.12-12 Summary of Total Estimated Construction Emissions 4-632
Table 4.2.12-13 Estimated WEP Pipeline Fugitive and Venting Emissions 4-633
Table 4.2.12-14 Estimated Total Potential Emissions from Operation of the Compressor Stations and Percentage Change over Existing Emissions 4-634
Table 4.2.12-15 Air Dispersion Modeling Results 4-634
Table 4.2.12-16 Local Noise Regulations 4-638
Table 4.2.12-17 Measured Noise Levels at NSAs Closest to the Compressor Stations 4-639
Table 4.2.12-18 Measured Noise Levels in the Vicinity of Proposed HDD Crossings 4-645
Table 4.2.12-19 Predicted HDD Noise Levels in the Vicinity of the Cowlitz River Crossing 4-651
Table 4.2.12-20 Predicted HDD Noise Levels in the Vicinity of the Newaukum River Crossing 4-652
Table 4.2.12-21 Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed Puyallup River HDD Crossing 4-653

Table 4.2.12-22 Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed Snohomish River HDD Crossing 4-653
Table 4.2.12-23 Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed South Fork Nooksack River HDD Crossing 4-654
Table 4.3-1 Past, Present, and Reasonably Foreseeable Future Actions 4-662
Table 4.3.1-1 Permanent Upland Vegetation Types Affected by Oregon LNG and the WEP 4-670
Table 4.3.1-2 Combined Federally Listed Species Effect Determinations 4-672
Table 4.3.2-1 Impacts Summary for JCE & PCGP and Oregon LNG Projects 4-681

LIST OF FIGURES

Figure 1.1-1: General Location Map for Oregon LNG Project 1-5
Figure 1.2-1: General Location Map for Washington Expansion Project 1-7
Figure 2.1.1-1: Proposed Terminal Layout 2-2
Figure 2.1.1-2: Area to be Dredged 2-4
Figure 2.1.1-3: Conceptual Design of LNG Storage Tanks 2-3
Figure 2.1.1-4: Terminal Access Road 2-9
Figure 2.1.1-5: Youngs Bay Mitigation Site 2-14
Figure 2.1.1-6: Carmichael Property Mitigation Site 2-16
Figure 2.1.2-1: Waterway for LNG Marine Traffic 2-18
Figure 2.1.2-2: Terminal Electric Transmission Line Route 2-21
Figure 2.1.2-3: Oregon LNG Electric Power Lines 2-23
Figure 2.1.2-4: Terminal Water and Wastewater Pipelines 2-24
Figure 2.1.4-1: Typical Pipeline Construction Sequence 2-33
Figure 2.1.4-2: Flume Waterbody Crossing Method 2-39
Figure 2.1.4-3: Open-cut Waterbody Crossing Method 2-41
Figure 2.1.4-4: Conceptual Horizontal Directional Drill Waterbody Crossing 2-42
Figure 2.2.3-1: Dam-and-pump Method Typical 2-65
Figure 2.2.3-2: Typical Side Slope Construction 2-68
Figure 3.2.1-1: Pipeline Systems in the Pacific Northwest 3-4
Figure 3.3.2-1: Terminal Site Alternatives Along the Lower Columbia River 3-14
Figure 3.3.2-2: Tansy Point 3-20
Figure 3.3.2-3: East Skipanon Peninsula (Proposed Site) 3-22
Figure 3.3.2-4: Tongue Point 3-24
Figure 3.3.2-5: Bradwood Landing 3-26

Figure 3.3.2-6: Wauna 3-28
Figure 3.3.2-7: Port Westward 3-30
Figure 3.3.2-8: Terminal Access Road Alternatives 3-34
Figure 3.3.3-1: Dredged Material Placement Alternatives 3-38
Figure 3.4.1-1: Major Pipeline Route Alternatives 3-43
Figure 3.4.1-2: Deer Island and Green Mountain Minor Route Alternatives 3-47
Figure 3.4.1-3: I 5 Crossing Minor Route Alternatives 3-48
Figure 3.4.1-4: Compressor Station Site Alternatives 3-53
Figure 4.1.1-1: Quaternary Faults and Historical Earthquakes, Oregon LNG Project Area 4-5
Figure 4.1.1-2: Cascadia Subduction Zone 4-6
Figure 4.1.1-3: Berm Around LNG Storage Tanks and Process Facilities 4-9
Figure 4.1.4-1: Typical Wetland Construction Right-of-way Cross Section 4-68
Figure 4.1.6-1: Riparian Vegetation Restoration 4-126
Figure 4.1.8-1: North Pacific Great Circle Route 4-160
Figure 4.1.9-1: Key Observation Points 4-243
Figure 4.1.9-2: Key Observation Point 1 – Tansy Point 4-246
Figure 4.1.9-3: Key Observation Point 2 – Warrenton Boat Basin 4-247
Figure 4.1.9-4: Key Observation Point 3 – East Bank Skipanon Peninsula, Western Dike Road 4-248
Figure 4.1.9-5: Key Observation Point 4 – East Bank Skipanon Peninsula, Eastern Dike Road 4-251
Figure 4.1.9-6: Key Observation Point 5 – Youngs Bay Bridge 4-252
Figure 4.1.9-7: Key Observation Point 6 – Astoria Column 4-254
Figure 4.1.9-8: State Forest Lands Crossed by the Project 4-277
Figure 4.1.12-1: Estimated Terminal Construction Noise 4-356
Figure 4.1.12-2: Estimated Terminal Operation Noise 4-360
Figure 4.1.12-3: Pipeline Noise Monitoring Locations 4-363
Figure 4.1.12-4: Estimated Construction Noise Levels vs. Distance 4-364
Figure 4.1.13-1: Vapor Fence Placement 4-396
Figure 4.1.13-2: Flammable Vapor Dispersion from the LNG Ship Transfer Trough with Parallel Wind 4-397
Figure 4.1.13-3: Flammable Vapor Dispersion Distance from the 3-inch LNG Design Spill with Winds from Any Direction 4-398
Figure 4.1.13-4: Flammable Vapor Dispersion from the 6-inch Diameter LNG Design Spill with Release and Wind Directions toward the West 4-399
Figure 4.1.13-5: Flammable Vapor Dispersion from the 4-inch Diameter LNG Design Spill with Release and Wind Directions toward the West 4-400

Figure 4.1.13-6: Flammable Vapor Dispersion from the 4-inch-diameter LNG Design Spill with Release and Wind Directions toward the South....4-401

Figure 4.1.13-7: Overpressures Produced by Ignition of a Stoichiometric Box of Propane Vapor Around a Congested Area of a Liquefaction Train....4-404

Figure 4.1.13-8: Revised Overpressure Modeling....4-405

Figure 4.1.13-9: H_2S Dispersion from the Acid Gas Design Spill....4-408

Figure 4.1.13-10: Dispersion of Benzene Resulting from the NGL Design Spills....4-409

Figure 4.1.13-11: Thermal Radiation Isopleths from Process Fluid Impoundments....4-412

Figure 4.1.13-12: Sandia Zones of Interest for Accidental Events....4-422

Figure 4.1.13-13: Sandia Zones of Concern for Intentional Events....4-423

Figure 4.2.1-1: Quaternary Faults and Historical Earthquakes, Washington Expansion Project Area....4-446

Figure 4.2.12-1: Noise-Sensitive Areas Near the Chehalis Compressor Station....4-640

Figure 4.2.12-2: Noise-Sensitive Areas Near the Sumner Compressor Station....4-641

Figure 4.2.12-3: Noise-Sensitive Areas Near the Snohomish Compressor Station....4-642

Figure 4.2.12-4: Noise-Sensitive Areas Near the Mt. Vernon Compressor Station....4-643

Figure 4.2.12-5: Noise-Sensitive Areas Near the Sumas Compressor Station....4-644

Figure 4.2.12-6: Cowlitz River HDD Crossing Noise Survey Area Plot....4-646

Figure 4.2.12-7: Newaukum River HDD Noise Survey Area Plot....4-647

Figure 4.2.12-8: Puyallup River HDD Noise Survey Area Plot....4-648

Figure 4.2.12-9: Snohomish River HDD Crossing Noise Survey Area Plot....4-649

Figure 4.2.12-10: South Fork Nooksack HDD River Crossing Noise Survey Area Plot....4-650

TABLE OF CONTENTS: VOLUME II

Appendix A: Distribution List

Appendix B: Consultation and Meetings

- B1: Coast Guard Documents
- B2: Meetings Hosted by Oregon LNG and Northwest
- B3: Summary of Tribal Consultations

Appendix C: Safety Advisory Report and MOU between Oregon LNG and Oregon Department of Energy

- C1: Response of the Federal Energy Regulatory Commission to the Safety Advisory Report of the Oregon Department of Energy for the Oregon LNG Terminal Project and ODE Safety Advisory Report
- C2: MOU between Oregon LNG and ODE

Appendix D: Terminal Diagrams

Appendix E: Oregon LNG Pipeline Facility Maps and Drawings

- E1: Pipeline Location Maps; Construction Staging/Storage Areas
- E2: Pipeline Construction Right-of-way Cross Sections
- E3: Pipeline Route Minor Variations
- E4: Additional Temporary Workspace for the Pipeline; Additional Temporary Workspaces within 50 Feet of Wetlands and Waterbodies
- E5: Maps and Table of Access Roads
- E6: Site-specific Residential Construction Plans

Appendix F: Oregon LNG Mitigation and Monitoring Plans

- F1: Stormwater Pollution Prevention Plan for Construction of the Oregon LNG Terminal and Pipeline, Including Erosion Prevention and Sediment Control Plan; Spill Prevention, Control, and Countermeasures Plan; and Frac-Out Contingency Plan
- F2: Agricultural Impact Mitigation Plan
- F3: Conceptual Mitigation Plan for the Oregon LNG Terminal and Oregon Pipeline Project
- F4: Wetland Mitigation Plan
- F5: Technical Memorandum: Oregon LNG Pipeline Waterbody Crossing: Fish Salvage Plan
- F6: Technical Memorandum: Migratory Birds—Regulatory Review and Mitigation

Appendix G: Oregon LNG Soils, Wetlands, and Waterbody Information

- G1: Wetlands and Waterbodies Crossed by the Oregon LNG Pipeline
- G2: Landslide Hazard Areas Crossed by the Oregon LNG Pipeline
- G3: Site-specific Waterbody Crossing Plans
- G4: Stream Channel Assessment and Scour Analysis
- G5: Riparian Areas Crossed by the Oregon LNG Pipeline
- G6: Landslide and Debris Flow Risk Near Waterbody Crossings

Appendix H: Other Special Status Species for Oregon LNG Project

Appendix I: WEP Facility Maps, Drawings, and Tables

- I1: WEP Facility Location Maps
- I2: Pipeline Construction Right-of-way Cross Sections and Configuration Tables
- I3: Pipeline Route Minor Variations
- I4: Additional Temporary Workspace for the Pipeline Route
- I5: Table of Access Roads
- I6: Site-specific Residential Construction Plans; Table of Residences within 50 Feet of WEP Construction Right-of-way; Site-specific School Construction Plans
- I7: Utilities Crossed
- I8: Major Roads and Railroads Crossed

Appendix J: WEP Mitigation and Monitoring Plans

- J1: Washington Expansion Project Erosion Control and Revegetation Plan
- J2: Draft Unanticipated Discovery of Contamination Plan
- J3: Washington Expansion Project Water Quality Monitoring Plan
- J4: Horizontal Directional Drilling Monitoring and Contingency Plan

Appendix K: WEP Soils, Wetlands, and Water Resources Information

- K1: Waterbodies and Wetlands Crossed by the WEP
- K2: Landslide Hazard Areas Crossed by the WEP
- K3: Private Wells within 200 Feet of Workspace
- K4: Site-specific Waterbody and Wetland Crossing Plans
- K5: Fish and Waterbody Tables

Appendix L: Other Special Status Species for the WEP

Appendix M: Demographics and Income Distribution of Census Tracts Adjacent to the WEP

Appendix N: References

Appendix O: List of Preparers

Appendix P: Keyword Index

Acronyms and Abbreviations

µPa	microPascal
7Q10	seven-day, 10-year low flow

A

AC	alternating current
ACDP	Air Containment Discharge Permit
ACHP	Advisory Council on Historic Preservation
AE	Aesthetics
AEGLS	Acute Exposure Guideline Levels
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Modeling Program
ANSI	American National Standards Institute
AOP	Air Operating Permits
APCI	Air Products & Chemicals, Inc.
APE	area of potential effect
API	American Petroleum Institute
AQCR	Air Quality Control Regions
AQRV	air quality related values
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ATWS	additional temporary workspaces
AW	agricultural [wetland]
AWSC	All-way stop-controlled intersection

B

B.C.	British Columbia
BA	Biological Assessment
BACT	best available control technology
Bcf	billion cubic feet
Bcf/d	billion cubic feet/day
BGEPA	Bald and Gold Eagle Protection Act
bgs	below ground surface
bhp	brake horsepower
BIA	Bureau of Indian Affairs
BLEVE	boiling-liquid-expanding-vapor explosion
BLM	Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
BOG	boil-off gas
BPA	Bonneville Power Administration
Bscfd	billion standard cubic feet per day

C

CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CARA	Critical Aquifer Recharge Area
CCIP	Columbia Channel Improvement Program
CDSM	cement deep soil mixing
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHU	Critical Habitat Unit
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COC	Certificate of Compliance
COI	Certificate of Inspection
COTP	Captain of the Port
Council	Oregon Energy Facility Siting Council
CRBA	Columbia River Basalt Aquifer
CREDDP	Columbia River Estuary Data Development Program
CREP	Conservation Reserve Enhancement Program
CRGNSA	Columbia River Gorge National Scenic Area
CRITFC	Columbia River Inter-Tribal Fish Commission
CRP	Conservation Reserve Program
CRPUD	Columbia River People's Utility District
CSZ	Cascadia Subduction Zone
CTGR	Confederated Tribes of Grand Ronde
CWA	Clean Water Act
CZM	Coastal Zone Management Program
CZMA	Coastal Zone Management Act

D

dB	decibel
dBA	A-weighted decibels
dbh	diameter at breast height
DE	design earthquake
DMMP	Dredge Material Management Plan
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOGAMI	Department of Geology and Mineral Industries
DOT	U.S. Department of Transportation
DPS	distinct population segment
Dthd	dekatherm per day
DW	Domestic Water

E

ECA	Emission Control Area
ECRP	Erosion Control and Revegetation Plan
EDNA	environmental designation for noise abatement
EEM	Estuarine Emergent

EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EI	Environmental Inspector
EIM	Environmental Information Management
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
ERP	Emergency Response Plan
ERPG	Emergency Response Planning Guidelines
ESA	Endangered Species Act
ESCI	Environmental Site Cleanup Information
ESD	emergency shutdown
ESU	evolutionarily significant unit
ETM	estuarine turbidity maximum

F

FA	Fish and Aquatic Life
FAA	Federal Aviation Administration
FEED	Front-End Engineering Design
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FMP	Fishery Management Plan
FPA	Forest Practices Act
FPC	Federal Power Commission
fps	feet per second
FSA	Farm Service Agency
FSH	Wildlife Fishing and Hunting
FSP	Facility Security Plan
FTA	Free Trade Agreement
FWS	U.S. Fish and Wildlife Service

G

GAO	Government Accountability Office
GBS	gravity-based structures
GHG	greenhouse gas
GIS	Geographic Information System
GMA	Growth Management Act
gpm	gallons per minute
GPS	geographic positioning system
GTN	Gas Transmission Northwest
GWP	global warming potential

H

H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HAZID	hazard identification
HAZOP	hazard and operability
HCA	high consequence area
HDD	horizontal directional drill
HDPE	high density polyethylene pipe
HGM	hydrogeomorphic
hp	horsepower
HPA	Hydraulic Project Approval
HUC	Hydrologic Unit Code
Hz	hertz

I

I-5	Interstate 5
IMO	International Maritime Organization
IMS	Interpretive Map Series
INGAA	Interstate Natural Gas Association of America
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organization

J

JARPA	Joint Aquatic Resource Permits Application
JCE	Jordan Cove Energy
JPA	Joint Permit Application

K

km	kilometers
KOP	Key Observation Point
kV	kilovolt
kVA	kilovolt-ampere
kw	kilowatt

L

LAA	Likely to Adversely Affect
LCNHP	Lewis and Clark National Historic Park
LCNHT	Lewis and Clark National Historic Trail
LCREP	Lower Columbia River Estuary Partnership
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
LFL	lower flammability limit
LIDAR	Light Detection and Ranging
LNG	liquefied natural gas
LOI	Letter of Intent
LOR	Letter of Recommendation
LUBA	Land Use Board of Appeals
LWD	large woody debris

M

m^3	cubic meter
MAOP	maximum allowable operating pressure
MARPOL	marine pollution
MARSEC	maritime security
MBTA	Migratory Bird Treaty Act

MCE	maximum considered earthquake
MCHE	main cryogenic heat exchanger
mg/L	milligrams per liter
MLLW	mean lower low water
MLV	mainline valve
MMBtu	million British Thermal Units
MMPA	Marine Mammals Protection Act
MOU	Memorandum of Understanding
MP	mile post
mph	miles per hour
MPRSA	Marine Protection Research and Sanctuaries Act
MR	mixed refrigerant
MSA	Magnuson-Stevens Act
msl	mean sea level
MSU	Montana State University
MTPA	million tons (metric) per annum
MTSA	Maritime Transportation Security Act
M_w	moment magnitude
MW	megawatt

N

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NGL	Natural Gas Liquids
NHPA	National Historic Preservation Act
NLAA	Not Likely to Adversely Affect
nm	nautical miles
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	Notice of Application
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Construction
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPI	Northwest Pipeline Interconnect
NPS	National Park Service
NPV	net present value
NRCA	Natural Resource Conservation Area
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	noise sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
NVIC	Navigation and Vessel Inspection Circular
NWCAA	Northwest Clean Air Agency
NWI	National Wetlands Inventory

O

OAAQS	Oregon Ambient Air Quality Standards
OAR	Oregon Administrative Rule
OBE	operating basis earthquake
OC	Oregon Coast
OCMP	Oregon Coastal Management Program
OCS	Oregon Conservation Strategy
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Energy
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODHS	Oregon Department of Human Services
ODLCD	Oregon Department of Land Conservation and Development
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OEP	Office of Energy Projects
OFSC	Oregon Facility Siting Council
OHP	Oregon Highway Plan
OHV	off-highway vehicle
OHW	ordinary high water
OPS	Office of Pipeline Safety
OPUC	Oregon Public Utilities Commission
ORA	Washington Governor's Office of Regulatory Assistance
ORBIC	Oregon Biodiversity Information Center
ORCAA	Olympic Region Clean Air Agency
ORNHIC	Oregon Natural Heritage Information Center
ORS	Oregon Revised Statute
ORV	off-road vehicle
OSHA	Occupational Safety and Health Administration
OWRD	Oregon Water Resources Department

P

PAB	Palustrine Aquatic Bed
PAH	polyaromatic hydrocarbins
PB	property boundaries
PCB	polychlorinated biphenyls
PCE	primary constituent elements
PCGP	Pacific Connector Gas Pipeline

PEM	Palustrine Emergent Marsh
PFMC	Pacific Fishery Management Council
PFO	Palustrine Forested
PGA	peak ground acceleration
PGE	Portland General Electric
PG&E	Pacific Gas & Electric
PHMSA	Pipeline and Hazardous Materials Safety Administration
PHS	Priority Habitat Species
PI	Point of Inflection
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PMI	Pacific Maritime Institute
PMSA	Portland Metropolitan Statistical Area
PORTS	Physical Oceanographic Real-Time System
POTW	Publicly Owned Treatment Works
ppm	parts per million
ppbv	parts per billion by volume
ppmv	parts per million by volume
ppmw	parts per million by weight
ppt	parts per thousand
PRIME	Plume Rise Model Enhancement
PRMMP	Paleontological Resources Monitoring and Mitigation Plan
PSCAA	Puget Sound Clean Air Agency
PSD	Prevention of Significant Deterioration
PSEL	plant site emission limits
PSG	Pacific Seabird Group
psig	pounds per square inch gauge
PSS	Palustrine Scrub-Shrub
PTE	potential-to-emit
PUB	Palustrine Unconsolidated Bed
PUC	Public Utility Commission

R

R	Riverine
RCW	Revised Code of Washington
RFPD	Rural Fire Protection District
RHA	Rivers and Harbor Act
RM	river mile
RMP	Risk Management Plan
rms	root mean square
RPT	rapid phase transition
RSET	Regional Sediment Evaluation Team

S

SAH	Salmon Anchor Habitat
SAR	Smolt to Adult Return
SCS	Soil Conservation Service
SEL	sound exposure level
SEP	surface emissive power
SEPA	State Environmental Policy Act
SER	significant emission rates
SHPO	State Historic Preservation Office
SHU	suitable habitat units
SIL	Significant Impact Levels
SLIDO-1	Statewide Landslide Information Database for Oregon
SMA	Shoreline Management Act
SMP	Shoreline Master Programs
SO_2	sulfur dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SPCC	Spill Prevention, Containment, and Countermeasures
SR	State Route
SRF	Snake River fall-run
SSE	safe shutdown earthquake
SSURGO	Soil Survey Geographic
STC	Sound Transmission Class
SVP	Society of Vertebrate Paleontology
SWCAA	Southwest Clean Air Agency
SWPPP	Stormwater Pollution Prevention Plan

T

TAP	toxic air pollutants
tBACT	toxic best available control technology
TEC	Turnstone Environmental Consultants
TMDL	total maximum daily load
tpy	tons per year
TSS	Total Suspended Solids
Tuscarora	Tuscarora Gas Transmission Company

U

U.S.	United States
U.S.C.	United States Code
UFL	upper flammability limit
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey

V

VOC	volatile organic compound

W

WA Ecology	Washington State Department of Ecology
WAAQS	Washington Ambient Air Quality Standards
WAC	Washington Administrative Code
WCR	Water Contact Recreation
WDFW	Washington State Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WEG	Wind Erodibility Group
WNHP	Washington Natural Heritage Program
WOEC	West Oregon Electric Cooperative, Inc.
WQLW	water quality limited waters
WRIA	Water Resource Inventory Area
WRP	Wetland Reserve Program
WSA	Waterway Suitability Assessment
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

INTRODUCTION

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this draft Environmental Impact Statement (EIS) to fulfill requirements of the National Environmental Policy Act of 1969 (NEPA) and the Commission's implementing regulations under Title 18 of the Code of Federal Regulations Part 380 (18 CFR 380). On June 7, 2013, LNG Development Company, LLC and Oregon Pipeline Company, LLC amended pending applications with FERC under Sections 3(a) and 7(c), respectively, of the Natural Gas Act of 1938 (NGA). Under Section 3(a) of the NGA, LNG Development Company, LLC requested authorization in Docket Nos. CP09-6-000 and CP09-6-001 to site, construct, and operate a liquefied natural gas (LNG) import/export terminal in Warrenton, Oregon. Under Section 7(c) of the NGA, Oregon Pipeline Company, LLC requested a Certificate of Public Convenience and Necessity (Certificate) in Docket Nos. CP09-7-000 and CP09-7-001 to construct and operate a pipeline from the LNG terminal to an interconnect with the interstate transmission system of Northwest Pipeline LLC (Northwest), a subsidiary of the Williams Companies, near Woodland, Washington. The two applicants are collectively referred to as Oregon LNG and the project is referred to as the Oregon LNG Terminal and Pipeline Project (Oregon LNG Project).

On June 25, 2013, Northwest filed an application with FERC under Sections 7(b) and 7(c) of the NGA in Docket No. CP13-507-000 seeking a Certificate to expand the capacity of its existing natural gas transmission facilities along the Interstate Highway 5 (I-5) corridor between Woodland and Sumas, Washington. The project is referred to as the Washington Expansion Project or WEP. The Oregon LNG Project as amended and the WEP would be connected actions, and therefore this EIS includes evaluations for both project proposals.

The purpose of this document is to inform the public and federal and state agencies about the potential environmental impacts of the projects and their alternatives, and to recommend appropriate mitigation that would avoid or reduce adverse impacts. FERC is the federal agency responsible for authorizing onshore LNG terminals and interstate natural gas transmission facilities under the NGA, and is the lead federal agency for the preparation of this EIS in compliance with the requirements of NEPA. The U.S. Coast Guard (Coast Guard), U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS), U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), and the U.S. Department of Energy (DOE) participated as cooperating agencies in the preparation of this EIS. A cooperating agency has jurisdiction by law or has special expertise with respect to environmental resource issues associated with a project.

PROPOSED ACTION

As part of the Oregon LNG Project, Oregon LNG proposes to construct and operate an onshore import/export LNG terminal and associated facilities on the East Bank Skipanon Peninsula in Warrenton, Clatsop County, Oregon. The terrestrial portion of the LNG terminal would be located on a 96-acre parcel and would include: feed gas pretreatment facilities; two liquefaction trains, each capable of 4.5 million metric tons per annum of LNG; two full-containment, 160,000-cubic-meter LNG storage tanks; regasification facilities; and various ancillary facilities and buildings. The marine facilities would encompass about 148 acres of aquatic area within the Oregon side of the Columbia River and include a turning basin and berth for one LNG marine carrier.

In order to transport natural gas to and from the terminal, Oregon LNG also proposes to construct and operate an 86.8-mile-long, 36-inch-diameter bidirectional natural gas pipeline along with the following appurtenant, auxiliary facilities necessary for the pipeline: a single 40-megawatt (MW), 48,000-horsepower (hp) electrically driven compressor station, meter stations, pig launchers/receivers, and mainline valves. The pipeline would interconnect with Northwest's existing interstate transmission system near Woodland, Washington.

According to Oregon LNG, the primary purpose of its project is to facilitate the re-export of Canadian-sourced natural gas (and to a lesser extent, the export of U.S.-sourced gas from the Rocky Mountain region) to foreign markets as well as facilitate the availability of such gas supplies for delivery to Pacific Northwest markets, including the Portland metropolitan area. Oregon LNG's pending application requests LNG import capabilities as part of the Oregon LNG Project.

For the WEP, Northwest proposes to expand the capacity of its existing Northwest Pipeline between Sumas and Woodland, Washington, by constructing and operating 10 noncontiguous 36-inch-diameter pipeline loops[1] totaling 140.6 miles. Aboveground facilities associated with the new pipeline loops that Northwest would construct include mainline valves, pig[2] launcher/receivers, and a meter station. Northwest would also increase compression at five existing compressor stations. As part of the project, Northwest would abandon by removal, or remove the following facilities: segments of its existing, previously abandoned 26-inch-diameter pipeline; compressor units and engines at two compressor stations; mainline valves; pig launcher/receivers; and a meter station. At most locations, the new 36-inch-diameter pipeline would be installed in the existing trench of the removed 26-inch-diameter pipeline.

Northwest states that the purpose of its project would be to provide 750,000 dekatherms per day (Dth/d) of incremental transportation capacity on Northwest's existing system from the natural gas supply hub at Sumas to Oregon LNG's pipeline at Woodland. Northwest's project also could serve other natural gas markets in Washington to address the needs of other interested parties.

PUBLIC INVOLVEMENT

Oregon LNG originally filed a request with FERC on May 31, 2007, as supplemented on June 5, 2007, to implement the Commission's pre-filing process for its import LNG project. FERC approved Oregon LNG's request on June 19, 2007, and issued a Notice of Intent (NOI) to prepare an EIS and notice of public scoping meetings in September 2007. FERC held three public scoping meetings on the import terminal and sendout pipeline. On April 28, 2008, FERC issued a Supplemental NOI and held three additional public scoping meetings on the additional lateral and compressor station proposed by Oregon LNG.

On July 3, 2012, Oregon LNG filed a request to initiate the pre-filing process for its Export Project[3] and on July 10, 2012, Northwest filed a request to initiate the pre-filing process

[1] A loop is a segment of pipeline that is usually installed adjacent to an existing pipeline and connected to it at both ends. The loop allows more gas to be moved through the system.

[2] A pipeline "pig" is a device used to clean or inspect the pipeline.

[3] Oregon LNG referred to its project filed for pre-filing review in July 2012 as its Export Project because it included only the proposed liquefaction facilities at the terminal, new pipeline segment, and modified compressor station location. On June 7, 2013, Oregon LNG amended its pending applications for an LNG import project to include LNG export capabilities, resulting in a bidirectional project.

for the WEP. FERC approved both pre-filing review requests on July 16, 2012, and issued a single NOI for both projects on September 24, 2012. We[4] held three public scoping meetings for the Oregon LNG Export Project, at which a total of 119 people presented comments. We held five public scoping meetings for the WEP, at which a total of 24 people presented comments.

In addition to comments presented at the scoping meetings, we received more than 4,600 comment letters, over 4,300 of which were form letters, from landowners, public officials, nongovernmental organizations, and government agencies regarding the projects. Substantive environmental issues identified through this public review process are addressed in this EIS. The transcripts of the public scoping meeting and all written comments are part of the FERC's public record for the projects and are available for viewing using the appropriate docket number.

A copy of the draft EIS was sent to those agencies, tribal organizations, and individuals that attended meetings or submitted written comments on the projects, as well as to our environmental mailing list. The draft EIS has been filed with the EPA and a formal notice of availability issued in the Federal Register. All substantive comments received on the draft EIS related to environmental issues will be addressed in the final EIS.

ENVIRONMENTAL IMPACTS AND MITIGATION

Construction and operation of the projects could result in numerous impacts on the environment. We evaluated the impacts of the Oregon LNG Project and the WEP, taking into consideration Oregon LNG's and Northwest's proposed mitigation measures, on geology, soils, water resources, vegetation, wildlife, fisheries, special status species, land use, recreation, visual resources, socioeconomics, cultural resources, air quality, noise, and safety. Where necessary, we have recommended additional mitigation measures to minimize or avoid these impacts. We also considered the cumulative impacts of these projects with other past, present, and reasonably foreseeable actions in the project areas and potential alternatives to the proposed actions. In section 3 of this EIS, we summarize the evaluation of alternatives to the projects, including the No Action Alternative, system alternatives, facility design and siting alternatives, route alternatives and variations, and aboveground facility siting alternatives.

Based on scoping comments, agency consultations, and our independent evaluation of resource impacts, the major issues identified in our analysis are geology, surface water quality, wetlands, wildlife and aquatic resources, threatened and endangered species, recreation, visual resources, socioeconomics, air quality and noise, reliability and safety, and the cumulative impacts of projects in the vicinity of the Oregon LNG Project and the WEP. Our analysis of these issues is summarized below and is discussed in detail in the appropriate resource sections in section 4 of this EIS. Sections 5.1 and 5.2 of this EIS contain our conclusions and a compilation of our recommended mitigation measures, respectively.

Geology

The overall seismicity of the Pacific Northwest region is relatively high because of the presence of the Cascadia Subduction Zone off the coast. Associated with earthquakes are other geologic hazards including surface faults, soil liquefaction, and tsunamis. We received a number of comments expressing concerns about the potential for a very large subduction zone earthquake to occur and its affect on an LNG terminal and pipeline. Oregon LNG performed a site-specific

[4] The pronouns "we," "us," and "our" refer to the environmental staff of FERC's Office of Energy Projects.

seismic hazard evaluation in order to develop criteria for use in the seismic design of the terminal. Oregon LNG did not identify any active faults at the site but incorporated potential unidentified faults using background seismicity into its seismic hazard analysis. Oregon LNG would use ground improvement in the areas of critical facilities to make the ground more resistant to soil liquefaction, to mitigate the effects of lateral spreading, and to reduce potential settlement. An earthen berm armored with riprap would protect the process area and LNG tanks in the event of a tsunami or other flooding events.

Geologic hazards that could affect the Oregon LNG pipeline include earthquakes, tsunamis, soil liquefaction, faults, and landslides. Because they are buried and are relatively flexible, welded steel pipeline generally perform well under most geologic hazard conditions. In addition, Oregon LNG would mitigate these hazards through special construction techniques and monitoring during operation.

With the exception of tsunamis, the WEP would have potential risks from the same geologic hazards as the Oregon LNG pipeline. The WEP would cross two fault zones, which are generally not conducive to mitigation measures because the precise rupture location is difficult to predict. Northwest proposes to implement measures to mitigate the landslide hazard impacts such as visual monitoring, on-surface displacement surveys, installing drainage systems, regrading slopes, installing strain gauges to monitor ground movement, and excavating to relieve strain.

We are recommending that both Oregon LNG and Northwest include in their pipeline design geotechnical reports a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan. We conclude that Oregon LNG's and Northwest's proposed mitigation measures and our recommendations would reduce the geologic risk to the project facilities to an acceptable level.

Surface Waters

Dredging of the turning basin and berth area at the terminal would create temporary increases in turbidity both in the dredging area and the dredged material disposal area, which would be located in deep water off the mouth of the Columbia River. The sand would settle from the water column fairly rapidly. The terminal would require about 2.3 billion gallons of water annually for operations, most of which would come from the Columbia River. Given the large size of the Columbia River, significant impacts from water withdrawal are not anticipated. Columbia River water would also be used by LNG marine carriers for engine cooling while docked at the terminal. Discharge of cooling waters would create a thermal plume but the temperature increases would be expected to stay within allowable ranges defined by National Pollutant Discharge Elimination System permits and Section 401 water quality certifications.

The greatest impact on surface waters from pipeline construction would result from in-water activities at waterbody crossings. The primary impact would include temporary increases in turbidity but impacts could also include temperature increases from loss of riparian vegetation and potential introduction of contaminants from spills of fuel during construction.

Oregon LNG's pipeline would cross 184 waterbodies, including 7 major crossings (greater than 100 feet wide). Oregon LNG would avoid in-water impacts at 11 waterbody crossings by installing the pipeline using horizontal directional drilling (HDD). All the major waterbodies, except Deer Island Slough, would be crossed using HDD. Deer Island Slough would be crossed just upstream of an existing tide gate using dry open cut methods. Oregon LNG would minimize impacts at other waterbody crossings by using dry crossing methods,

implementing measures in our *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) with approved alternative measures (referred to in this EIS as Oregon LNG's Procedures), and following its waterbody crossing plans. Oregon LNG would minimize the risk of spills by implementing its *Spill Prevention, Control, and Countermeasures Plan* and by implementing measures in our *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) without changes (referred to in this EIS as Oregon LNG's Plan).

The WEP would cross 271 waterbodies, 7 of which are classified as major. All major waterbodies would be crossed using trenchless methods with the exception of the Toutle River and Kalama River. The Toutle River would be crossed using a wet open-cut trench. The Kalama River would be crossed by replacing the previously abandoned 26-inch-diameter pipeline currently in an existing aerial span with the new 36-inch-diameter pipeline. Northwest determined that HDD was not feasible for the Toutle River crossing because of the geologic conditions. To minimize adverse impacts at waterbody crossings, Northwest would follow our Plan and Procedures with approved alternative measures (referred to in this EIS as Northwest's Plan and Procedures) and has developed site-specific crossing plans for all major waterbody crossings, including the Toutle River, which we have reviewed and found acceptable. Northwest has developed Spill Plans for Oil and Hazardous Materials that outline spill prevention practices and emergency response procedures that would be followed in the case of incidents during construction.

Wetlands

Construction of the terminal would result in the permanent conversion of about 33.9 acres of wetlands to commercial/industrial use. An additional 2.0 acres of short-term wetland impacts would also occur. Removal of wetland vegetation would deprive wildlife and aquatic resources of valuable habitat. Construction of the Oregon LNG pipeline would cause short-term impacts on about 84.1 acres of wetlands and permanently impact about 22.8 acres of wetlands in Oregon and Washington.

Following construction, wetlands along the pipeline right-of-way would be restored to preconstruction soil and hydrology conditions, and revegetated. Operational vegetation maintenance activities would preclude forested wetlands in a 30-foot-wide corridor, and shrub-scrub wetlands from a 10-foot-wide corridor centered over the pipeline. Oregon LNG would mitigate construction-related wetland impacts by implementing its Stormwater Pollution Prevention Plan, its Plan and Procedures, and by complying with the USACE's Section 404 and the Oregon Department of State Land's (ODSL) Section 401 permit conditions. For unavoidable wetland impacts at the terminal and along the pipeline, Oregon LNG would provide compensatory mitigation following the USACE, ODSL, and Washington Department of Ecology (WA Ecology) rules and guidance for no net loss of wetland functions and values.

The construction of the WEP would temporarily impact about 176.6 acres of wetlands and permanently impact about 30.6 acres of wetlands. Because the pipeline would be installed along a maintained pipeline corridor, the majority of the wetlands impacted by the project would be palustrine emergent wetlands, which have been previously disturbed by pipeline installation and are maintained in an emergent state due to ongoing maintenance activities. Northwest would follow our Plan and Procedures during construction to mitigate impacts on wetlands and would use HDD techniques to avoid impacts on wetlands near certain river crossings. Unavoidable permanent impacts wetlands would be mitigated through off-site wetland mitigation banking sites. Specific sites would be identified during the final permitting stage in coordination with the USACE and WA Ecology.

Based on our review of the avoidance and minimization measures proposed by Oregon LNG and Northwest, and taking into consideration the compensatory mitigation that would be required for the projects, we conclude that impacts on wetland resources would be effectively minimized or mitigated.

Wildlife and Aquatic Species

Activities associated with construction and operation of the LNG terminal with the greatest potential to impact aquatic resources include dredging, pile driving, and vessel traffic. Other activities such as water withdrawals for hydrostatic testing, stormwater runoff, lighting, and inadvertent spills could also affect aquatic resources; however, with the implementation of the proposed mitigation measures, these impacts are expected to be minimal.

Potential impacts on aquatic resources from dredging activities include direct take and habitat modification as well as temporary increases in noise, turbidity, and suspended solid levels. Most fish species are highly mobile and would be expected to leave the area during dredging activities. However, dredging would result in direct mortality of benthic organisms (e.g., aquatic macroinvertebrates, mollusks, and crustaceans, which are important food sources for many species of fish) within the dredge footprint. Dredging would convert shallow estuary habitat important for many fish and bird species to deep water habitat. Oregon LNG proposes to offset the permanent loss of shallow water estuary habitat by creating new habitat for fish and wildlife; reconnecting 120 acres of historical tidal floodplain of the Youngs River. Oregon LNG would monitor dredging operations and meet conditions of its project-specific Clean Water Act Section 401 Water Quality Certificate (administered by the Oregon Department of Environmental Quality) during dredging.

The primary impacts on aquatic resources from pile driving activities would be avoidance of the area, stress, or injury due to the underwater sound pressure levels. Oregon LNG would implement its noise mitigation strategy for pile driving that would include attenuation measures, noise monitoring during pile driving, and adaptive management to address noise levels that could harm fish or marine mammals. Oregon LNG would also implement marine mammal monitoring during pile driving and associated stop work provisions to reduce the exposure of noise on marine mammals that frequent the Columbia River.

During operation, the thermal plume generated by the discharge of LNG marine carrier engine cooling water would occupy much less than 1 percent of the total cross-sectional area of the Columbia River. As a result, we conclude that the localized temperature increases caused by the cooling water discharge would not negatively affect aquatic species and migratory corridors for salmon would not be blocked.

The Oregon LNG's and Northwest's pipelines would cross numerous waterbodies that support fish, including EFH, and other aquatic species. Oregon LNG and Northwest would use HDD methods to avoid impacts on most major waterbodies and riparian areas. Oregon LNG and Northwest would implement their Plan and Procedures to avoid and minimize impacts on fish, EFH, and aquatic species during waterbody crossings. Following construction of the crossings, the streambanks would be restored to preconstruction contours and replanted with native vegetation. In addition, we are recommending that both Oregon LNG and Northwest work with state resource agencies to develop plans for large woody debris placement to mitigate for construction impacts on waterbodies and loss of riparian forests.

Clearing for pipeline construction would result in vegetation and tree removal, and could increase habitat fragmentation. During construction, wildlife would be displaced from the project area and in some cases construction may result in direct mortality of some wildlife species. Displacement to adjacent habitats would be a temporary effect during construction and wildlife would be expected to return after restoration of the right-of-way is complete. In some areas, forest clearing may result in a permanent shift in vegetation structure and associated wildlife. To minimize the amount of forest clearing, the Oregon LNG pipeline would cross mainly commercial forest land and the WEP would follow Northwest's existing pipeline right-of-way. Oregon LNG proposes compensatory mitigation to offset habitat impacts associated with pipeline construction, including wetlands restoration and acquisition of large tracts of forest land.

The vegetative communities in the project areas provide potential habitat for migratory bird species, including nesting habitat for bird species of concern. The LNG terminal would be constructed on sandy dredge spoils, most of which is devoid of vegetation or covered by poor-quality nesting habitat (Scot's broom and Himalayan blackberry), generally avoiding impacts on migratory bird habitat. Oregon LNG and Northwest would cut trees and other woody vegetation outside the migratory bird nesting season (generally March 15 through August 15 for most bird species). In addition, we have recommended that Oregon LNG and Northwest each prepare Migratory Bird Conservation Plans in consultation with the FWS.

Threatened and Endangered Species

We have identified 45 federally listed threatened, endangered, or candidate species occurring or potentially occurring on lands and in waterbodies affected by the Oregon LNG Project and the WEP (11 species overlap both projects). Based on agency input and our analysis of the project, we preliminarily conclude that the Oregon LNG Project would not likely adversely affect 15 species and would likely adversely affect 21 species. The WEP would not likely adversely affect 13 species, likely adversely affect 6 species, and have no effect on 1 species. Many of these species have designated critical habitat (habitats that are considered to be essential for the recovery of the species) that are crossed by the project and one species has proposed critical habitat. We are in the process of completing our Biological Assessment, our consultation with FWS and National Marine Fisheries Service (NMFS) is in progress, and our final determination regarding the effects on species is pending. Therefore, we are recommending that no ground disturbance occur until we have completed our Section 7 Endangered Species Act consultation with the FWS and NMFS before Oregon LNG and Northwest proceed with construction.

Land Use, Recreation, and Visual Resources

The terminal site would be on a 96-acre parcel of land, which is owned by the State of Oregon and leased to the Port of Astoria by the ODSL, which subleases the parcel to LNG Development Company, LLC. The USACE is currently in litigation, related to the sublease, with LNG Development Company, LLC in the U.S. District Court for the District of Oregon, Portland Division over which party has superior title to the terminal site.

Land uses impacted at the terminal include open space, wetlands, existing rights-of-way, and small amounts of residential and commercial/industrial areas. We are recommending that prior to construction, Oregon LNG file with the FERC documentation of concurrence from the Oregon Department of Land Conservation and Development that the Oregon LNG Project is consistent with the Coastal Zone Management Act.

Construction and operation of the terminal would not impact the marinas near the terminal and along the LNG marine carrier transit route within the Columbia River or commercial and recreational boats when moored in the marinas. However, recreational vessels would be restricted from the construction area during construction and from the 200-yard security zones at the terminal during operation. The security zones would present a minor inconvenience relative to the size of the river at this location. Construction of the terminal is not anticipated to affect commercial river uses in the federal navigation channel. The moored LNG marine carrier and its surrounding security zone would not impact the movement of vessels in the shipping channel nor would it limit movement in and out of the Skipanon Waterway.

The Lower Columbia River Water Trail and Lewis and Clark National Historic Trail would be within 0.25 mile of the terminal and would experience minor, temporary, and short term traffic increases, dust, odors, and noise during construction. The terminal would not be visible from the Fort Clatsop Interpretive Center but may cause minor visual impacts for recreational visitors at other locations within the Lewis and Clark National Historic Park, such as the Dismal Nitch and Station Camps, and at Fort Columbia State Park. The storage tanks, pier, and berthed carriers would be visible from the Youngs Bay Bridge. However, views from the bridge would be from moving vehicles and of short duration.

The terminal would be visible from locations near Tansy Point. The presence of the LNG storage tanks and the offshore facilities would be noticeable and would change the visual quality of the area. From the Warrenton Boat Basin area, the most visible components of the terminal would be the tops of the LNG storage tanks and the 230-kilovolt power line. The LNG storage tanks would be more visible from the waterway than from the boat basin. Components of the terminal would be seen to varying degrees from within the Astoria viewshed. At night, aviation lighting on the LNG tanks and cooling towers, marine navigation lighting on the offshore facilities and berthed carriers, and general operational lighting at the terminal would be visible.

Oregon LNG's mitigation measures to reduce the visual impacts of the terminal components would include: coloring the tanks and other structures to mimic nearby colors in the landscape, screening facilities from views outside of the terminal area, and controlling potential impacts associated with lighting, including a dual aviation lighting system to reduce visual impacts at night. We conclude that the terminal would change the visual character of the East Skipanon Peninsula. Although the terminal facilities would introduce a new element into the viewshed, it would not appear out of character with the existing industrial facilities that are also visible along the shoreline in this area.

Land uses impacted by pipeline construction and operation include forest, agricultural, wetlands, existing rights-of-way, open space, open water, commercial/industrial, and residential. Pipeline construction would result in direct temporary impacts on several recreational areas, including Four County Point Monument, Four County Point Trail, and Lions Day Park. The Four County Point Trail, which is lightly used, would be closed for a brief period for safety. In coordination with the Oregon Department of Forestry, Oregon LNG has developed measures to mitigate the impacts of the trail closure. Construction workspace for the pipeline would be within Lions Day Park and we are recommending that Oregon LNG develop a plan to mitigate impacts on users of the park. In addition, Oregon LNG has indicated it would work with the City of Woodland to minimize impacts on a proposed park and sports complex that would be crossed by the pipeline.

Oregon LNG would cross scenic highways and the Lewis and Clark National Historic Trail using HDD or conventional bore to avoid visual impacts. In other locations, vegetation

clearing for the pipeline right-of-way would result in both short-term and long-term impacts on visual resources, depending on the type of vegetation that is removed. After pipeline installation, Oregon LNG would recontour and revegetate the landscape to as near to preconstruction conditions as possible. Oregon LNG would include visual screening along the western/southwestern side of the compressor station to help screen views from Highway 30 and other areas farther west. Existing, mature vegetation would screen views of the compressor station along the north, east, or south sides of the site, including areas along both sides of Deer Island Slough.

About 94 percent of the WEP pipeline would be constructed within Northwest's existing pipeline right-of-way. About half of the land that would be affected by construction would be within Northwest's existing pipeline right-of-way or within the existing compressor station footprints. Land uses that would be impacted include forest, agricultural, wetlands, existing rights-of-way, barren land, open water, commercial/industrial, and residential.

The WEP crosses through some heavily populated areas. About 740 residences would be within 50 feet of the construction right-of-way and additional temporary workspace. Northwest would reduce or offset the construction right-of-way for short distances to avoid houses and minimize impacts. There would be no permanent displacement of any businesses or residences; however, no structures would be permitted on the permanent right-of-way.

Eighteen schools, colleges, or learning institutions would be within 2,000 feet of the WEP. The majority of the loops would be constructed during the summer when school is not open and Northwest has prepared site-specific mitigation plans for four schools where the construction right-of-way would be within 25 feet of school property. With Northwest's proposed mitigation measures, we conclude that impacts on schools would be minor.

Several parks and trails would be affected by the WEP, primarily by temporary construction impacts that would include traffic delays, temporary road and trail detours or closures, and temporary park closures. Following construction, Northwest would restore disturbed areas to preconstruction conditions and recreational activities would continue as before construction. We are recommending that Northwest develop final site-specific plans for each affected recreation area prior to construction.

Similar to Oregon LNG, pipeline construction for the WEP would result in visual impacts, particularly where mature trees are removed. However, because most of the pipeline would be constructed within Northwest's existing pipeline right-of-way and scenic highways would be crossed by boring, we conclude that in general, visual impacts for the WEP would be minimal.

Socioeconomics

Construction of the terminal would occur over a 48-month construction period. Terminal construction would stimulate about 9,584 jobs (direct, indirect, and induced) in Oregon, including about 2,755 direct jobs. Oregon LNG would directly employ about 145 workers for terminal operations, which would generate over $14 million in direct net personal income annually. Pipeline construction would stimulate about 256 direct jobs in Oregon and Washington with a payroll of $195 million. The construction and operation of the project would have positive economic benefits for the local communities because the project would generate direct and indirect jobs, income from wages, purchases, rental of housing, and taxes. We conclude that the

economic impacts of the Oregon LNG Project would be positive. Construction and operation of the Oregon LNG Project would not significantly affect the availability of housing.

In accordance with the Energy Policy Act of 2005, Oregon LNG's Emergency Response Plan must offer a Cost-sharing Plan, and outline how Oregon LNG would fill resource gaps and supplement the first-responder capabilities of the local jurisdictions. Oregon LNG would be required to file a final Emergency Response Plan, including a Cost-sharing Plan prior to the beginning of project construction activities.

Potential conflicts between LNG marine carrier and cruise ship schedules would be avoided by coordination of inbound and outbound transit details between the Coast Guard, bar and river pilots, escort tug masters, and other escort assets 24 hours prior to arrival. The 200-yard security zone around the LNG marine carrier while the carrier is moored at the facility would not impact the movement of vessels in the shipping channel or the Skipanon Waterway. Therefore, we conclude that LNG marine carrier traffic would not significantly impact other vessel traffic on the Columbia River.

Construction of the Oregon LNG terminal and pipeline would affect roadway transportation and traffic in the project area by increasing the number of vehicle trips per day on area roads as a result of worker commuting and construction vehicle traffic. Construction of the pipeline would also include temporary closures of some minor roads. Oregon LNG would develop a Traffic Mitigation Plan to manage and alleviate temporary impacts from pipeline construction traffic. We are recommending that Oregon LNG work with the City of Warrenton and Oregon Department of Transportation to prepare a Terminal Construction Traffic Management Plan. Operations would not contribute a large amount of traffic to the terminal area; however, intersections with already low levels of service could worsen during the first year of operations. Pipeline operation would not have an effect on traffic.

The WEP would create economic benefits for local communities by generating additional tax revenue, employment opportunities, and local expenditures by workers. Construction of the WEP would require about 1,400 workers, with a maximum of 350 people working on any one spread at any one time. The project is not expected to have a significant impact on the local population or housing in any of the eight counties. Northwest estimates that property tax would generate about $12.9 million in annual revenue. We conclude that the economic impacts of the WEP would be positive.

Temporary impacts on traffic during construction would result from the workforce commuting daily to the construction site. The number of construction vehicle trips would be low on any particular roadway at any one time because staging areas and construction spreads would be distributed along the pipeline route and construction would move sequentially along the construction right-of-way.

Air Quality and Noise

Air quality impacts associated with the terminal and pipeline construction would result from combustion of fuel-burning equipment/vehicles, fugitive dust associated with site preparation/grading and travel on the access road, and dredging activities. Construction emissions would not have a long-term impact on ambient air quality, and implementation of Oregon LNG's proposed emission control measures, as well as other measures specified by the Oregon Department of Environmental Quality, would further reduce construction emissions.

Operation of the LNG terminal would result in direct air emissions from stationary equipment (liquefaction trains, heaters, flares, generators, pumps, etc.) and marine vessels (LNG marine carriers and tugs). Modeling results show that emissions from terminal operations would not cause impacts exceeding the National Ambient Air Quality Standards or exceed the Prevention of Significant Deterioration increments. Indirect air pollutant emissions from LNG marine carriers and project-related harbor craft would be less than 0.01 percent of estimated calendar year 2000 global marine vessel emissions. Therefore, while marine vessel emissions from the project would have an impact on air quality, the additional marine vessels would be a very small contributor to air impacts on a global scale.

Construction of the Oregon LNG pipeline and compressor station would have temporary adverse impacts on air quality from fossil-fuel burning and fugitive dust. Routine operation of the electrically powered compressor station would produce negligible air emissions. Along the pipeline route, leaks and venting could occur at the compressor station and potentially from small leaks at flanges and valves.

Oregon LNG would be required to meet all federal and state air quality permitting requirements as a condition of operation. With Oregon LNG's compliance with federal and state air quality permitting rules, including the installation of mitigation measures and technologies required to meet federal and state air quality regulations, we conclude that the project would not result in significant air quality impacts.

Construction activities associated with the terminal would contribute noise in and around the project area over a 48-month construction period. Based on noise modeling, the only perceptible noise increases that would occur at noise sensitive areas (NSA) would be from pile-driving. Pile driving would be limited to daytime hours and is anticipated to last 2 to 3 months. Operation of the terminal would be required to comply with the most restrictive noise limits at each NSA. A detailed acoustical design would be developed as part of the final design process. We are recommending that Oregon LNG conduct a noise survey after the terminal begins operation and install noise controls, if necessary.

Construction activities associated with the Oregon LNG pipeline and aboveground facility construction would contribute temporary noise in the areas close to the construction activity. With the possible exception of HDD activities, construction work would be normally restricted to times between 7 a.m. and 7 p.m., Monday through Friday. Noise from HDD activities would impact the surrounding area and each drill would take from several days to weeks to complete. Although Oregon LNG currently proposes to limit HDD activities to daytime hours, site and soil conditions may require HDD activities at some locations to operate on a 24-hour basis. If 24-hour HDD activities are required, Oregon LNG would make all reasonable efforts to limit HDD noise to a day-night sound level of 55 decibels on the A-weighted scale. We are recommending that Oregon LNG file an HDD noise mitigation plan prior to construction and implement this plan during HDD activities.

The primary source of operational noise from the pipeline facilities would be Oregon LNG's compressor station, and a secondary source would be the meter station at the interconnect with the Northwest pipeline system. The compressor station would be a new noise source on a previously unused site. Oregon LNG would incorporate acoustical controls to ensure the compressor station would comply with the applicable noise limits. We are recommending that Oregon LNG conduct a noise survey after placing the compressor station into service and install noise mitigation, if necessary. With Oregon LNG's proposed mitigation measures and our

recommendations, we conclude that the project would not result in significant long-term noise or vibration impacts at the nearest NSAs.

Construction of the WEP would result in temporary impacts on air quality from fossil-fuel burning and fugitive dust. Pipeline construction would occur over a 2-year period, while construction activities at each existing compressor station would take about 9 months.

During operation of the pipeline and the five modified compressor stations, emissions of criteria pollutants, greenhouse gases, hazardous air pollutants, and Washington-regulated toxic air pollutants would occur. Along the pipeline route, leaks and venting could occur at compressor stations and potentially from small leaks at flanges and valves. Emissions expected during operation of the pipeline would be relatively minor.

Northwest would be required to meet all federal and state air quality permitting requirements as a condition of operation. Northwest would comply with federal and state air quality permitting rules, including the installation of mitigation measures and technologies required to meet federal and state air quality regulations. Therefore, we conclude that the WEP would not result in significant air quality impacts.

During construction, Northwest would employ a combination of noise mitigation methods, including equipment noise controls and administrative measures, to minimize noise related to construction activity at NSAs near the WEP. These would include appropriate mitigation measures to achieve compliance during HDD installation operations and equipping haul trucks and other engine-powered equipment with adequate mufflers. Northwest would restrict timing of noisy construction or demolition work to 7 a.m. to 7 p.m. Monday through Saturday. We are recommending that Northwest file a noise mitigation plan prior to construction and implement this plan during HDD construction activities.

The primary source of operational noise for the WEP would be the modified compressor stations. Northwest would be required to meet the most restrictive noise level limits established by jurisdictional agencies. Northwest would implement mitigation measures at each site to ensure that the applicable standards are met at the nearest NSA. New turbines would be installed in acoustically rated buildings or enclosures that are designed to mitigate equipment vibrations from being transmitted off site. We are recommending that Northwest conduct noise surveys after completing the compressor station modifications to confirm that noise standards are met. With Northwest's proposed mitigation measures and our recommendations, we conclude that the project would not result in significant noise or vibration impacts at the nearest NSAs.

Reliability and Safety

We evaluated the safety of the proposed LNG terminal, including assessments of hazards, preliminary engineering design, siting, emergency response, and security systems. As a cooperating agency, DOT assisted FERC staff in evaluating Oregon LNG's proposed design. Based on the hazardous area calculations we reviewed, the areas impacted by design spills meet the DOT's exclusion zone requirements by either being within the facility property boundary, within land controlled by Oregon LNG, or over a road easement or a navigable body of water. As a result of our technical review of the preliminary engineering design, we conclude that the facility design proposed by Oregon LNG plus our recommended mitigation would provide acceptable layers of protection that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. If the facility is constructed and becomes operational, the facility would be subject to DOT's inspection and enforcement

program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

As a cooperating agency, the Coast Guard analyzed the suitability of the waterway for LNG marine traffic. Based on its review and its own independent risk assessment, the Coast Guard has determined that the waterway could be made suitable for the type and frequency of LNG marine traffic associated with the proposed import/export LNG facility. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks.

Oregon LNG's pipeline and Northwest's pipeline would be designed, built, and inspected according to DOT safety standards. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification, minimum design requirements, and protection of pipelines from corrosion. Although the pipeline facilities would incrementally increase the risk of a pipeline accident, we conclude that construction and operation of the facilities would not have a significant impact on public safety.

Cumulative Effects

Our analysis of cumulative impacts includes other projects in the vicinity of the proposed Oregon LNG Project and the WEP that could affect the same resources in the same approximate time frame. Each of the projects considered would result in temporary and minor effects during construction, but each project would be designed to avoid or minimize impacts on resources such as water quality, forest and marine resources, and wildlife. Additionally, potential impacts on sensitive resources resulting from these projects would be mitigated, as appropriate, and mitigation generally leads to the minimization of cumulative impacts. The projects' contribution to cumulative impacts would be greatest on federally listed species, timber resources, housing, and traffic, which are discussed below.

The projects would have cumulative impacts on federally listed species, including certain fish, whales, marbled murrelets, and northern spotted owls. The Oregon LNG pipeline would cross 21 waterbodies[5] that may provide habitat for federally listed fish and the WEP would cross 32 waterbodies[6] that may provide habitat for federally listed fish, for a total of 53 waterbodies. Reasonably foreseeable actions such as utility corridors, roads, and urban development would likely affect these same waterbodies, but would be unlikely to do so at the same time and in the same location as the proposed projects.

LNG marine carrier traffic combined with other reasonably foreseeable actions would increase current ship traffic in the lower 11 miles of the Columbia River by about 10 percent. This would amount to about 25 ships per month and would pose a whale strike risk of about 0.2 individuals per year per species compared to 0.02 individuals per year, per species for the Oregon LNG Project alone.

The Oregon LNG Project and the WEP would result in incremental loss of late successional forests or forests that could become late successional during the life of the projects; therefore, we conclude the projects would have cumulative adverse effects on northern spotted

[5] The following are counted as one waterbody each: Lewis and Clark River is crossed four times, Nehalem River twice, Rock Creek twice, and Milton Creek twice.

[6] Saar Creek is crossed twice, but counted as one waterbody.

owl and marbled murrelet. Most of the impacts are associated with the Oregon LNG Project, and Oregon LNG plans to mitigate impacts by acquiring large tracts of forest land in the Coast Range to be managed for future spotted owl and marbled murrelet habitat.

Construction of the Oregon LNG Project and the WEP, along with other reasonably foreseeable actions, would cumulatively result in impacts on forest land, particularly in Oregon. Timber operations would not be able to continue within a portion of the permanent rights-of-way for these projects or other utilities; thus, the addition of new utility corridors or widening of existing corridors would segment and lessen the amount of available timberland available for active forest management.

If construction of the terminal were to occur concurrently with other reasonably foreseeable actions, temporary housing may be slightly more difficult to find and/or more expensive to secure in Warrenton and Astoria during the summer tourist season. Housing along either Oregon LNG's or Northwest's pipeline would not be significantly affected by the influx of out-of-town workers. Even considering other construction actions occurring at the same time, the counties crossed by the WEP are expected to be able to accommodate the additional temporary workforce.

Five of seven intersections studied in the terminal area are currently failing to meet operational standards. Traffic from other construction actions that may occur during construction of the terminal would add to the already mounting congestion. Warrenton has plans for park, trail, street, utility, and marina improvements, but construction years are not certain. For the purposes of evaluating long range cumulative impacts, traffic conditions were projected into the future both with and without the presence of the Oregon LNG terminal and assuming no mitigation. The volume to capacity ratios and delays at the studied intersections generally showed slightly higher numbers with the terminal present, but the overall level of service was the same as conditions without the terminal present. Therefore, the analysis projects that operations associated with the proposed terminal would not have significant cumulative impacts on future traffic conditions. Construction of the Oregon LNG pipeline and the WEP would temporarily impact localized areas of traffic, and these impacts could be cumulative if other actions were occurring in the vicinity at the same time. Operation of the Oregon LNG pipeline and the WEP would not contribute to cumulative traffic impacts.

Although the Oregon LNG Project and the WEP would contribute to cumulative impacts on some resources, we conclude that the contribution by the projects would not be significant.

ALTERNATIVES CONSIDERED

The No Action Alternative would eliminate or delay the short- and long-term environmental impacts identified in this EIS, but the objectives of the projects would not be met. If the No Action Alternative were selected for the Oregon LNG Project, the WEP would likely not be constructed as currently proposed. The No Action Alternative for the WEP would cause Oregon LNG to either pursue other means of obtaining natural gas supply, or it would not construct the Oregon LNG Project.

Existing pipeline systems would need to be expanded to reach the Oregon LNG terminal, and a system alternative that replaced the WEP would require construction of a new pipeline, which would result in significantly greater environmental impacts than the proposed action. Therefore, we do not consider other proposed or existing pipeline systems to be reasonable system alternatives to the proposed projects. We also determined that no existing or other

proposed LNG facilities would be an economically or practically feasible alternative to the Oregon LNG Project and the WEP.

We reviewed alternative terminal site locations and concluded that none would have a significant environmental advantage over the proposed terminal site. Of the existing permitted dredged material disposal site alternatives, the only one not eliminated from consideration because of logistical and availability issues is the Deepwater Site. We conclude that the Deepwater Site is a suitable location for dredged material disposal, but Oregon LNG would need to obtain approval from the EPA prior to its use.

We also assessed two major route alternatives for the Oregon LNG pipeline but neither would offer significant environmental advantages over the proposed route. A number of minor route variations were evaluated by Oregon LNG based on feedback from landowners and agencies during the project review process. Oregon LNG incorporated many of these variations into the proposed route if they were practicable and would result in fewer environmental impacts. Several alternative compressor station sites were evaluated but did not offer significant environmental advantages over the proposed site.

Because about 94 percent of the length of the WEP would be installed within Northwest's existing easement, and any major route alternative would have greater impacts than the proposed project, we did not consider major route alternatives. We did assess minor route variations at four river crossings and two wetland crossings and concluded that the proposed routes are preferred over the other route variations.

MAJOR CONCLUSIONS

We determined that construction and operation of the projects would result in adverse environmental impacts but most impacts would be reduced to less-than-significant levels. This determination is based on a review of the information provided by Oregon LNG and Northwest and further developed from environmental information requests; site visits; scoping; literature research; alternatives analyses; and contacts with federal, state, and local agencies, and other stakeholders.

Although many factors were considered in this determination, the principal reasons are:

- Oregon LNG would minimize impacts on natural and cultural resources during construction and operation of the project by implementing its Plan and Procedures, and other project-specific plans including: Stormwater Pollution Prevention Plan, Erosion Prevention and Sediment Control Plan; Spill Prevention, Control, and Countermeasures Plan; Inadvertent Release Contingency Plan; Agricultural Impact Mitigation Plan; Residential Construction Plans; Fish Salvage Plan; Procedures for Unanticipated Discovery of Cultural Resources and Human Remains; and Traffic Management Plan.
- Northwest would minimize impacts on natural and cultural resources during construction and operation of the project by implementing FERC's Plan and Procedures and its project-specific plans including: Erosion Control and Revegetation Plan; Inadvertent Release Contingency Plan; Residential Construction Plans; Site-specific School Construction Plans; Unanticipated Discovery of Contamination Plan; Plan and Procedures for the Unanticipated Discovery of Cultural Resources and Human Remains; and Water Quality Monitoring Plan.

- Oregon LNG and Northwest would use trenchless crossing methods for most major waterbodies which would generally avoid direct impacts on these resources.
- The majority of the WEP (94 percent) would be constructed within Northwest's existing pipeline right-of-way.
- Adequate safety features would be incorporated into the design and operation of the projects.
- We would complete Endangered Species Act consultations with the FWS and NMFS prior to allowing any construction to begin.
- We would complete the process of complying with Section 106 of the National Historic Preservation Act prior to allowing any construction to begin.
- We would ensure compliance with all mitigation measures that become conditions of the FERC authorizations and other approvals during our oversight of the environmental inspection and mitigation monitoring programs for both projects.

In addition, we developed site-specific mitigation measures that Oregon LNG and Northwest would implement to further reduce the environmental impacts that would otherwise result from construction of their projects. We determined that these measures are necessary to reduce adverse impacts associated with the projects, and in part, are basing our conclusions on implementation of these measures. Therefore, we are recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. These recommended mitigation measures are presented in section 5.2 of the draft EIS.

1.0 INTRODUCTION

On October 10, 2008, LNG Development Company, LLC and Oregon Pipeline Company, LLC filed applications with the Federal Energy Regulatory Commission (FERC or Commission) under Sections 3(a) and 7(c), respectively, of the Natural Gas Act of 1938 (NGA). The Commission issued a notice of Oregon LNG's applications on October 27, 2008. In Docket No. CP09-6-000, under Section 3(a) of the NGA, LNG Development Company, LLC requested authorization to site, construct, and operate a liquefied natural gas (LNG) import terminal in Warrenton, Oregon. Under Section 7(c) of the NGA and as filed in Docket No. CP09-7-000, Oregon Pipeline Company, LLC requested a Certificate of Public Convenience and Necessity (Certificate) to construct and operate a send-out pipeline from the proposed LNG import terminal to Molalla Gate Station in Clackamas County, Oregon. The two applicants are collectively referred to herein as Oregon LNG. The project, including the LNG terminal, natural gas pipeline, compressor station, and associated aboveground facilities, is referred to as the Oregon LNG Project.

The major components of Oregon LNG's import project included:

- one LNG import terminal facility including an LNG marine carrier turning basin in the Columbia River;
- one pier with a ship berth for one LNG marine carrier;
- three full-containment LNG storage tanks, each with a usable storage capacity of 160,000 cubic meters (m^3);
- vaporization, vapor handling, regasification, and sendout systems;
- 121-mile-long, 36-inch-diameter send-out pipeline from the terminal in Warrenton, Clatsop County, through Clatsop, Tillamook, Washington, Yamhill, Marion, and Clackamas Counties, Oregon, to Molalla Gate Station in Clackamas County, Oregon;
- one 9.5-mile, 24-inch-diameter lateral beginning at milepost (MP) 52.0 in Timber, Oregon, and terminating at the NW Natural South Mist Pipeline Extension, in Washington County, Oregon;
- appurtenant, auxiliary facilities necessary for the pipeline and lateral, including metering and regulating facilities, corrosion protection systems, pigging facilities, and mainline valves (MLV); and
- one single 21-megawatt (MW), 28,000-horsepower (hp) electrically driven compressor station near MP 52.0 in Timber, Washington County, Oregon.

On June 7, 2013, Oregon LNG amended its pending applications to include LNG export capabilities. The changes to the original proposal included **elimination of** the following:

- one 160,000 m^3 LNG storage tank;
- ambient air vaporizers;
- about 75 miles of 36-inch-diameter pipeline from MP 47.5 to MP 121.0 in Washington, Yamhill, Marion, and Clackamas Counties, Oregon;
- the 24-inch-diameter lateral in Washington County, Oregon;
- the meter station in Molalla, Oregon; and
- the Timber Compressor Station in Washington County, Oregon.

The changes to the original proposal included **addition of** the following major components:

- shell-and-tube vaporizers, natural gas pretreatment and liquefaction facilities, a water treatment system, and a new flaring system at the terminal;
- one 36-inch-diameter pipeline from MP 47.5 to MP 86.8 in Columbia County, Oregon, and Cowlitz County, Washington;
- one meter station at MP 86.8;
- one single 40-MW, 48,000-hp electrically driven gas compressor station at MP 80.9 in Columbia County, Oregon; and
- one nonjurisdictional water pipeline from and wastewater pipeline to the City of Warrenton Publicly Owned Treatment Works (POTW).

As a result of these changes, Oregon LNG's amended proposal includes an import/export LNG terminal with vaporization and liquefaction facilities and an 86.8-mile-long, 36-inch-diameter bidirectional pipeline from the terminal through Clatsop, Tillamook, and Columbia Counties in Oregon and Cowlitz County in Washington. The pipeline would interconnect with the interstate transmission system of Northwest Pipeline LLC (Northwest), a subsidiary of the Williams Companies, near Woodland, Washington. These facilities are described in more detail in section 1.2. The Commission issued a notice of Oregon LNG's applications to amend its pending applications on June 20, 2013.

On June 25, 2013, Northwest filed an application with FERC under Sections 7(b) and 7(c) of the NGA. In Docket No. CP13-507-000, Northwest seeks a certificate to expand the capacity of its existing natural gas transmission facilities along the Interstate Highway 5 (I-5) corridor between Woodland and Sumas, Washington. Northwest would accomplish the expansion by constructing and operating 140.6 miles of 36-inch-diameter loop[1] in 10 noncontiguous segments and adding compression facilities to existing compressor stations. Portions of Northwest's previously abandoned-in-place 26-inch-diameter pipeline would be removed to accommodate the new 36-inch-diameter pipeline. The loops and compressor stations would be in Cowlitz, Lewis, Thurston, Pierce, King, Snohomish, Skagit, and Whatcom Counties, Washington. In addition, under Section 7(b) of the NGA, Northwest is requesting approval to abandon[2] compressor equipment and a meter station by removal. Northwest's project is referred to as the Washington Expansion Project or WEP. The Commission issued a notice of Northwest's application on July 10, 2013.

The Oregon LNG Project as amended and the WEP would be connected actions, and therefore FERC is evaluating both project proposals in this environmental impact statement (EIS).

FERC is the federal agency responsible for authorizing onshore LNG terminals and interstate natural gas transmission facilities, as specified in Section 311(e)(1) of the Energy Policy Act of 2005 (EPAct) and the NGA. For the Oregon LNG Project and the WEP, in accordance with Section 313(b)(1) of the EPAct, FERC is the lead federal agency for the coordination of all applicable federal authorizations, and is also the lead federal agency for preparation of an EIS in compliance with the requirements of the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) regulations for implementing the NEPA (Title 40, Code of Federal Regulations [CFR] 1500-1508), and FERC's regulations implementing the NEPA (18 CFR Part 380).

[1] A loop is a segment of pipeline that is usually installed adjacent to an existing pipeline and connected to it at both ends. The loop allows more gas to be moved through the system.

[2] In utility law, the term "abandon" refers to government authorization for a utility to cease provision of a particular service and/or shut down a particular facility.

The U.S. Army Corps of Engineers (USACE), U.S. Coast Guard (Coast Guard), U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS), U.S. Department of Transportation (DOT), and U.S. Department of Energy (DOE) are cooperating agencies for the development of this EIS. A cooperating agency has jurisdiction by law or special expertise with respect to environmental impacts involved with the proposal, and is involved in the NEPA analysis.

The USACE has authority to issue dredging and wetland permits for the project, and also regulates the construction, alteration, or removal of federal flood control dikes and levees (see section 1.4.2). The Coast Guard makes recommendations regarding LNG facilities that affect the safety and security of LNG marine traffic in the waterway en route to the terminal. The Coast Guard also makes recommendations related to the suitability of the waterway for LNG marine traffic by issuing a Letter of Recommendation (LOR) (see section 1.4.3). The DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) has authority to enforce safety regulations and standards for the LNG terminal (see section 1.4.6) as well as the design and operation of Oregon LNG's pipeline and Northwest's pipeline expansion. The DOE has exclusive jurisdiction over the export of natural gas, including LNG, as a commodity in accordance with Section 3 of the NGA (see section 1.4.7).

NEPA requires FERC to take into account the environmental impacts that would result if it approves projects. This EIS discloses and assesses the potential environmental impacts associated with the projects. The EIS is generally organized so that each project is independently discussed within each chapter.

Prior to the publication of this draft EIS, FERC prepared an administrative draft EIS that was distributed for review to those agencies who formally agreed to be cooperating agencies in the development of the EIS (i.e., the Coast Guard, USACE, FWS, DOE, and EPA). Sections of this draft EIS were written with the cooperation and assistance of these agencies.

1.1 OREGON LNG

Oregon LNG proposes to construct and operate an onshore import/export LNG terminal and associated facilities on the East Bank Skipanon Peninsula near the confluence of the Skipanon and Columbia Rivers in Warrenton, Clatsop County, Oregon.

The components of the project are:

Terminal Facilities

- one marine terminal facility, including an LNG marine carrier turning basin in the Columbia River;
- one pier with a ship berth for one LNG marine carrier;
- one marine cargo transfer system consisting of three LNG unloading arms, a single vapor return arm, and a single LNG transfer pipeline connected to the onshore facility via a piping trestle;
- pretreatment facilities to remove sulfur compounds, carbon dioxide, water, and mercury from natural gas before liquefaction;
- liquefaction facilities consisting of two trains with capacity of 4.5 million tons (metric) per annum (MTPA) each, for an overall nominal liquefaction rate of 9.0 MTPA;
- refrigerant storage;

- flare system;
- two full-containment LNG storage tanks, each with a usable storage capacity of 160,000 m^3;
- one LNG spill containment and collection system;
- one vapor handling, regasification, and send-out system;
- interconnecting facilities, including piping, electrical, and control systems;
- administrative offices, a control room, and warehouse, security, and other buildings and enclosures;
- utilities, telecommunications, and other supporting systems;
- interconnecting roadways and civil works;
- deluge firewater system that draws from the Skipanon River;
- water intake and pump station on the Columbia River and water pipeline from the intake to the water treatment system; and
- water treatment system.

Pipeline Facilities

- one 86.8-mile-long, 36-inch-diameter pipeline with a transportation capacity of up to 1.25 billion standard cubic feet per day (Bscfd) of natural gas in Clatsop, Tillamook, and Columbia Counties, Oregon, and Cowlitz County, Washington;
- appurtenant, auxiliary facilities necessary for the pipeline, including metering and regulating facilities, corrosion protection systems, pigging facilities, and mainline valves; and
- existing and new access roads.

Compressor Station

- one single 40-MW, 48,000-hp electrically driven gas compressor station near MP 80.9 in Columbia County, Oregon.

Nonjurisdictional Facilities

- LNG marine waterway;
- water pipeline from and wastewater pipeline to the City of Warrenton POTW;
- one new 2.0-mile-long, double-circuit 230 kilovolt (kV) high-voltage power line from Pacific Power's new 230 kV substation in Warrenton to the terminal, a substation at the terminal, and upgrades to existing electrical facilities; and
- an electrical substation and 0.5-mile-long transmission line that would connect Bonneville Power Administration (BPA) power lines to the compressor station.

The general location of the Oregon LNG Project is shown on figure 1.1-1. The proposed facilities are more fully described in section 2.1. Nonjurisdictional facilities are those facilities related to the project that are constructed, owned, and operated by others that are not subject to FERC's jurisdiction. These facilities are addressed in section 2.1.2.

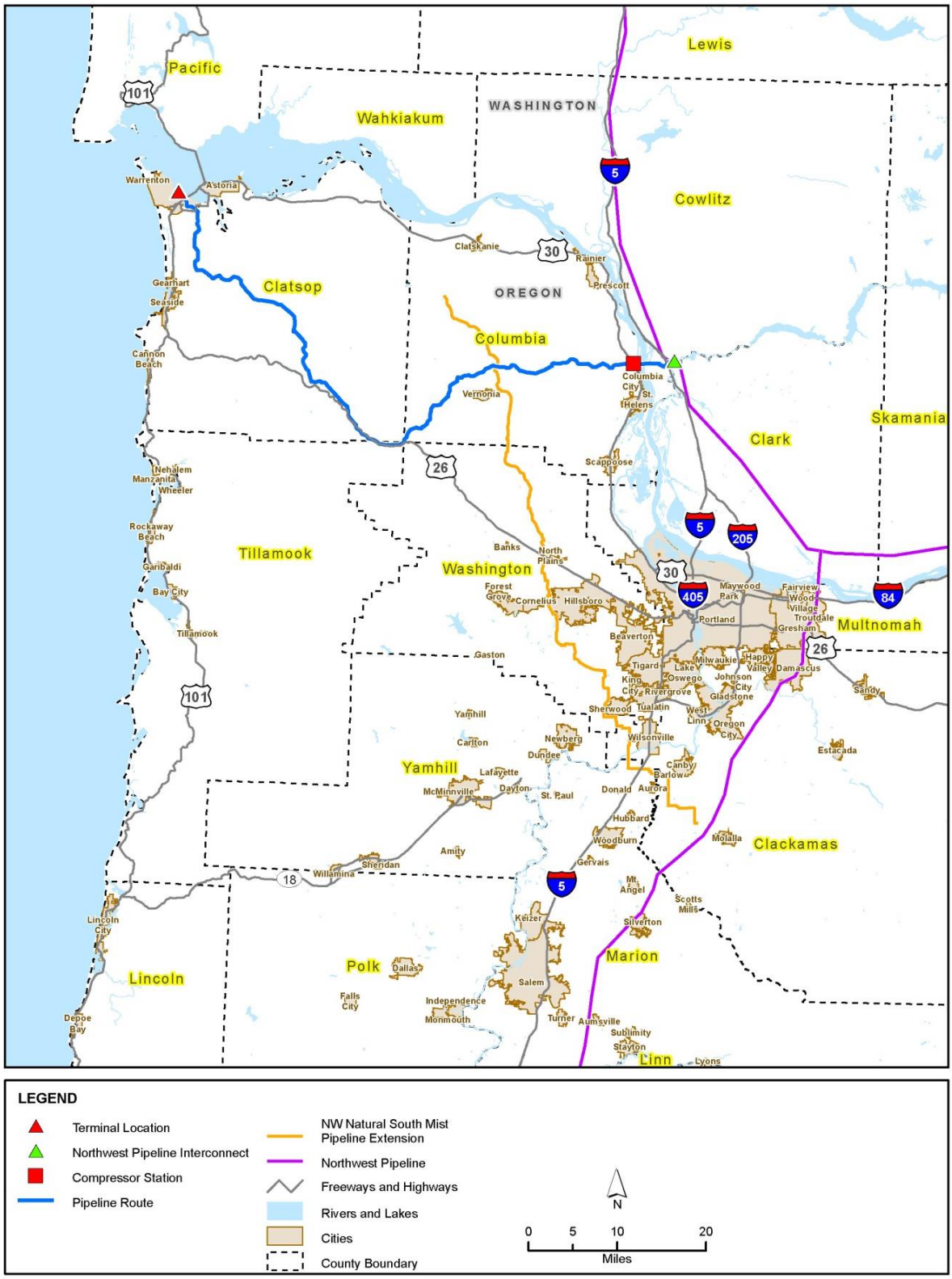


Figure 1.1-1: General Location Map for Oregon LNG Project

1.2 WASHINGTON EXPANSION PROJECT

Northwest would construct and operate 140.6 miles of 36-inch-diameter loop along its existing Northwest Pipeline in 10 segments between Woodland and Sumas, Washington. The major components of the WEP considered in this EIS are:

Pipeline Facilities

- Woodland Loop, 45.3 miles in Cowlitz and Lewis Counties;
- Chehalis Loop, 24.4 miles in Lewis and Thurston Counties;
- Sumner South Loop, 13.8 miles in Pierce County;
- Sumner North A Loop, 7.0 miles in King County;
- Sumner North B Loop, 11.0 miles in King County;
- Snohomish Loop, 15.6 miles in Snohomish County;
- Mt. Vernon South Loop, 4.5 miles in Skagit County;
- Mt. Vernon North A Loop, 4.8 miles in Skagit County;
- Mt. Vernon North B Loop, 8.4 miles in Skagit and Whatcom Counties; and
- Sumas Loop, 5.9 miles in Whatcom County.

Compressor Station Facility Additions

- 7,684 hp at Chehalis Compressor Station in Lewis County;
- 40,966 hp at Sumner Compressor Station in Pierce County;
- 14,996 hp at Snohomish Compressor Station in Snohomish County;
- 14,996 hp at Mt. Vernon Compressor Station in Skagit County; and
- 44,978 hp at Sumas Compressor Station in Whatcom County.

Ancillary Facilities

- new meter station facilities at Sumas Compressor Station;
- 10 new 36-inch pig launcher/receiver facilities; and
- 25 new 36-inch MLVs.

Abandonment and Removal of Facilities

- removal of existing, previously abandoned 26-inch-diameter pipeline at most locations to allow placement of the new 36-inch-diameter pipeline in the same trench, including segment attached to Kalama River aerial span;
- abandonment by removal of two compressor units at Sumner Compressor Station in Pierce County;
- abandonment by removal of four reciprocating engines at Sumas Compressor Station in Whatcom County;
- abandonment by removal of the existing Sumas Meter Station;
- removal of 2 existing 26-inch and 10 existing 36-inch pig launcher/receiver facilities; and
- removal of 14 existing 26-inch MLVs.

No nonjurisdictional facilities would be required for the WEP.

The general location of the WEP is shown on figure 1.2-1. The proposed facilities are more fully described in section 2.2.

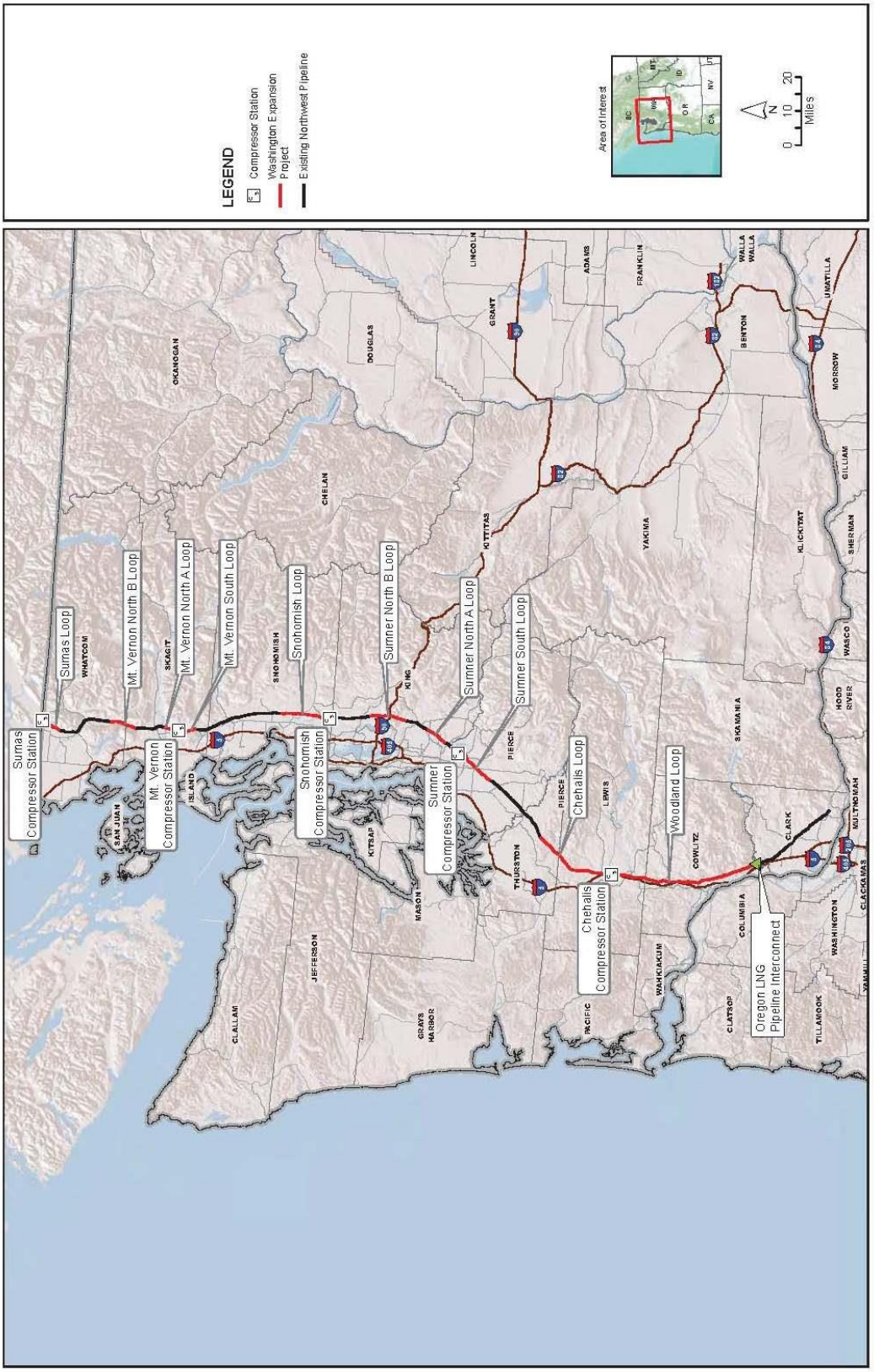


Figure 1.2-1: General Location Map for Washington Expansion Project

1.3 PROJECT PURPOSE AND NEED

Oregon LNG states that the primary purpose of the Oregon LNG Project is to facilitate the re-export of Canadian-sourced natural gas (and to a lesser extent, the export of U.S.-sourced gas from the Rocky Mountain region) to foreign markets as well as facilitate the availability of such gas supplies for delivery to Pacific Northwest markets, including the Portland metropolitan area. The Oregon LNG Project would also enable the delivery of gas to isolated U.S. markets in need of supply, including Hawaii and coastal Alaskan communities. While the Northwest pipeline system interconnects with gas supplies in the Rocky Mountain region, the Rockies are unlikely to be a significant source of gas for the project under the current economic conditions. With its LNG storage tanks, the Oregon LNG Project would also serve as a peaking gas resource to help manage regional demand. Should the current market conditions of natural gas oversupply change in the future, the project facilities are designed to be used for importing and revaporizing foreign-sourced LNG for consumption in U.S. markets.

Northwest states that the purpose of the WEP would be to provide 750,000 dekatherms per day (Dth/d) of incremental transportation capacity on Northwest's existing system from the natural gas supply hub at Sumas to Oregon LNG's pipeline. Northwest also anticipates that the WEP could serve other natural gas markets in Washington to address the needs of other interested parties. Northwest further indicates that the combination of the WEP and the Oregon LNG Project would provide international customers in the Pacific Rim and regional customers in the Pacific Northwest access to natural gas supplies from western Canadian supply basins, in addition to alternate U.S. domestic sources.

Section 3 of the NGA, as amended, requires that authorization be obtained from the DOE prior to importing or exporting natural gas, including LNG, from or to a foreign country. For applicants that have, or intend to have, a signed gas purchase or sales agreement/contract for a period of time longer than 2 years, long-term authorization is required. Under Section 3 of the NGA, FERC considers, as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities for importation or exportation, FERC shall authorize the proposal unless it finds that the proposed facilities will not be consistent with the public interest.

Under Section 7(c) of the NGA, the Commission determines whether interstate natural gas transportation facilities are in the public convenience and necessity and, if so, grants a Certificate to construct and operate them. The Commission bases its decisions on technical competence, financing, rates, market demand, gas supply, environmental impact, long-term feasibility, and other issues concerning a proposed project.

1.4 PURPOSE AND SCOPE OF THIS EIS

1.4.1 Federal Energy Regulatory Commission

FERC is the federal agency responsible for authorizing onshore LNG import and export facilities. FERC will use this EIS as a tool to assist in its review of Oregon LNG's and Northwest's applications. The Commission will consider the environmental issues, including our recommended mitigation measures, as well as nonenvironmental issues. Final authorization would be granted only if the Commission finds that the projects are in the public interest. The assessment of environmental impacts and mitigation described in this EIS will be important factors in the Commission's decision of whether or not to authorize the projects.

Our principal purposes for preparing this EIS are to:

- identify and assess potential impacts on the natural and human environment that would result from the implementation of the proposed action;
- identify and assess reasonable alternatives to the proposed action that would avoid or minimize adverse effects on the human environment;
- identify and recommend specific mitigation measures to minimize the environmental impacts; and
- facilitate public involvement in identifying significant environmental impacts on specific resources.

Our analysis in this EIS focuses on facilities that are under FERC's jurisdiction (i.e., the LNG terminal, pipelines, compressor station facilities, and ancillary facilities).

The EIS describes the affected environment as it currently exists and the environmental consequences of the proposed projects, and also compares the potential impacts of other alternatives. The topics addressed in this EIS include: alternatives; geology; soils; water resources; wetlands; vegetation; fish; wildlife; migratory birds; threatened, endangered and other special status species; land use; recreation; visual resources; social economics; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. This EIS also presents our conclusions and recommended mitigation measures.

1.4.2 U.S. Army Corps of Engineers

The Oregon LNG Project has a water-dependency purpose as it relates to processing and exportation or importation of natural gas. The project requires construction of a marine berth for loading and unloading of LNG vessels associated with waterborne transport of LNG. The USACE is the primary agency responsible for issuing dredging and wetland permits pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbor Act (RHA) (see section 1.5.1.1). Along with EPA, the USACE has responsibilities under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) (see section 1.5.1.7). The USACE is also responsible for review and approval of impacts on public works facilities, including but not limited to levees, sea walls, bulkheads, jetties, and dikes.

The USACE must comply with the requirements of the NEPA before issuing permits under these statutes. In addition, when a Section 404 discharge is proposed and a standard permit is required, the USACE must consider whether the proposed Section 404 discharge represents the least environmentally damaging, practicable alternative pursuant to the CWA Section 404(b)(1) guidelines. The USACE must also carry out its public interest review process before a standard permit can be issued. Although this EIS addresses environmental impacts associated with the projects as they relate to the USACE's jurisdictional permitting authority, it does not serve as a public notice for any USACE permits or take the place of the USACE's permit review process.

1.4.3 U.S. Coast Guard

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (50 United States Code [U.S.C.] 191), the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. 1221 et seq), and the Maritime Transportation

Security Act of 2002 (46 U.S.C. 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of the facilities or equipment in or adjacent to navigable waters up to the last valve immediately before the storage tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility. As required by its regulations, the Coast Guard is responsible for assessing the suitability of the waterway and issuing an LOR. The recommendations contained in the LOR are based on a review of the following items:

- density and character of marine traffic;
- locks, bridges, and other manmade obstructions in the waterway;
- environmental effects of LNG marine carriers during transit from open water to the facility;
- maritime security (MARSEC)/port security considerations; and
- the following factors adjacent to the facility:
  - depth of water;
  - tidal range;
  - protection from high seas;
  - natural hazards, including reefs, rocks, and sandbars;
  - underwater pipes and cables; and
  - distance of berthed vessels from the channel and the width of the channel.

In accordance with 33 CFR 127.007, Oregon LNG submitted a Letter of Intent (LOI) in May, 2007, to the local Captain of the Port (COTP) to begin the LOR process. Following the guidance in the Coast Guard's 2005 *Navigation and Vessel Inspection Circular (NVIC) – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas Marine Traffic*, Oregon LNG submitted a Waterway Suitability Assessment (WSA) in May 2007 to the Coast Guard for the proposed terminal development in Warrenton. A revised WSA was submitted in June 2008 to respond to comments from the Coast Guard. The Coast Guard issued its LOR and LOR Analysis on April 24, 2009. These documents are provided in appendix B1. Oregon LNG notified the Coast Guard that the proposed terminal had changed to an import/export facility in its Annual Review of the WSA submitted in November 2012. On February 24, 2014, the Coast Guard notified Oregon LNG that no update was necessary to the WSA. The Coast Guard will fulfill its obligations as a cooperating agency under the terms of the current NVIC (Coast Guard, 2011). See section 4.1.13.7 for additional information on marine safety.

1.4.4 U.S. Environmental Protection Agency

The EPA has responsibilities under NEPA, the Clean Air Act (CAA), CWA, and MPRSA (see section 1.5.1). The EPA shares responsibility for administering and enforcing Section 404 of the CWA with the USACE and has authority to veto USACE permit decisions. The EPA also co-administers the MPRSA with the USACE.

In addition, Section 309 of the CAA directs the EPA to review and comment in writing on the environmental impact associated with all major federal actions. This obligation is independent of its role as a cooperating agency under the NEPA regulations. Consistent with this direction, EPA evaluates all

federally issued EISs for adequacy in meeting the procedural and public disclosure requirements of the NEPA.

1.4.5 U.S. Fish and Wildlife Service

The FWS has responsibilities under the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). The FWS also has special expertise regarding effects on fish and wildlife and other environmental values and works to conserve, protect, and recover species under the ESA (see section 1.5.1.3). The FWS will use its role as a cooperating agency to assist in the creation of an environmentally acceptable project.

1.4.6 U.S. Department of Transportation

Under 49 U.S.C. 60101, the DOT has prescribed the minimum federal safety standards for LNG facilities. Those standards are codified in 49 CFR 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. A portion of the National Fire Protection Association (NFPA) Standard 59A, "Standard for the Production, Storage, and Handling of Liquefied Natural Gas," is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 1985 Memorandum of Understanding (MOU) on LNG facilities and the 2004 Interagency Agreement on the safety and security review of waterfront import/export LNG facilities, the DOT participates as a cooperating agency and assists in assessing any mitigation measures that may become conditions of approval for any project. DOT staff has reviewed the FERC staff's analysis and provided comments.

1.4.7 U.S. Department of Energy

The DOE must meet its obligation under Section 3 of the NGA to authorize the import and export of natural gas, including LNG, unless it finds that the import or export is not consistent with the public interest. By law, under Section 3(c) of the NGA, applications to export natural gas to countries with which the United States has free trade agreements that require national treatment for trade in natural gas (FTA) are deemed to be consistent with the public interest and the Secretary of Energy must grant authorization without modification or delay. LNG Development Company, LLC (d/b/a Oregon LNG) filed an application with the DOE (FE Docket No. 12-48-LNG) on May 3, 2012, seeking authorization to export up to 9.6 MTPA of LNG (the equivalent of 456.3 billion cubic feet per year [Bcf/y] of natural gas) for a 30-year period to FTA countries, commencing the earlier of either the date of first export or 10 years from the date of issuance of the requested authorization. On May 31, 2012, the DOE issued DOE/FE Order No. 3100 granting authorization to Oregon LNG to export LNG by vessel from the proposed Oregon LNG Terminal to FTA countries.

In the case of LNG export applications to countries with which the United States does not have a free trade agreement requiring the national treatment for trade in natural gas (non-FTA countries), Section 3(a) of the NGA requires DOE to conduct a public interest review and to grant the applications unless DOE finds that the proposed exports would not be consistent with the public interest. Additionally, NEPA requires DOE to consider the environmental impacts of its decisions on non-FTA export applications. In this regard, DOE acts as a cooperating agency with FERC as the lead agency in the EIS pursuant to the requirements of NEPA.

On July 16, 2012, Oregon LNG filed an application with the DOE (FE Docket Nos. 12-77-LNG) seeking authorization to export up to 9.6 MTPA of LNG (the equivalent of 456.3 Bcf/y) for a 25-year period, commencing on the earlier of either the date of first export or 8 years from the date of issuance of

the requested authorization. Oregon LNG seeks to export LNG from the Oregon LNG Terminal to any country with which the United States does not have a free trade agreement requiring the national treatment for trade in natural gas (non-FTA) and with which trade is not prohibited by U.S. law or policy (non-FTA countries).

On July 31, 2014, the DOE issued DOE/FE Order No. 3465 conditionally granting Oregon LNG authorization to export LNG by vessel to non-FTA countries. The authorization granted is conditioned on the satisfactory completion of this environmental review of Oregon LNG's proposed LNG Terminal under NEPA and on issuance by DOE of a Record of Decision pursuant to NEPA. In accordance with 40 CFR 1506.3, after an independent review of the EIS, the DOE may adopt it prior to issuing a Record of Decision on Oregon LNG's application for authority to export LNG.

1.4.8 Topics Outside the Scope of this EIS

During the pre-filing public scoping period (see section 1.6 below), we[3] received comments about issues outside the scope of this EIS. Examples of out-of-scope issues include the need to export LNG; horizontal hydraulic drilling through shale formations during exploration for natural gas (often referred to as "fracking"); induced production of natural gas; "life-cycle" cumulative environmental impacts associated with the entire LNG export process; the concept of a "programmatic" EIS to cover LNG export terminals throughout the United States; and administrative information technology system operations at FERC.

With regard to the public benefit or need to export LNG from the United States to foreign nations, that decision rests with the DOE, and is therefore outside of the jurisdiction of FERC. While the Commission has the authority to site and approve or disapprove the construction and operation of onshore LNG terminals, the DOE retains the authority to approve or disprove the import or export of the commodity itself.[4]

Some commenters claim that the export of LNG from the Oregon LNG terminal would result in the indirect impact of inducing additional drilling activities or stimulating natural gas production. FERC does not have any authority over activities related to the exploration, production, and gathering of natural gas. Those activities, rather, are regulated by state and local governments. Natural gas from the Rocky Mountains in Canada can be supplied through the WEP. As the Commission has stated before, knowing the identity of a supplier of gas to be shipped on a pipeline, and even the general area where a producer's existing wells are located, does not enable the Commission to forecast (as opposed to speculate about) the number, location, or timing of the development of the new or existing wells that might produce the gas which would be transported on the project facilities. In the absence of such information, the Commission cannot forecast and analyze the specific impacts which might be associated with any additional production.[5]

The Oregon LNG Project does not depend on additional U.S. production because most of the gas is expected to come from Canadian sources. It is speculative to assume that the Oregon LNG Project would cause increased natural gas production because other factors, unrelated to the project and over which the Commission has no control, may also influence production such as regional domestic market demands, permitting for new gas wells, or technologies and efficiencies in exploration. Therefore,

[3] The pronouns "we," "us," and "our" refer to the environmental staff of FERC's Office of Energy Projects.

[4] The Commission explained the division of responsibilities between the Commission and DOE in *Sabine Pass Liquefaction, LLC*, 139 FERC ¶ 61,039, at PP 22-30 (2012).

[5] The Commission addressed this issue in *Sabine Pass Liquefaction*, LLC, 151 FERC ¶ 61,012 (2015), and also in *Central New York Oil and Gas Company*, 137 FERC ¶ 61,121 (2011).

induced or additional natural gas production is not a "reasonably foreseeable" indirect effect of the project, and is not addressed in this NEPA document.[6]

Similarly, the "life-cycle" cumulative environmental impacts from exploration, production, and gathering of natural gas; transportation to the WEP; and shipment of LNG overseas from the Oregon LNG terminal are far beyond the jurisdictional authority of FERC or the activities directly related to the project. Nor can those impacts be reasonably calculated, given the number of unknown elements in the chain and actions by entities other than Oregon LNG and Northwest. As mentioned above, the number and location of wells producing natural gas that will supply the project are unknown, as are the gathering systems that would ultimately transport that gas to the WEP. Oregon LNG has not identified the specific type of vessels that would ship the LNG abroad, the routes of those vessels, or the identities of the customers for the LNG. Without knowing the final destination of the LNG, it would not be possible to calculate the environmental impacts associated with its overseas shipping. The Commission does not intend to conduct a nation-wide, programmatic analysis of proposed LNG export terminals. As stated above, the DOE determines the public benefits of exporting LNG from terminals in the United States. The FERC's review and approval of individual projects under the NGA does not constitute a coordinated federal program. The Commission does not "direct the development of the gas industry's infrastructure, neither on a broad regional basis nor in the design of specific projects."[7] Further, the Commission does not engage in regional planning exercises that would result in the selection of one terminal location over another. Instead, the Commission allows market forces to influence where LNG terminals should be situated, assuming that the locations are environmentally acceptable based on a project-specific EIS. Developers of projects select the location of their proposed facilities based on market and other factors, and the Commission staff analyzes the environmental impacts of construction and operation of those facilities at the selected locations.

There were also some comments on administrative issues that are not environmental topics and will not be addressed in this EIS. Those comments were mainly about the FERC's information management system. Those issues are outside the scope of this EIS.

1.5 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

1.5.1 Federal

As the lead federal agency for the Oregon LNG Project and the WEP, FERC is required to comply with various federal environmental laws and regulations. These laws and regulations include but are not limited to, the CWA, the RHA, the CAA, Section 7 of the ESA, the MBTA, the BGEPA, the MSA, the Marine Mammal Protection Act (MMPA), MPRSA, Section 106 of the National Historic Preservation Act (NHPA), the Coastal Zone Management Act (CZMA), and Coast Guard regulations relating to LNG waterfront facilities. Each of these statutes has been taken into account in the preparation of this document and is described more fully below.

Specific information related to the status of permit applications and approvals for the projects is provided in the permit tables (see section 1.5.4). Information relative to project-specific permits is also included with the discussions of resources in section 4.

[6] The Commission has consistently held that natural gas production as an indirect effect of an LNG project is beyond the scope of the review required by NEPA. *See Corpus Christi Liquefaction, LLC*, 151 FERC ¶ 61,098, at P 12 (2015). *See also* Oregon LNG and Oregon Pipeline August 26, 2013 Answer at 4-10 (citing *Cheniere Creole Trail Pipeline*, 142 FERC ¶ 61,137, at P 55 (2013); and *Sabine Pass Liquefaction*, 139 FERC ¶ 61,039, at PP 94-99 (2012)).

[7] *Texas Eastern Transmission, LP*, 141 FERC ¶ 61,043, at P 25 (2012). *See also Corpus Christi Liquefaction, LLC*, 151 FERC, at P 27 (2015).

1.5.1.1 Clean Water Act and River and Harbors Act

The CWA (33 U.S.C. 1344) addresses the issue of managing developments to improve, safeguard, and restore the quality of the nation's waters, including coastal waters, and to protect the natural resources and existing uses of those waters. Under Section 404 of the CWA, the USACE issues permits (after notice and opportunity for public hearings) for the discharge of dredged or fill material into waters of the United States at specified disposal sites. The EPA has the authority to review and overrule USACE decisions on Section 404 permits.

Section 10 of the RHA (33 U.S.C. 403) regulates any work or structures that potentially affect the course, condition, or capacity of a navigable waterway. It requires authorization from the USACE for building any wharfs, piers, jetties, or other structures or excavating or filling in any port, navigable river, or other waters of the United States.

According to 33 U.S.C. 408, there shall be no temporary or permanent alteration, occupation or use of any public works including but not limited to levees, sea walls, bulkheads, jetties and dikes for any purpose without the permission of the Secretary of the Army. Under the terms of 33 U.S.C. 408, any proposed modification requires a determination by the Secretary that such proposed alteration or permanent occupation or use of a federal project is not injurious to the public interest and will not impair the usefulness of such work.

Oregon LNG and Northwest must obtain Water Quality Certifications pursuant to Section 401 of the CWA and National Pollutant Discharge Elimination System (NPDES) permits pursuant to Section 402 of the CWA. The federal authority to issue these certifications and permits has been delegated to the Oregon Department of Environmental Quality (ODEQ) and the Washington State Department of Ecology (WA Ecology).

1.5.1.2 Clean Air Act

The EPA has regulatory authority under the CAA and provides review and oversight of these regulations but has delegated permitting authority to the ODEQ in Oregon and to local clean air agencies in Washington. ODEQ would have jurisdiction over Oregon LNG's terminal and compressor station facilities. The Southwest Washington Clean Air Agency, Puget Sound Clean Air Agency, and Northwest Washington Clean Air Agency would have jurisdiction over the WEP compressor station facilities. In addition, Section 309 of the CAA directs the EPA to review and comment on an EIS issued by a federal agency regarding actions that may affect air quality.

The primary objective of the CAA, as amended, is to establish federal standards for various air pollutants and to provide for the regulation of polluting emissions via state implementation plans. In addition, the CAA is designated to prevent significant deterioration in certain areas where air quality exceeds national standards and to provide for improved air quality in areas that do not meet federal standards (e.g., nonattainment areas). Emissions from all phases of construction and operation of the Oregon LNG Project and the WEP would be subject to applicable federal and state air regulations. Sections 4.1.12 and 4.2.12 provide more detailed information about air quality permits and issues.

1.5.1.3 Endangered Species Act

Section 7(a)(1) and (2) of the ESA, as amended, states that any project authorized, funded, or conducted by a federal agency should not "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which

is determined...to be critical" (16 U.S.C. 1536(a)(1) and (2)(1988)). The lead federal agency, or the applicant as a nonfederal party, is required to consult with the FWS and the U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), to determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the vicinity of the proposed project. If, upon review of existing data or data provided by the applicant, the federal agency determines that these species or habitats may be affected by the proposed project, it is required to prepare a Biological Assessment (BA) to identify the nature and extent of adverse impacts, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impacts to acceptable levels.

FERC will submit a combined BA for the Oregon LNG Project and the WEP to NMFS and the FWS prior to issuance of the final EIS. Because the projects are likely to adversely affect some listed species, we will request formal consultation and that the FWS and NMFS develop Biological Opinions (BO) to ensure that the Oregon LNG Project and the WEP does not jeopardize the continued existence of any listed species or adversely modify designated critical habitat. Construction may only proceed after formal consultations with the FWS and NMFS have been completed in compliance with the ESA and MSA. See sections 4.1.8 and 4.2.8 for details of our ESA analysis.

1.5.1.4 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act

The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the U.S. Department of the Interior. The BGEPA prohibits harming eagles, their nests, or their eggs.

Executive Order 13186 provides additional direction to federal agencies regarding responsibilities to protect migratory birds. As part of the requirements of Executive Order 13186, on March 30, 2011, FERC and the FWS signed an MOU identifying specific activities of cooperation between the two agencies that will contribute to the conservation of migratory birds and their habitat. The MOU outlines a collaborative approach to promoting the conservation of migratory bird populations and furthering implementation of the migratory bird conventions, the MBTA, and the BGEPA.

1.5.1.5 Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a federal fisheries management plan. The MSA requires that federal agencies consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH (MSA 305(b)(2)). Although absolute criteria have not been established for conducting EFH consultations, NMFS recommends consolidating EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, or the ESA to reduce duplication and improve efficiency (50 CFR 600.920(e)). As part of the consultation process for this project, an EFH Assessment will be included within the BA.

1.5.1.6 Marine Mammal Protection Act

All marine mammals are protected under the MMPA of 1972, as amended by the U.S. Congress in 1994. The MMPA prohibits, with certain exceptions, the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the United States. The term "take," as defined in Section 3 of the MMPA, means "to harm, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C.

1362(13)). "Harassment" is also defined in the MMPA (at U.S.C. 1362(18)) and in regulations promulgated by NMFS (50 CFR 216.3).

Under MMPA Section 101(a)(5)(D), an Incidental Harassment Authorization can be granted by NMFS if it finds that the incidental "take" would have a negligible impact on the species or stock, or would not have an unmitigatable adverse impact on the availability of the species or stock for subsistence uses (where relevant). NMFS has defined "negligible impact" as "an impact resulting from the specified activity that cannot be reasonably expected to, and would not be reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." Incidental Harassment Authorizations include permissible methods of taking and requirements for mitigation and monitoring to ensure that takings result in the least practicable adverse impact on affected marine mammal species or stocks. The public has an opportunity to comment to the NMFS in response to its Notice of Receipt of an application for an Incidental Harassment Authorization, or its receipt of a request for the implementation of regulations governing incidental taking.

Impacts from the Oregon LNG Project on marine mammals are addressed in section 4.1.5. A complete assessment of the possible adverse impacts on marine mammals will be included in the BA.

1.5.1.7 Marine Protection, Research and Sanctuaries Act

Section 103 of the MPRSA of 1972 assigns the USACE responsibility for issuing permits for the ocean dumping of dredged materials, and for authorizing the transport of dredged material for ocean disposal at designated sites. That permit decision would be made using the EPA's environmental criteria and would be subject to EPA's concurrence. If disposal is proposed at an EPA-designated site under Section 102 of the MPRSA, that disposal must be consistent with the site-specific Site Management and Monitoring Plan.

Section 102 of the MPRSA gives authority to the EPA for designating ocean disposal sites. The materials proposed for dredging must first be sampled and analyzed to determine if they meet EPA-established ocean dumping criteria.

Dredging and dredged material disposal in the Lower Columbia River Management Area is overseen by an interagency team called the Regional Sediment Evaluation Team (RSET) co-chaired by the EPA Region 10 and the Northwestern Division of the USACE (USACE et al., 2006). RSET consists of the following federal and state agencies with regulatory responsibilities for managing sediments:

- USACE Seattle District, Portland District, Walla Walla District, and Northwestern Division;
- EPA Region 10;
- WA Ecology;
- Washington Department of Natural Resources (WDNR);
- ODEQ;
- Idaho Department of Environmental Quality;
- U.S. Forest Service; and
- FWS.

1.5.1.8 National Historic Preservation Act

Section 106 of the NHPA requires the lead federal agency to take into account the effects of an undertaking on historic properties, and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Historic properties are cultural resources that are listed on, or are eligible for listing on, the National Register of Historic Places (NRHP), including prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance. The ACHP promulgated regulations for the implementation of Section 106 at 36 CFR 800. In accordance with those procedures, Oregon LNG and Northwest, as nonfederal parties, are assisting in the preparation of information and analyses necessary to comply with the NHPA. Sections 4.1.11 and 4.2.11 include summaries of the status of investigations to comply with the NHPA.

1.5.1.9 Coastal Zone Management Act

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone" (16 U.S.C. 1452, Sections 303 (1) and (2)).

The CZMA requires applicants for a federal license or permit to conduct an activity affecting the resources of a coastal zone to provide a certification that the proposed activity complies with the state's approved coastal zone management program.

The Oregon Coastal Management Program (OCMP) manages the land and water areas within Oregon's Coastal Zone. All shorelands and drainage basins that have a significant and direct effect on coastal waters are included, with the exception of the Columbia, Umpqua, and Rogue River basins, which are included only to the extent of significant tidal influence. The coastal zone is formally defined as extending from the Washington border on the north to the California border on the south; seaward to the extent of state jurisdiction as recognized by federal law (the Territorial Sea, extending 3 nautical miles offshore); and inland to the crest of the coastal mountain range. The Oregon LNG Project would be within the Oregon Coastal Zone in Clatsop and Tillamook Counties.

The Oregon Department of Land Conservation and Development (ODLCD) is the state's designated coastal management agency and established the OCMP. The OCMP's mission is to work in partnership with coastal local governments, state and federal agencies, and other stakeholders to ensure that Oregon's coastal and ocean resources are managed, conserved, and developed consistent with statewide planning goals. To accomplish this mission, the OCMP combines various state statutes for managing coastal lands and waters into a single, coordinated package. These include: 1) the 19 Statewide Planning Goals, which are Oregon's standards for comprehensive land use planning; 2) city and county comprehensive land use plans; and 3) state agencies and natural resource laws such as the Oregon Beach Bill and the Removal-Fill Law. The ODLCD reviews coastal zone consistency certifications and makes formal determinations as to whether a project is consistent with the CZMA.

The Washington State Coastal Zone Management (CZM) Program manages the land and water areas within Washington's Coastal Zone. The program applies to the 15 coastal counties that front salt water. WA Ecology is the state's designated coastal zone management agency. The WEP would be within the Washington Coastal Zone in Thurston, Pierce, King, Snohomish, Skagit, and Whatcom Counties. The Oregon LNG Project would not be within the Washington Coastal Zone. See sections 4.1.9 and 4.2.9 for further information regarding consistency with the CZMA.

1.5.1.10 U.S. Department of Defense Consultation

Under Section 311 of the EPAct and Section 3 of the NGA, FERC is required to consult with the Department of Defense (DOD) to determine if there would be any impacts associated with LNG projects on military training or activities on any military installations. This process would coincide with the release of the draft EIS.

In accordance with a 2007 MOU between FERC and the DOD, FERC notified the DOD of the Oregon LNG Project in September 2012 and requested comments on whether the planned project would potentially have an impact on testing, training, or operational activities at any active military installation. In addition, FERC requested contact information for any defense or military establishments in the project area that may be affected by the project. The DOD reviewed the Oregon LNG Project and responded in November 2012 that it predicted the project would have minimal impact on the military operations conducted in the area.

1.5.2 Oregon Laws and Regulations

In addition to the federal permitting authorities that have been delegated to the states, various laws and regulations promulgated by the State of Oregon are applicable to the Oregon LNG Project.

1.5.2.1 Safety Advisory and Agency Coordination

According to Section 311 of the EPAct, the governor of a state in which an LNG terminal is proposed is to designate an appropriate state agency to consult with the Commission. That state agency is required to provide FERC with an advisory report on state and local safety concerns within 30 days of FERC's notice of an application for an LNG terminal. The Commission will consider the report prior to making a decision.

The Oregon Department of Energy (ODE) has been designated by the Governor of Oregon as the state agency to coordinate the review of proposed LNG projects by other state agencies and consult with FERC. The ODE provided FERC a safety advisory report in November 2009. This report and FERC's response are included in appendix C1.

In June 2009, Oregon LNG filed with FERC an MOU it had completed with the ODE to address safety issues for its import project. The 2009 MOU is being replaced with two stand-alone MOUs for the import/export project. One MOU was completed August 15, 2014 and addresses development of an emergency planning and preparedness program for the terminal (see appendix C2). This MOU also includes provisions for Oregon LNG to reimburse the ODE for ODE's costs related to the tasks outlined in the MOU. The second MOU is expected to address carbon dioxide (CO_2) emissions and financial obligations for facility retirement. Requirements for a terminal Emergency Response Plan (ERP) and associated Cost-Sharing Plan are discussed in more detail in section 4.1.13.9.

1.5.2.2 State-Listed Endangered and Threatened Species

Under state law (ORS 496.171-496.192) the Fish and Wildlife Commission through Oregon Department of Fish and Wildlife (ODFW) maintains the list of native wildlife species in Oregon that have been determined to be either "threatened" or "endangered" according to criteria set forth by rule (Oregon Administrative Rule (OAR) 635-100-0105). The Oregon Department of Agriculture (ODA) maintains the state list of endangered and threatened plant species, in accordance with OAR Chapter 603, Division 73, and reviews reports of botanical surveys under Oregon Senate Bill 533 and its corresponding Oregon

Revised Statute (ORS) 564. These state laws and regulations require surveys for state-listed species on nonfederal public lands prior to ground-disturbing activities, unless habitat for the species does not exist in the project area. Section 4.1.8.2 addresses potential project impacts on Oregon-listed species.

1.5.2.3 Oregon Removal-Fill Law

Under Oregon's Removal-Fill Law ORS 196.795-990), permits are issued by the Oregon Department of State Lands (ODSL) for:

- projects requiring the removal or fill of 50 cubic yards or more of material in waters of the state;
- the removal or fill of any material regardless of the number of cubic yards affected in a waterbody designated as essential salmon habitat; and
- the removal or fill of any material from the bed and banks of scenic waterways regardless of the number of cubic yards affected.

All permits include standard and special design and operating conditions that are intended to ensure the protection, conservation, and best use of the state's water resources and to prevent harm to fishery and recreational uses of the waters. A common condition is that the project be conducted during the "in-water work period" established by the ODFW for the specific waterbodies. For projects involving impacts on wetlands, compensatory mitigation to offset loss of wetland resources is required per OAR 141-085-0121. A Joint Permit Application (JPA) is used for the Oregon Removal-Fill Permit and the USACE permit under Section 10 of the RHA and Section 404 of the CWA. However, the JPA must be submitted to both agencies and separate permits are issued.

Section 4.1 contains information about project-related impacts on surface waters, wetlands, fisheries, and recreational use of waters in Oregon and Oregon LNG's proposed mitigation.

1.5.2.4 Fish and Wildlife Habitat Mitigation Policy

The purpose of the Fish and Wildlife Habitat Mitigation Policy (OAR 345-022-0060) is to apply consistent goals and standards to mitigate impacts on fish and wildlife habitat caused by land and water development actions. The policy provides goals and standards for general application to individual development actions, and for the development of more detailed policies for specific classes of development actions or habitat types. In implementing this policy, the ODFW would recommend mitigation for losses of fish and wildlife habitat resulting from development actions. Priority is given for native species. Section 4.1.7.3 includes additional information about how Oregon LNG intends to comply with this policy.

1.5.2.5 Forest Practices Act

The Oregon Department of Forestry (ODF) manages state forests for the "greatest permanent value." The ODF's Forest Management Plan provides strategic direction and guides management activities. Part of the plan is to identify multipurpose objectives and protect sensitive resources according to the state's Land Management Classification System. The ODF also monitors the commercial harvest of forest products from private timber lands in accordance with the Oregon Forest Practices Act (FPA). The forest practice rules provide resource protection and set standards for planning forestry practices. They apply to timber harvesting, road construction and maintenance, protecting water quality in waters of the state, limiting effects on specified resource sites (i.e., waterbodies, wetlands, nesting bird sites),

providing for public safety downslope of high landslide hazard locations, and determining reforestation or land conversion requirements. The ODF is responsible for protection of nonfederal and private forest lands from wildfires. For project-related impacts on forest lands, see section 4.1.6.

1.5.2.6 Oregon State Historic Preservation Office

FERC, as the lead federal agency, on behalf of the cooperating agencies, must consult with the Oregon State Historic Preservation Office (SHPO) regarding the identification, evaluation, and determination of effects on historic properties, in accordance with the ACHP's regulations at 36 CFR 800 for implementing Section 106 of the NHPA. SHPO also has authorities, under ORS 358.920, to issue permits for cultural resources surveys on nonfederal public land, and for the excavation of archaeological sites on nonfederal public and private lands. Consultations with the Oregon SHPO and compliance with the NHPA are discussed in section 4.1.11.

1.5.3 Washington Laws and Regulations

Various laws and regulations promulgated by the State of Washington are applicable to the Oregon LNG Project and the WEP.

1.5.3.1 State Environmental Policy Act

In Washington, state and county agencies conduct environmental reviews of proposed projects pursuant to the State Environmental Policy Act (SEPA) (Chapter 43.21C Revised Code of Washington (RCW)). The SEPA process involves the identification and evaluation of probable environmental impacts, and the development of mitigation measures that would reduce adverse environmental impacts. WA Ecology is the lead SEPA agency for projects that would cross more than one county. The lead agency is responsible for compliance with SEPA procedural requirements and for compiling and assessing information on the environmental aspects of the proposal for all agencies with jurisdiction in Washington.

WA Ecology could adopt this EIS if its independent review confirms that the document is adequate, meets applicable environmental review standards, and the requirements of the State of Washington Administrative Code (WAC) 197-11-610 and 197-11-630. If the decision is made to adopt this EIS, an adoption form would be circulated to agencies with jurisdiction and to persons or organizations that have expressed an interest in the proposal. After a 21-day notice period, state and local agencies could begin issuing permits.

1.5.3.2 Growth Management Act

The Growth Management Act (GMA) was passed in 1990 to address what the Washington State Legislature referred to as uncoordinated and unplanned growth that posed a threat to the environment, sustainable economic development, and the quality of life in Washington. The GMA requires state mandated comprehensive planning for the most populated and fastest growing counties of the state. The GMA also mandates that all counties develop and adopt an ordinance that classifies, designates, and protects critical areas.

1.5.3.3 Shoreline Management Act and Hydraulic Project Approval

The Shoreline Management Act (SMA) was passed by the Washington State Legislature in 1971. The SMA is the principal means of regulating shoreline land and water uses throughout the state and

requires cities and counties to develop Shoreline Master Programs (SMP). WA Ecology reviews and formally adopts the programs. The SMPs must be consistent with statewide policies but contain specific regulations and polices that are tailored to local conditions to promote orderly and reasonable development of waterfront lands. The overall intent is to protect the resources and ecology of Washington's largest streams, lakes, and marine waters. Shoreline permit decisions are made and issued by local governments; however, WA Ecology reviews those decisions. In addition, for shoreline conditional use or variance permits, WA Ecology is responsible for approving, denying, or approving with additional conditions, the local decision.

In addition, any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water or saltwater of the state, requires a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife (WDFW). Similar to Oregon's JPA, Washington has an application that can be used to apply for multiple permits from multiple agencies for a single project in Washington State. The Joint Aquatic Resource Permit Application (JARPA) can be used for HPAs and shoreline permits, as well as Section 404 and 401 permits.

1.5.3.4 Washington State Historic Preservation Office

Similar to the description in section 1.5.2.6 for the State of Oregon, FERC must also consult with Washington SHPO regarding historic properties. SHPO responsibilities in Washington are carried out by the Washington Department of Archaeology and Historic Preservation. Consultations with Washington SHPO and compliance with the NHPA are discussed in section 4.1.11 for the Oregon LNG Project and in section 4.2.11 for the WEP.

1.5.4 Permit Summary Tables

1.5.4.1 Oregon LNG Project

Table 1.5.4-1 lists the major federal, state, and local permits, approvals, and consultations identified for construction and operation of the Oregon LNG Project. Consultations with Native American tribes are discussed in section 4.1.11.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
CANADIAN			
National Energy Board	25-year gas export license	Review application and consider for approval.	Approved May 1, 2014.
FEDERAL			
FERC	NEPA 40 CFR 1500-1508 Sections 3 and 7 of the NGA 18 CFR 380 and Section 311 of EPAct 18 CFR 153, 157, 375, and 385 Order No. 687	Prepare EIS. Issue Approval of Place of Import and Authorization of Siting, Construction, and Operation of LNG Terminal Facilities (Section 3(a) of the NGA). Issue Certificate of Public Convenience and Necessity to construct, install, own, operate, and maintain a pipeline (section 7(c) of the NGA).	Pending. Pending; Oregon LNG filed its applications with FERC on October 10, 2008 and filed amended and revised applications on June 7, 2013. A FERC decision will be made after the final EIS is issued.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
ACHP	Section 106 of the NHPA 16 U.S.C. 470 36 CFR 800	Opportunity to comment on the project.	Pending.
U.S. Department of Homeland Security, U.S. Coast Guard (Cooperating agency)	33 CFR 127 and Navigation and Vessel Inspection Circular No. 01-2011, Guidance Related to Waterfront LNG Facilities	COTP issues an LOR determining the suitability of the waterway for LNG marine traffic.	Oregon LNG submitted its WSA in April 2008. The Coast Guard issued its LOR and LOR analysis on April 24, 2009. In November 2012, Oregon LNG notified the Coast Guard of the change to an import/export facility. On February 24, 2014, the Coast Guard notified Oregon LNG that no update was necessary to the WSA.
	33 CFR 165	Establish safety and security zones for LNG vessels in transit and while docked.	The Coast Guard issued the LOR on April 24, 2009. The Coast Guard stated in its letter of February 24, 2014, that waterway impacts associated with the operation of the export facility should not change or exceed those described in the original WSA.
	Ports and Waterway Safety Act Maritime Transportation Act 33 CFR 101, 103, 104, 105	Ensure navigation safety. Review and approve LNG Vessel Transit Management Plan, Emergency Plan, and Facility Security Plan. Permit to Establish Aids to Navigation.	Pending; will be filed with FERC after the final EIS is completed. Vessel Transit Management Plan and Emergency Plan must be approved at least 60 days prior to first arrival.
USACE, Portland District (Cooperating agency)	Section 10 of the Rivers and Harbors Act	Issue permit for the construction of structures that would obstruct navigable waters of the United States, including piers and dolphins.	Pending; Oregon LNG filed its JPA for Oregon in July 2013. Public notice for comment period issued Nov. 18, 2014.
	Section 404 of the CWA	Issue permit for the discharge, dredge and/or fill of material into waters of the United States, including wetlands.	Pending; Oregon LNG filed its JPA for Oregon in July 2013. Updated 404 application filed October 2014.. Public notice for comment period issued Nov 18, 2014.
	33 U.S.C. 408	Issue permit for any modification or crossing of levees and/or dikes.	Pending; application in process.
	Section 103 of MPRSA	Issue Permit for Ocean Dumping of Dredged Material. Approve transport of dredged material for ocean dumping.	Oregon LNG submitted application in June 2013. Public notice for comment period issued Nov 18, 2014.
DOD	Section 311 of the EPAct Section 3 of the NGA	Provide information regarding project effects on military installations.	In September 2012 FERC sent the Notice of Intent (NOI) and project information to the DOD. The DOD commented on November 9, 2012 that the project would have minimal impact on military operations.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
DOE (Cooperating agency)	Authorization to Export LNG –FTA Countries		Granted May 31, 2012.
	Conditional Authorization to Export LNG – Non- FTA Countries	Conditional Authority based on completion of FERC EIS and DOE issuing a Record of Decision.	Granted July 31, 2014.
DOT PHMSA	LNG Facilities Petition for Approval	Issue approval that the new LNG facility meets standards governing siting, design, installation, personnel qualifications, and training.	Prior to start of commercial operations.
	Natural Gas Pipeline Safety Act 49 U.S.C. 601 49 CFR Parts 190-199	Administer national regulatory program to ensure the safe transportation of natural gas.	Prior to start of commercial operations.
EPA (Cooperating agency)	Section 404 of the CWA	Review (with authority to veto) wetland permits issued by the USACE.	Pending; Oregon LNG filed its JPA for Oregon in July 2013 and a draft JARPA for Washington in October 2014.
	Section 103 of the MPRSA	Review USACE Permit for Ocean Dumping of Dredged Material.	An application will be filed after the final EIS is issued.
	Section 309 of the CAA	Review EIS for compliance with CAA.	Pending issuance of the EIS.
	CEQ Regulations, 1506.9 and 1502.10, federal agencies are required to file EISs with EPA	Check EISs for completeness and compliance with CEQ Regulations.	Pending issuance of the EIS.
Federal Aviation Administration (FAA)	18 CFR Subchapter E FAR Part 77	Review notification of proposed construction activity possibly affecting navigable air space.	FAA Determination of No Hazard for terminal facilities received in April 2012. Updated April 2014.
FWS (Cooperating agency)	Section 7 of the ESA	Consider lead agency determination of effects on federally listed species and their habitat. Provide a Biological Opinion if the project is likely to adversely affect such species or their designated critical habitat.	Pending.
	MBTA	Consider project impacts on migratory bird species of special concern.	Pending review of the EIS.
	BGEPA	Consider project impacts on Bald and Golden Eagles.	Pending review of the EIS.
NMFS	Section 7 of the ESA	Consider lead agency determination of effects on federally listed species and their habitat. Provide a Biological Opinion if the project is likely to adversely affect such species or their habitat.	Pending.
	MMPA	Consult on protected marine mammals. Issue Incidental Harassment Authorization per Section 101(a)(5)(D).	Oregon LNG would submit application for Incidental Harassment Authorization 12 months before start of construction.
	MSA	Provide conservation recommendations for projects that may adversely impact EFH.	Pending.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
STATE OF OREGON			
ODA	Oregon Endangered Species Act Oregon Senate Bill 533 and ORS 564	Consult on Oregon-listed plant species, and review botanical survey reports covering nonfederal public lands where state-listed plant species are likely to occur prior to ground-disturbing activities.	Ongoing.
ODE	Section 311 of the EPAct OAR 330-001-0005	Furnish a safety advisory report to FERC on state and local safety considerations, and conduct operational safety inspections. Lead state agency for review and for coordinating comments from Oregon agencies.	ODE provided its safety advisory report to FERC on November 10, 2008.
ODEQ	Section 401 of the CWA	Water quality certification.	Pending; Oregon LNG filed its JPA in July 2013. Public notice for comment period issued Nov 18, 2014.
	Section 402 of the CWA	Issue NPDES permits for discharge of hydrostatic test water, vaporizer condensate, and stormwater.	NPDES permit application submitted to ODEQ July 3, 2013. Initial completeness review letter dated August 2, 2013. General permit application for pipeline construction was determined to lack necessary Land Use Compatibility Statement or alternative land use findings.
	CAA	Issue Air Contaminant Discharge Permit (ACDP) for Prevention of Significant Deterioration (PSD)	Pending: Oregon LNG filed its permit application in July 2013. Preliminary review completed August 8, 2013.
	NPDES Construction Stormwater Discharge Permit 1200-C	Issue permit for treatment and discharge of stormwater during construction, including hydrostatic test water.	Oregon LNG submitted its permit application on July 3, 2013.
ODFW	Fish and Wildlife Coordination Act and the Oregon Endangered Species Act under OAR 635 and ORS 496, 506, and 509	Consult on sensitive species and habitats that may be affected by the project and conservation of fish and wildlife resources. Issue Wildlife Capture, Handling, Transport, Release Authorization.	Ongoing.
	Oregon Fish Passage Law	Review and approve application and passage plan for waterbody crossings. Issue Fish Scientific Take Permit.	Pending.
	Limited Water Use License issued by Oregon Water Resources Department (OWRD)	Consult with Oregon LNG and OWRD regarding fish issues, water withdrawal rates, and screen sizes.	Pending.
ODF	FPA OAR 629, ORS 477 and 527	Review project for conformance with FPA and Forest Management Plans. Monitor project-related timber harvest and approve wildfire prevention and suppression plans.	Application for an Operations permit, including a wildfire suppression plan, would be submitted by Oregon LNG before start of construction. Oregon LNG would notify State Forester 15 days before each activity on forest land.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
ODLCD	CZMA 15 CFR 930 ORS 196.435	Consider consistency with CZMA program policies.	Oregon LNG filed its consistency certification with the ODLCD in July 2013. Public notice for comment period issued Nov 18, 2014.
Oregon Parks and Recreation Department, (Oregon SHPO)	Section 106 of the NHPA ORS 338.920	Review cultural resources reports and comment on recommendations for NRHP eligibility and project effects. Issue permits for surveys on nonfederal public lands and permits for excavations on nonfederal public and private lands.	Pending; Oregon LNG filed copies of the cultural resources inventory report in June 2013 and a revised report in April 2014. Oregon SHPO accepted area of potential effect (APE) in May 2013; Washington SHPO accepted APE in May 2012. Oregon SHPO commented on first draft survey report in May 2008; commented on survey report in application in July 2013; and commented on revised survey report in June 2014.
ODSL	Submerged and Submersible Land Easement OAR 141-122	Grant submerged land easements (e.g., waterbody crossings).	Pending; Oregon LNG filed its permit application in July 2013.
	Wetland Removal/Fill Permit ORS 196.795-990	Approve removal or fill of material in waters of the state.	Pending; Oregon LNG filed its JPA in July 2013.
	Compensatory Wetland Mitigation Rules OAR 141-085-0121	Review and approve wetland mitigation plans.	Pending.
Oregon Department of Transportation (ODOT)	Section 303(c) DOT Act 49 CFR 303	Consultation and clearance letter regarding recreational land disturbance and construction-related traffic impacts.	Prior to start of construction.
	Access Permit ORS 184, OAR 734-051	Issue permits to cross state-funded roadways.	Prior to start of construction.
OWRD	ORS 537, OAR 690-310	Issue permits to appropriate surface water during project operation.	Oregon LNG submitted in July 2013.
	ORS 537, OAR 690-340	Issue Limited Water Use License for temporary use of surface waters for hydrostatic testing.	Oregon LNG submitted in July, 2013
		Registration of Reclaimed Municipal Water Use – City of Warrenton publicly owned treatment works.	Oregon LNG submitted July 2, 2013.
Oregon Public Utilities Commission (OPUC)	OAR 860-031	Inspect the natural gas facilities for safety.	Prior to start of commercial operations.
STATE OF WASHINGTON			
Department of Archaeology and Historic Preservation, State Historic Preservation Office	Section 106 of the NHPA RCW Chapter 27	Review cultural resources reports and comment on recommendations for NRHP eligibility and project effects. Issue permits for surveys on nonfederal public lands and permits for excavations on nonfederal public and private lands.	Pending; Oregon LNG filed copies of the cultural resources inventory report on June 4, 2013.

Table 1.5.4-1

Environmental Permits, Approvals, and Reviews for the Oregon LNG Project

Agency	Authority/Regulation/Permit	Agency Action	Status
Washington State Department of Ecology (WA Ecology)	Section 401 of the CWA	Water Quality Certification	Pending; Oregon LNG filed a draft JARPA in October 2014.
	Construction Stormwater National Pollutant Discharge Elimination System Permit	Consider issuance of permit to discharge stormwater from construction areas.	Application submittal pending.
	Shoreline Management Act	Review local jurisdiction determination of project consistency with the Shoreline Management Act.	Pending.
WDFW	HPA permit is authorized through Chapter 77.55 RCW, and administered through rules in Chapter 220-110 WAC.	Review proposed plans to ensure that project would not result in impacts to the state's fish and habitat.	Oregon LNG filed a draft HPA application with the draft JARPA in October 2014.
Washington Department of Natural Resources (WDNR)	Aquatic Use Authorization, Aquatic Lands Lease (WAC 332-30-123)	Protect and manage the use of state-owned aquatic lands.	Oregon LNG submitted application in October 2013.
Washington State Department of Transportation		Issue State Highway Crossing Permit.	Oregon LNG submitted application in September 2013.
LOCAL			
City of Warrenton, Oregon	Site plan and associated approvals	Issue development-oriented approvals.	Consolidate land use application submitted June 13, 2014, deemed complete.
City of Woodland, Washington	Right-of-way Permit	Consider issuance of permit for work within City right-of-way.	Oregon LNG has stated it does not intend to apply for local authorizations in Washington.
	Critical Area permits	Consider issuance of permit(s) for wetland areas and other environmentally sensitive areas.	Oregon LNG has stated it does not intend to apply for local authorizations in Washington.
Clatsop County	Conditional Use Permit Review Use Permit Geological Hazard Permit	Review application for compliance with local and state land use plans and regulations.	Consolidated land use permit application submitted October 2009. Conditional approval granted November 8, 2010 but has since been withdrawn.
Tillamook County	Conditional Use Permit Development Permit	Review application for compliance with local and state land use plans and regulations.	Approved May 12, 2010. Extension requested October 2014.
Cowlitz County, Washington	Shoreline Development Permit	Issue Shoreline Development Permit to cross waterbodies covered by the Shoreline Management Act.	Oregon LNG has stated it does not intend to apply for local authorizations in Washington.
	Critical Areas Ordinance under State of Washington GMA	Review consistency of the project with the county Critical Areas Ordinance.	Oregon LNG has stated it does not intend to apply for local authorizations in Washington.
Clatsop, Tillamook, and Columbia Counties, Oregon Cowlitz County, Washington	Various development, grading, and road crossing permits	Consider impacts associated with pipeline development and the issuance of permits to cross county roads.	Prior to start of construction.

1.5.4.2 Washington Expansion Project

Table 1.5.4-2 lists the major federal, state, and local permits, approvals, and consultations identified for construction and operation of the WEP. Consultations with Native American tribes are discussed in section 4.2.11.

Table 1.5.4-2

Environmental Permits, Approvals, and Reviews for the WEP

Agency	Authority/Regulation/Permit	Agency Action	Status
FEDERAL			
FERC	NEPA 40 CFR 1500-1508	Prepare EIS.	Pending.
	Section 7(c) of the NGA 18 CFR 380 18 CFR 157, 375, and 385 Order No. 687	Issue Certificate of Public Convenience and Necessity to construct, install, own, operate, and maintain a pipeline.	Pending; Northwest filed its application with FERC on June 25, 2013. A FERC decision will be made after the final EIS is issued.
ACHP	Section 106 of the NHPA 16 U.S.C. 470 36 CFR 800	Opportunity to comment on the project.	Pending.
USACE, Seattle District (Cooperating agency)	Section 10 of the Rivers and Harbors Act	Issue permit for activities that would obstruct the navigable capacity of any waters of the United States, including occupying, filling, or grading land.	Application submittal pending.
	Section 404 of the CWA	Issue permit for the placement of dredged or fill material into waters of the United States, including wetlands.	Application submittal pending.
	33 U.S.C. 408	Issue permit for any modification or crossing of levees and/or dikes.	Application submittal pending.
DOT Federal Highway Administration	Encroachment Permit	Issue permit to cross federally funded highways.	An application will be filed after the final EIS is issued.
DOT PHMSA	Natural Gas Pipeline Safety Act 49 U.S.C. 601 49 CFR Parts 190-199	Administer national regulatory program to ensure the safe transportation of natural gas.	Prior to start of commercial operations.
EPA (Cooperating agency)	Section 404 of the CWA	Review (with authority to veto) wetland permits issued by the USACE.	Application submittal pending.
	Section 309 of the CAA	Review EIS for compliance with CAA.	Pending issuance of the EIS.
	CEQ Regulations, 1506.9 and 1502.10	Federal agencies are required to file EISs with EPA. EPA checks EISs for completeness and compliance with CEQ Regulations.	Pending issuance of the EIS.
FWS (Cooperating agency)	Section 7 of the ESA	Consider lead agency determination of effects on federally listed species and their habitat. Provide a Biological Opinion if the project is likely to adversely affect such species or their habitat.	Pending.
	MBTA	Consider project impacts on migratory bird species of special concern.	Pending review of the EIS.
	BGEPA	Consider project impacts on Bald and Golden Eagles.	Pending review of the EIS.

Table 1.5.4-2

Environmental Permits, Approvals, and Reviews for the WEP

Agency	Authority/Regulation/Permit	Agency Action	Status
NMFS	Section 7 of the ESA	Consider lead agency determination of effects on federally listed species and their habitat. Provide a Biological Opinion if the project is likely to adversely affect such species or their habitat.	Pending.
	MSA	Provide conservation recommendations for projects that may adversely impact EFH.	Pending.
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms	Explosive User's Permit	Consider issuing permit to blasting subcontractor to purchase, store, and use explosives to fracture rock during pipeline installation.	Application would be submitted by blasting subcontractor before construction begins.
STATE OF WASHINGTON			
Department of Archaeology and Historic Preservation (Washington SHPO)	Section 106 of the NHPA RCW Chapter 27	Review cultural resources reports and comment on recommendations for NRHP eligibility and project effects. Issue permits for surveys on nonfederal public lands and permits for excavations on nonfederal public and private lands.	Pending; Northwest filed copies of the cultural resources inventory report in September 2013. Washington SHPO accepted APE in November 2012 and April 2013. Washington SHPO commented on 2014 Addendum Survey Report in September 2014.
Puget Sound Clean Air Agency	Clean Air Act – Air Quality Notice of Construction (NOC) Permit	Issue NOC Permit and Title V Permit for any additional source of air pollution at Sumner Compressor Station and Snohomish Compressor Station.	Application submittal pending.
Northwest Clean Air Agency	Clean Air Act – Air Quality NOC Permit	Issue NOC Permit, revise Title V Permit, and revise PSD Permit for any additional source of air pollution at Sumas Compressor Station and Mt. Vernon Compressor Station.	Application submittal pending.
Southwest Clean Air Agency	Clean Air Act – Air Quality NOC Permit	Issue NOC Permit, revise Title V Permit, and revise PSD Permit for any additional source of air pollution at Chehalis Compressor Station.	Application submittal pending.
WA Ecology	Section 401 of the CWA	Water Quality Certification.	Application submittal pending.
	CZMA 15 CFR 930	Consider consistency with CZMA program policies.	Application submittal pending.
	Temporary Water Use Permit	Consider issuance of permit to withdraw from surface waters for the purpose of hydrostatic testing.	Application submittal pending.
	Construction Stormwater National Pollutant Discharge Elimination System Permit	Consider issuance of permit to discharge stormwater from construction areas.	Application submittal pending.
	Shoreline Management Act	Review local jurisdiction determination of the WEP's consistency with the Shoreline Management Act.	Application submittal pending.

Table 1.5.4-2

Environmental Permits, Approvals, and Reviews for the WEP

Agency	Authority/Regulation/Permit	Agency Action	Status
	SEPA	Complete SEPA review.	Pending review of the EIS and adoption by WA Ecology, or request for supplemental information. WA Ecology would issue a SEPA determination.
WDFW	HPA permit is authorized through Chapter 77.55 RCW, and administered through rules in Chapter 220-110 WAC.	Consider permit to allow withdrawal of surface water.	Pending.
Washington Department of Natural Resources (WDNR)	Aquatic Lands Lease (WAC 332-30-123)	Issue or amend existing right-of-way agreements to allow new pipeline crossing of state-owned lands.	Application submittal pending.
	Forest Practices Act (Chapter 76.09 of RCW and administered under Title 222 of WAC.	Consider whether the WEP is consistent with the Forest Practices Act.	Application submittal pending.
Washington State Department of Transportation		Issue State Highway Crossing Permit.	Application submittal pending.
Washington Department of Commerce	GMA	Consider whether the WEP is consistent with the GMA.	Application submittal pending.
LOCAL			
All counties crossed	Critical Areas Ordinance under State of Washington GMA	Review consistency of the project with the county Critical Areas Ordinance.	Application submittal pending.
	Grading Permit	Consider issuing a permit for excavation and grading.	Application submittal pending.
	Shoreline Substantial Development Permit	Issue Shoreline Development Permit to cross waterbodies covered by the Shoreline Management Act.	Application submittal pending.
	Shoreline Conditional Use Permit	Consider issuance of a permit to construct within designated state shorelines	Application submittal pending.
	County Road Crossing Permits	Issue permits to allow pipeline installation across or under county roads.	Application submittal pending.
Cowlitz County, Washington	Building Permit	Consider permit for building associated with new meter station at the WEP Interconnect with Oregon LNG.	Application submittal pending.
	Driveway Permit	Consider permit for each new permanent access associated with the WEP interconnect with Oregon LNG	Application submittal pending.
Lewis County, Washington	Floodplain Permit	Consider issuance of a permit to construct in floodplains of designated state shorelines.	Application submittal pending.
	Building and Mechanical Permits	Consider permit for building associated with compressor modifications at Chehalis Compressor Station.	Application submittal pending.
	Road Closing Permit	Consider issuance of a permit to allow for road closure during construction	Application submittal pending.

Table 1.5.4-2

Environmental Permits, Approvals, and Reviews for the WEP

Agency	Authority/Regulation/Permit	Agency Action	Status
Thurston County, Washington	Special Use Permit	Consider issuance of special use if meets criteria for location.	Application submittal pending.
	Forest Conservation Permit	Review consistency with critical areas ordinance.	Application submittal pending.
King County, Washington	Floodplain Permit	Consider issuance of a permit to construct in floodplains of designated state shorelines.	Application submittal pending.
Snohomish County, Washington	Floodplain Permit	Consider issuance of a permit to construct in floodplains of designated state shorelines.	Application submittal pending.
	Building or Mechanical Permit	Consider permit for modifications to Snohomish Compressor Station	Application submittal pending.
Skagit County, Washington	Floodplain Permit	Consider issuance of a permit to construct in floodplains of designated state shorelines.	Application submittal pending.
	Building Permit	Consider permit for building associated with compressor modifications at Mt. Vernon Compressor Station.	Application submittal pending.
Whatcom County, Washington	Floodplain Permit	Consider issuance of a permit to construct in floodplains of designated state shorelines.	Application submittal pending.
	Major Project Permit	Consider issuance of a permit to construct a project costing greater than $5 million.	County council to decide if permit would apply.
	Building Permit	Consider permit for building associated with compressor modifications at Sumas Compressor Station.	Application submittal pending.

1.6 PUBLIC REVIEW AND COMMENT

1.6.1 Notices and Meetings

FERC's environmental review of the Oregon LNG Project began with the initiation of our Pre-filing Review Process. On May 31, 2007, as supplemented on June 5, 2007, Oregon LNG requested authorization to use the Commission's NEPA Pre-filing Review Process for its proposed import project. The Commission approved Oregon LNG's request on June 19, 2007.

On August 24, 2007, FERC issued a *Notice of Intent (NOI) to Prepare an Environmental Impact Statement for the Oregon LNG Terminal and Pipeline Project, Request for Comments on Environmental Issues, and Notice of Public Meetings*. In September 2007, during the pre-filing phase, FERC held public scoping meetings in Warrenton, Forest Grove, and Woodburn, Oregon. FERC issued a Supplemental NOI on April 28, 2008, because of the addition of the Oregon LNG lateral and compressor station to the Oregon LNG Project. In May 2008, FERC conducted public scoping meetings for the lateral and compressor station in Banks, Warrenton, and Woodburn, Oregon.

On July 3, 2012, Oregon LNG filed a request to initiate the Pre-filing Process for its Export Project;[8] and on July 10, 2012, Northwest filed a request to initiate the Pre-filing Process for the related

[8] Oregon LNG referred to its project filed for pre-filing review in July 2012 as its Export Project because it included only the proposed liquefaction facilities at the terminal, new pipeline segment, and modified compressor station location. On June 7,

WEP. FERC approved both pre-filing review requests on July 16, 2012, and issued a single NOI for both projects on September 24, 2012. Three public scoping meetings were held for the Oregon LNG Export Project and five public scoping meetings were held for the WEP during October 2012. A total of 24 people presented comments at the WEP public scoping meetings and 119 people presented comments at the public scoping meetings for the Oregon LNG Export Project.

The NOIs described above were sent to interested parties on our mailing list for the projects, including:

- federal, state, and local officials;
- agency representatives;
- nongovernmental organizations;
- local libraries and newspapers;
- commenters who provided addresses;
- property owners within 0.5 mile of the proposed LNG terminal;
- property owners within 0.5 mile of the existing and proposed compressor stations; and
- property owners along the proposed pipeline routes.

Table 1.6.1-1 lists the dates and locations of public scoping meetings for the Oregon LNG Project and the WEP. The meetings provided an opportunity for the public to learn more about the projects and comment on environmental issues to be addressed in this EIS. Public comments were accepted at each meeting via oral testimony or in written form and filed with the Secretary of the Commission (Secretary). The FERC e-filing system also accepted comments during the public comment periods.

Table 1.6.1-1

Public Scoping Meetings

Project	Date	Location	Subject
Oregon LNG Import Project	9/18/ 2007	Warrenton, OR	Import terminal and send-out pipeline
	9/19/2007	Forest Grove, OR	Import terminal and send-out pipeline
	9/20/2007	Woodburn, OR	Import terminal and send-out pipeline
	5/20/2008	Banks, OR	Lateral and compressor station
	5/21/2008	Warrenton, OR	Lateral and compressor station
	5/22/2008	Woodburn, OR	Lateral and compressor station
Oregon LNG Export Project	10/15/2012	Warrenton, OR	Terminal export facilities, new pipeline segment
	10/16/2012	Woodland, WA	Terminal export facilities, new pipeline segment
	10/18/2012	Vernonia, OR	Terminal export facilities, new pipeline segment
Washington Expansion Project	10/15/2012	Sedro-Woolley, WA	Loops, additional compression
	10/16/2012	Snohomish, WA	Loops, additional compression
	10/17/2012	Chehalis, WA	Loops, additional compression
	10/17/2012	Auburn, WA	Loops, additional compression
	10/18/2012	Longview, WA	Loops, additional compression

FERC conducted site reviews of the Oregon LNG Project and the WEP as listed in table 1.6.1-2. The public was invited to participate in several of these site reviews, which were announced in NOIs.

2013, Oregon LNG amended its pending applications for an LNG import project to include LNG export capabilities, resulting in an import/export project.

Table 1.6.1-2

Site Reviews

Date	NOI Date if Applicable	Purpose	Attendees
9/18-20/2007	8/24/2007	View terminal site and portions of Oregon LNG pipeline route in conjunction with public scoping meetings.	Oregon LNG, FERC, public
2/3/2008		View terminal site, helicopter overflight of the Oregon LNG pipeline right-of-way, and field-check certain areas along the pipeline route.	FERC, Oregon Department of Geology and Mineral Industries, Oregon LNG.
8/26-28/2008		View terminal site and Oregon LNG pipeline sites of particular interest, including the Molalla Gate Station, residences and unknown structures, agricultural and forest land, stream crossings, and the Palomar Pipeline route.	Oregon LNG, FERC
9/15-17/2009	9/1/2009	View terminal site revisions and Oregon LNG pipeline route variations in Clackamas, Marion, Yamhill, Washington, Columbia, and Clatsop Counties.	Oregon LNG, FERC, public
12/1-2/2009	11/5/2009	View environmental resources of concern in selected areas of the Oregon LNG pipeline route and observe areas where the Oregon LNG and Palomar pipeline routes would parallel.	Oregon LNG, FERC, public
12/3-4/2012		View waterbody crossings along the new pipeline segment and compressor station site for the Oregon LNG Export Project.	Oregon LNG, FERC
12/5/2012		View waterbody crossings and landslide areas between Woodland and Chehalis for the WEP.	FERC, Northwest, WDNR, NMFS, WDFW
10/22-24/2013	10/8/2013	View residential areas, waterbody crossings, and park and school crossings between Chehalis and Sumas for the WEP.	FERC, Northwest, Ecology, WDFW, NMFS, City of Sumner, Washington Utilities and Transportation Commission, public

In addition to public scoping meetings, FERC staff held interagency meetings to obtain input from representatives of federal agencies, state agencies, and tribes. Table 1.6.1-3 lists the interagency meetings held by FERC staff for the Oregon LNG Project and the WEP. Notes from all interagency meetings were placed into FERC's public record.

FERC staff also participated in a number of interagency meetings and discipline-specific subgroup meetings held by Oregon LNG and two interagency meetings held by Northwest. The subgroup meetings, which were attended by a range of federal, state, and local agencies, included sessions devoted to dredging, waterbody crossings, cultural resources, habitat categorization, mitigation, and fish issues associated with the Oregon LNG Project. These meetings are listed in table B2-1 of appendix B2.

Table 1.6.1-3

Interagency Meetings Held by FERC Staff

Date	Location	Attendees
Pre-filing—Oregon LNG Import		
1/15/2008	Conference Call	FERC, NMFS, Oregon LNG
1/24/2008	Salem, OR	FERC, Bureau of Land Management, Confederated Tribes of Warm Springs, Confederated Tribes of Siletz, Oregon Legislative Committee on Indian Services, Cow Creek Band of Umpqua Indians, OR SHPO, CTGR, Palomar, FWS, Oregon LNG
2/4/2008	Conference Call	FERC, USACE, Oregon LNG
2/21/2008	Conference Call	FERC, NMFS, Oregon LNG
3/27/2008	Conference Call	FERC, FWS, Oregon LNG
3/31/2008	Sandy, OR	FERC, CTGR, Confederated Tribes of Warm Springs, OR SHPO, Bureau of Land Management, U.S. Forest Service, Palomar, Oregon LNG
5/21/2008	Salem, OR	FERC, ODE, ODOJ, ODFW, ODLCD, ODOT

Table 1.6.1-3

Interagency Meetings Held by FERC Staff

Date	Location	Attendees
Post-application—Oregon LNG Import		
1/12/2009	Conference Call	FERC, EPA
1/14/2009	Portland, OR	FERC, Coast Guard
2/2/2009	Conference Call	FERC, Coast Guard
2/2/2009	Conference Call	FERC, USACE
2/27/2009	Conference Call	FERC, WA Ecology, ORA
7/28/2009	Conference Call	FERC, USACE
9/1/2009	Conference Call	FERC, USACE
10/23/2009	Conference Call	FERC, USACE
1/21/2010	Conference Call	FERC, FWS
1/21/2010	Conference Call	FERC, NMFS
Pre-filing—Oregon LNG Export and Washington Expansion		
10/16/2012	Portland, OR	FERC, ODE, ODLCD, ODFW, CTGR, USACE, ODOJ, FWS, ODOT, ODSL, OR SHPO, OR Governor's Office, EPA, Oregon LNG
10/17/2012	Lacey, WA	FERC, NW Clean Air Agency, FWS, WDNR, WDFW, WA Ecology, CTGR, USACE, EPA, Washington Utilities and Transportation Commission, ORA, Northwest, Oregon LNG
12/5/2012	Lacey, WA	FERC, WA Ecology, ORA
4/24/2013	Portland, OR	FERC, FWS
4/24/2013	Portland, OR	FERC, EPA, USACE
4/25/2013	Portland, OR	FERC, USACE

ORA Washington Governor's Office of Regulatory Assistance
CTGR Confederated Tribes of Grand Ronde
ODOJ Oregon Department of Justice

1.6.2 Scoping Comments

We have received comments on a wide variety of environmental issues for the Oregon LNG Project and the WEP. Between May 31, 2007 and July 3, 2012 when Oregon LNG filed its pre-filing review request for the Export Project, we received 308 comment letters on the Oregon LNG Project, including 224 letters from individuals, 21 letters from public organizations and businesses, 14 letters from federal agencies, 44 letters from state and local agencies, 1 letter from the Governor of Oregon, 2 letters from U.S. Senators, and 2 letters from U.S. Representatives.

Since Oregon LNG filed its pre-filing review request for the Export Project on July 3, 2012, and Northwest filed its pre-filing review request for the WEP on July 10, 2012, we have received 4,660 letters commenting on the projects. This includes 4,387 form letters, 233 letters from individuals and businesses, 11 letters from organizations, 8 letters from federal agencies, 17 letters from state and local agencies, 2 letters from U.S. Senators, and 2 letters from Native American tribes.

In these letters, the most frequently mentioned environmental topics were socioeconomics, alternatives, wildlife and aquatic resources, safety, and water resources. Table 1.6.2-1 summarizes the major environmental issues identified during the pre-filing public scoping process for the Oregon LNG Project and the WEP. Scoping comments are addressed throughout this EIS, where applicable, in the sections listed below.

Table 1.6.2-1

Summary of Scoping Comments

Topic	EIS Sections Addressing Comments
Purpose and Need	
Purpose and need of project; economic viability; natural gas market	1.4
Supply, demand, and energy goals	1.4
Environmental/local cost versus benefit and need; need for multiple LNG projects	1.4.8
Alternatives	
No Action alternative	3.1
Alternative energy sources, including renewable energy	3.1
Alternative onshore or offshore LNG terminal sites	3.3
Alternative pipeline routes	3.4
Collocation alternatives	3.2.1
Alternative vaporization technologies	3.3.2.3
Alternatives that minimize impacts and avoid areas of scenic, natural or environmental value	3.0
Dredging methods, placement, and minimization alternatives	3.3.3
Alternative construction and operation methods to minimize project infrastructure	3.0
Alternative waterbody crossing methods	3.4.1.3, 3.4.2.2, 4.1.3.2, 4.2.3.2
Geology	
Geologic stability of terminal site and land along proposed pipeline routes	4.1.1.1, 4.1.1.2, 4.2.1.4
Potential for earthquakes, tsunamis, erosion, landslides	4.1.1.1, 4.1.1.2,, 4.2.1.3, 4.2.1.4
Blasting methods, effects and mitigation measures	4.1.1.2, 4.2.1.1
Geologic characterization of project area	4.1.1.1, 4.1.1.2, 4.2.1.1
Soils and Sediments	
Increased soil destabilization, erosion, and compaction due to project construction and maintenance	4.1.2.1, 4.1.2.2, 4.2.2.2
Develop erosion and sediment mitigation plan	4.1.2.1, 4.1.2.2, 4.2.2.2
Potential contamination of soils and sediments during construction and development of hazardous materials spill response plan	4.1.2.1, 4.1.2.2, 4.2.2.3
Existing contamination of soils and soil/sediment testing/remediation is needed	4.1.2.1, 4.1.2.2, 4.2.2.3
Impact on agricultural soil productivity (due to topsoil/subsoil mixing) and soil compaction	4.1.2.2, 4.2.2.2
Dredging issues; dredged material contamination; dredged material placement; minimize dredging to avoid environmental impacts; future maintenance dredging	3.3.3, 4.1.2.1, 4.1.3.2
Impact of the anticipated suspension and deposition of sediments outside of the dredging footprint	4.1.3.2
Water Resources	
Groundwater quality	4.1.3.1, 4.2.3.1
Pollution risk from handling and storage of contaminants from the liquefaction pretreatment process	4.1.3.1
Impacts on water supplies, springs, aquifers and private wells	4.1.3.1, 4.2.3.1
Water rights	4.1.3.2, 4.2.3.1
Dredging, hazardous material, and vessel traffic impacts on Columbia River water quality	4.1.3.2
Flooding	4.1.1.1, 4.1.1.2, 4.2.1.4
Surface water withdrawal and discharge impacts	4.1.3.2, 4.2.3.2
Construction and post-construction impacts on water quality (e.g., increased turbidity, potential inadvertent releases, increased erosion and sedimentation issues)	4.1.3.2, 4.2.3.2
Stormwater impacts on aquatic habitats	4.1.3.2, 4.2.3.2
Consistency with Washington and Oregon water quality standards and the Clean Water Act	4.1.3.2, 4.2.3.2
Consider Critical Aquifer Recharge Areas crossed by the pipeline routes	4.1.3.1, 4.2.3.1
Alteration of channel morphology	4.1.3.2, 4.2.3.2

Table 1.6.2-1

Summary of Scoping Comments

Topic	EIS Sections Addressing Comments
Waterbody crossing methods	2.1.4.2, 2.2.3.2, 4.1.3.2, 4.2.3.2
Assess impacts from sewage, grey water, and garbage discharge from vessels	4.1.3.2
Impacts and mitigation measures associated with hydrostatic testing	4.1.3.2, 4.2.3.2
Minimize construction of impervious surfaces	4.1.3.1, 4.1.3.2
Potential to suspend contaminants from Astoria Marine Construction Company site into groundwater and river	4.1.2.2
Monitor decommissioned pipeline at waterbody crossings	4.2.3.2
Wetlands	
Avoid/minimize impacts on wetlands	4.1.4.1, 4.1.4.2, 4.2.4.2
Wetland restoration, monitoring and follow-up activities	4.1.4.2, 4.2.4.2
Identify impacts on a watershed level	4.1.4.2
Consider state and local wetland guidance	4.1.4, 4.2.4
Assess ecological functions and values of affected wetlands	4.1.4, 4,2,4
Buffers and right-of-way widths for wetland and riparian areas	4.1.4, 4.2.4
Biological Resources	
Direct and indirect impacts on endangered and threatened species, species of concern, no listed species; aquatic, riparian, and upland habitats; critical habitats; EFH, and other coastal and marine habitats; develop monitoring plan; survey concerns	4.1.5, 4.1.8, 4.2.5, 4.2.8
Wetland restoration project impact	4.3.1
Impact avoidance/minimization and mitigation	4.1, 4.2
Follow ODFW's Fish and Wildlife Habitat Mitigation Policy, FWS Mitigation Policy, ODF Forest Practice Act, and Northwest Forest Plan; develop compensatory mitigation plan	4.1.5.2, 4.1.8.1, appendix F, L
Habitat conversion through direct loss or reduced ecological function of sensitive areas should be avoided	4.1.5.2, 4.1.7.3, 4.1.8, 4.2.5.2, 4.2.7.3, 4.2.8
Invasive species management plan	4.1.5.2, 4.1.6, 4.2.6
Species-specific surveys for threatened, endangered or Washington State Priority Species and Priority Habitat	4.1.8, 4.2.8.2
Consider in-water work windows during construction and follow up activities	4.1.5, 4.1.8.1, 4.2.5.2
Implement watershed and aquatic habitat restoration activities	4.1.5, 4.1.6.2, 4.2.5.2
Small take authorization or incidental harassment authorization should be sought under section 101(a)(5) of the MMPA	4.1.8.1
Vegetation	
Forest impacts including loss of habitat, loss of timber production, increased wildfires potential, and loss of old growth trees and forest areas	4.1.6.2, 4.2.6
Revegetation methods	4.1.6.2, 4.2.6.2
Wildfire prevention and suppression	4.1.6.2, 4.1.13.10
Noxious weed and invasive plant species control/plan; herbicide use	4.1.6, 4.2.6
Terminal Revegetation and Restoration Plan addressing poor revegetation potential of site	4.1.6.1
Include forest stand age class in habitat assessment for the pipeline route	4.1.6.2
Assess the salvage, propagation, and reintroduction of special status and ESA-listed plants	4.1.8, 4.2.8
Wildlife	
Impacts on wildlife from loss of habitat and fragmentation, noise (particularly timing restrictions during construction and operation), and water quality	4.1.7, 4.2.7
Impacts on listed and no listed species from construction and operation	4.1.7, 4.1.8.1, 4.2.7, 4.2.8.2
Impacts on migratory birds during pipeline construction	4.1.7.5, 4.2.7.4
Wildlife passage design	4.1.7.1

Table 1.6.2-1

Summary of Scoping Comments

Topic	EIS Sections Addressing Comments
Aquatic Resources	
Impacts on fish, other aquatic species, and habitat	4.1.5, 4.1.8.1, 4.2.5, 4.2.8.1
Impacts on recovery efforts, and restoration and preservation areas	4.1.5, 4.1.8, 4.2.5, 4.2.8
Dredging and dredged material placement impacts	4.1.5.2, 4.1.8.1
Impacts from increased vessel traffic (e.g., wildlife strikes or wake strandings) and vessel spills	4.1.5.2, 4.1.8.1
Aquatic invasive species introduction	4.1.5.2
Water uptake and discharge impacts; ballast water impacts; screening and entrainment concerns	4.1.3.2, 4.1.5.2, 4.1.5.3, 4.1.8.1, 4.2.3.2
Waterbody crossing impacting fish passage; minimize number of waterbody crossings	4.1.3.2, 4.1.5.2, 4.1.8.1, 4.2.3.2
Aquatic illumination impacts	4.1.5.2, 4.1.8.1
Hazardous materials spill response plan for handling, storage, and transportation	4.1.3, 4.1.5.2, 4.1.8.1, 4.2.3.2
Land Use	
Consistency with statewide planning goals; Coastal Zone Management Act; Forest Management Plan; Forest Practices Act; local comprehensive plans; consultation with local land use jurisdictions	4.1.9, 4.2.9
Agricultural land impacts; specialty crop impacts; crop and operation restrictions in pipeline easement area, noxious weed establishment; irrigation system and drain tile impacts; organic farm impacts (loss of certification and restoration of soil complexity)	4.1.9.2, 4.2.9.1
Impacts on forest land, mining operations, restored land, public land, wildlife refuge, railroads, and airports	4.1.9, 4.2.9
Property impacts; restrictions in pipeline easement area	4.1.9.2, 4.2.9.1
Existing infrastructure and utility conflicts	4.1.9.2, 4.2.9
Modification of federally authorized levees	4.1.3.2, 4.2.3.2
Port lease issue and court decision	4.1.9.1
Impacts on Washington State trust lands (waterbody crossings) inside and outside the right-of-way	4.1.3.2, 4.2.3.2
Document land cover and uses within the project corridor, impacts, and mitigation	4.1.9, 4.2.9
Recreation	
Impacts on boating, hiking, and other recreational activities	4.1.9, 4.2.9
Impacts and restrictions on recreational fishing and recreational river traffic	4.1.9, 4.2.9
National and state parks, trails, and wildlife refuge impacts	4.1.9, 4.2.9
All-terrain vehicle issues	4.1.9.2, 4.2.9
Visual Resources	
Visual mitigation plan; light pollution avoidance and minimization plan; mitigation measures or alternative design features that minimize disturbance	4.1.9.1, 4.1.9.2, 4.2.9.12
Viewshed degradation; scenic and recreational area visual impacts; impacts due to LNG tanks and terminal facility	4.1.9.1, 4.2.9.12
Socioeconomics	
Construction and operation impacts on environmental justice populations	4.1.10.1, 4.1.10.2, 4.2.10.9
LNG vessel traffic impacts and restrictions on commercial shipping, recreational boaters, commercial and recreational fisheries	4.1.10.1
Traffic impact analysis for terminal and compressor stations	4.1.10.1, 4.1.10.2
Economic impacts on fisheries, cruise ships, industrial development, tourism, outdoor recreation businesses, timber industry, and agricultural operations	4.1.10, 4.2.10
Cost to local governments and taxpayers and community resources impacts	4.1.10, 4.2.10

Table 1.6.2-1

Summary of Scoping Comments

Topic	EIS Sections Addressing Comments
Construction and operation traffic/transportation impacts; develop transportation mitigation plan; airport traffic interference	4.1.10.1,4.1.10.2, 4.2.10.7
Landowner and property impacts; residential impacts; eminent domain; change in property values and insurance rates	4.1.9, 4.2.9
Uncertainty of LNG export capacity and effect on the cost of domestic natural gas	1.4.8
Impact of job creation in the short term and long run; economic benefits	4.1.10, 4.2.10
Cultural Resources	
Impacts on cultural, historic, and Native American sites and resources; and associated mitigation	4.1.11.2, 4.2.11.4
Effects on Tribal treaty fishing rights	4.1.10.1, 4.2.10.8
Consult with tribal governments and SHPO	4.1.11.1, 4.2.11.1
Air Quality	
Develop air quality mitigation plan	4.1.12.1, 4.2.12.1
Construction and operation impacts; natural gas venting impacts; greenhouse gas emissions	4.1.12.1, 4.2.12.1
Investigate possible mitigation techniques to curtail greenhouse gas emissions	4.1.12.1, 4.2.12.1
Consistency with the Clean Air Act	4.1.12.1, 4.2.12.1
Noise	
Avoidance/minimization of construction and operation noise impacts	4.1.12.2, 4.2.12.2
Evaluate noise impacts to individuals, communities, and wildlife	4.1.5.2, 4.1.7, 4.1.8.1, 4.1.9, 4.1.12.2, 4.2.7.3, 4.2.8.1, 4.2.9, 4.2.12.2,
Underwater noise impacts, minimize adverse underwater noise impacts by use of sound-attenuating construction methods	4.1.5.2, 4.1.5.3, 4.1.8.1, 4.1.12.2
Reliability and Safety	
Public safety; safety of nearby residents	4.1.13, 4.2.13.3
Proximity of pipeline to schools, restaurants, and shopping centers	4.1.9,2, 4.2.9
Terminal safety design; pipeline construction and operation safety	4.1.13.6, 4.1.13.13, 4.2.13.1
Waterway, roadway, railway, and airport safety	4.1.9.1, 4.1.9.2, 4.1.13, 4.2.9.10
Wave, wind, fog impediments	4.1.1.1, 4.1.12.1, 4.1.13
Explosion and fire potential; assessment of risks of a catastrophic accident	4.1.13, 4.2.13
Terrorist attacks	4.1.13.10
Emergency response and facility capability	4.1.10, 4.1.13.9, 4.1.13.13, 4.2.10, 4.2.13.1
Safety monitoring	4.1.13, 4.2.13.1
Development of an Emergency Response Plan	4.1.13.9, 4.2.13.1
Cumulative Impacts	
Cumulative impacts from multiple LNG terminals and pipelines	4.3.2
Cumulative impacts from future dredging, construction, coal terminal, and airport projects	4.3.1
Cumulative impacts from construction and operation on aquatic resources, wildlife species, and habitats	4.3.1
Extent to which drilling activity might be stimulated by the construction of an LNG export facility on the west coast, and associated environmental effects	1.4.8
Other	
Incorporate a Compensatory Mitigation Plan	2.1.1.3, 4.1.4.3, 4.1.5.2, 4.1.7, 4.1.8, 4.2.4.3, Appendix F
Consider direct and indirect impacts	4.1, 4.2

Table 1.6.2-1

Summary of Scoping Comments

Topic	EIS Sections Addressing Comments
Identify activities within the Columbia River as occurring in Washington, Oregon, or both	2.1.1, 2.1.2
Compensatory mitigation for unavoidable impacts	2.1.1.3, 4.1.4.3, 4.1.7, 4.1.8 , 4.2.4.3
Include decommissioning process and associated impacts	2.1.8, 2.2.7
Consider the potential influence of climate change on the proposed project	4.1, 4.2
Cost of extracting, refining, and transporting natural gas	1.4.8

2.0 DESCRIPTION OF PROPOSED ACTIONS

2.1 OREGON LNG PROJECT

Oregon LNG proposes to construct and operate a new import/export LNG terminal on the East Skipanon Peninsula near the confluence of the Skipanon and Columbia Rivers at Warrenton, Oregon, capable of both export and import of LNG (see figure 1.1-1 in section 1.0). The terminal site would include marine facilities, LNG storage tanks, LNG vaporization facilities, natural gas liquefaction facilities, and associated support facilities. In addition, Oregon LNG would construct and operate an 86.8-mile-long, 36-inch-diameter pipeline from the terminal to an interconnect with the Northwest Pipeline near Woodland, Washington. The pipeline would be routed through Clatsop, Tillamook, Washington, and Columbia Counties in Oregon, and Cowlitz County in Washington. Oregon LNG would construct and operate an electrically driven compressor station near MP 80.9 in Columbia County, Oregon.

2.1.1 Project Components

The following text describes terminal facilities, pipeline and associated aboveground facilities, and Oregon LNG's proposed wetland and habitat mitigation sites.

2.1.1.1 Terminal Facilities

The terminal would be located at the northern portion of the East Skipanon Peninsula at Columbia River Mile (RM) 11.5 and would include an LNG marine carrier turning basin in the Columbia River, a pier with a ship berth and loading/unloading facilities, two LNG storage tanks, vaporization and liquefaction systems, and support facilities. The terrestrial portion of the terminal (i.e., the LNG storage tanks, process area, and terminal access road) would occupy about 73.5 acres of land within a 96-acre site controlled by Oregon LNG. An additional 3.6 acres would be used during construction. The marine facilities would be in an adjacent aquatic area within the Oregon side of the Columbia River and would encompass about 148.2 acres. A layout of the terminal is provided in figure 2.1.1-1. Detailed cross sections of the terminal facilities and the turning basin area are included in appendix D as figures 2a through 2k.

Under liquefaction (or export) mode, natural gas that arrives at the terminal by pipeline would first be treated at a feed gas pretreatment facility to make it suitable for liquefaction. The pretreated natural gas would then be liquefied at the terminal via two identical liquefaction trains. The LNG produced in these trains would flow into two 160,000 m^3 aboveground, full-containment LNG storage tanks. The LNG would be transferred through pipelines to LNG marine carriers for shipping. Process cooling would be provided by cooling water, cooled in an evaporative cooling tower.

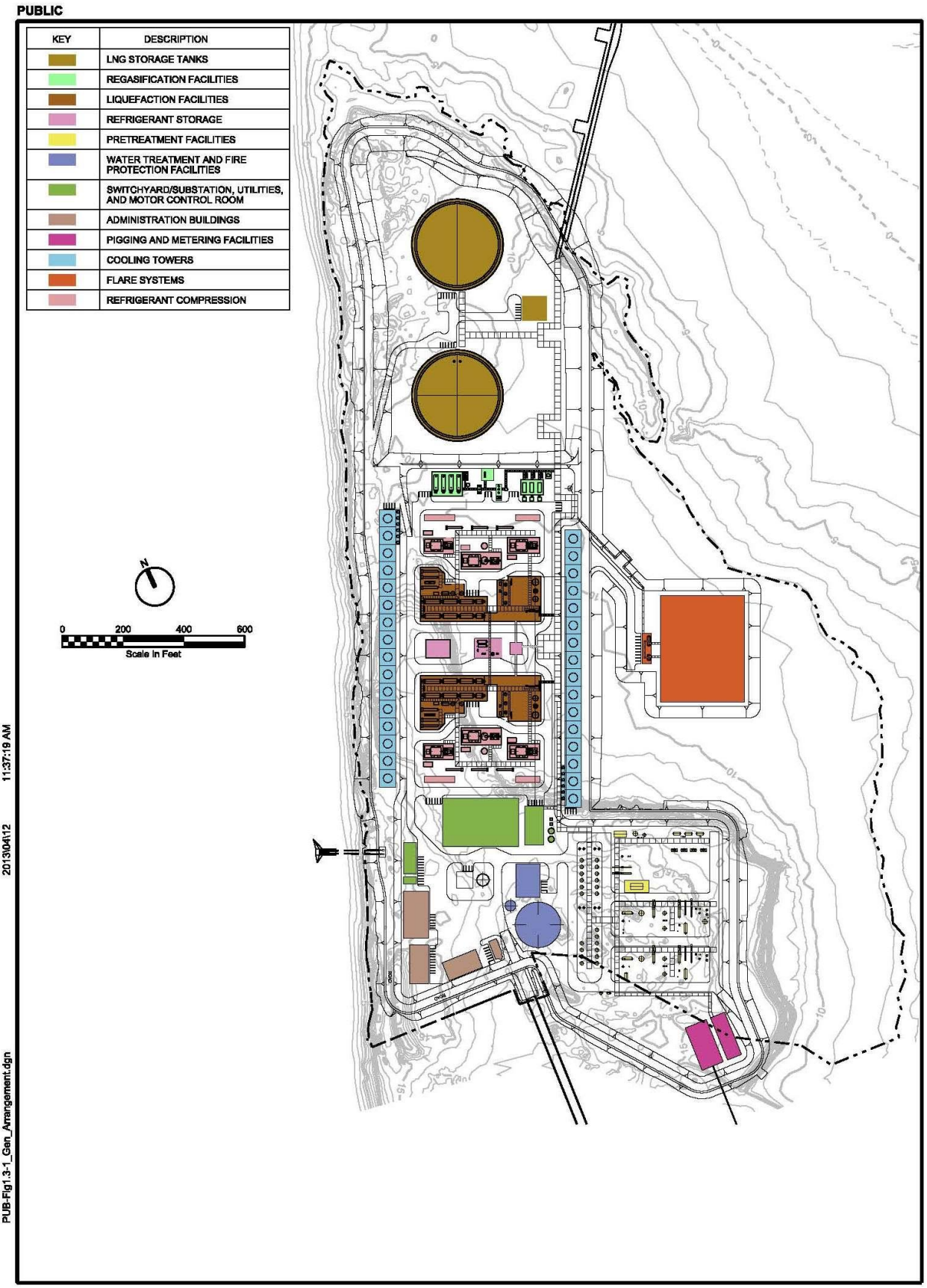


Figure 2.1.1-1: Proposed Terminal Layout

Turning Basin and Berth

The turning basin would extend from the edge of the federal navigation channel to the berth to provide an area suitable for vessel turning, docking, and undocking. The width of the navigable area within the turning basin would be about 4,600 feet at the entrance and would decrease to about 1,600 feet at the upstream end. The end of the turning basin would be about 2,450 feet from the southern edge of the federal navigation channel. The turning basin would cover about 134.7 acres in the Columbia River outside of the existing navigation channel northeast of Warrenton. At this location the navigation channel is about 600 feet wide and 43 feet deep. The Pacific Maritime Institute (PMI) in Seattle, Washington, conducted a simulation study for Oregon LNG to evaluate the feasibility of navigation, berthing, and vessel maneuvering. The results of the study included recommendations for wind and wave limits for safe navigation as well as docking, undocking, and river transit procedures (PMI, 2008).

The berth would be located where the water depth is currently about 20 to 30 feet mean lower low water (MLLW). To create the berthing area and turning basin, Oregon LNG would dredge to a depth of -48 and -43 feet MLLW, respectively, with 2 additional feet allowed for overdredging in both cases. Within the footprint of the 134.7-acre turning basin, about 83 acres would require dredging of about 1.2 million cubic yards of sediments from the Columbia River bottom (see figure 2.1.1-2).

The berth at the terminal would be about 1,800 feet from the existing navigation channel in the Columbia River. An LNG marine carrier at berth would be a minimum of 1,500 feet from the edge of the federal navigation channel. The berth would be designed to offload or load one LNG marine carrier at a time and would include four breasting dolphins, six mooring dolphins, an unloading platform, interconnecting walkways, and an access trestle to the shore. Figure 1 of appendix D shows a plan and profile of the trestle and berth.

The 2,128-foot-long marine trestle would consist of a 12-foot-wide access roadway and an 11-foot-wide pipeway. Platforms to support piping expansion loops would be provided at 310-foot intervals. A concrete trough containment trench would be installed beneath the pipeway to contain any spills that may occur along the trestle. The superstructure elements of the marine trestle would consist primarily of a precast concrete u-shaped girder for carrying piping and spill containment, two precast concrete girders supporting the roadway, and an open grate type roadway deck. The substructure elements would consist of precast or cast-in-place concrete pile caps supported by 60-inch-diameter driven steel cylinder piles.

The 124-foot-long by 94-foot-wide loading/unloading platform would support three LNG transfer arms and a vapor return arm, a vessel access gangway, a tower and fire monitor, and associated piping and equipment. A control room would be located on the berth platform to monitor and control ship loading/unloading operations. An open area would be provided for vehicle parking and turnaround. A 32-foot-wide mezzanine platform along the outboard side of the platform would facilitate access to transfer arm controls and valving.

The superstructure elements of the loading/unloading platform would consist of a cast-in-place concrete deck and girders, including perimeter curbing to contain spills where the potential for LNG spills exists. At locations where no spill potential exists, the superstructure would consist of steel open-grid deck supported by precast concrete girders. The mezzanine platform would be framed using steel open-grid deck with rolled steel beams and columns. Foundations would be a combination of 42- and 60-inch-diameter driven steel cylinder piles.

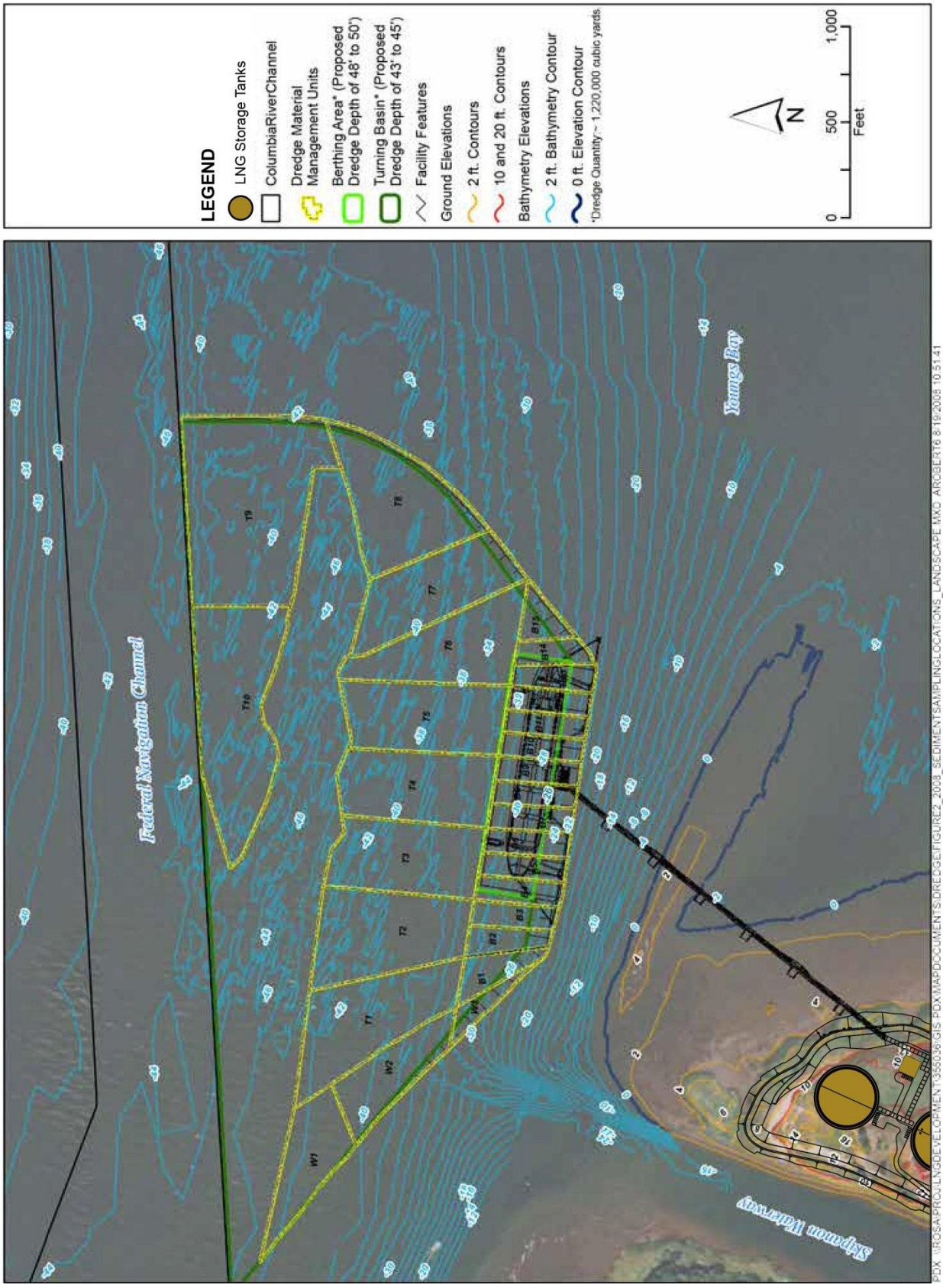


Figure 2.1.1-2: Area to be Dredged

The four 34-foot-long by 24-foot-wide breasting dolphins would be constructed of steel pipe piles with concrete caps. Each mooring dolphin structure would consist of a cast-in-place concrete pile cap supported by 42-inch-diameter driven steel cylinder batter piles. Four of the mooring dolphins would be 18 feet square, and two would be 42 feet long by 18 feet wide. Personnel would access the breasting and mooring dolphins via 4-foot-wide walkways that would be supported directly on the platform and dolphin superstructures.

Table 2.1.1-1 summarizes the location, number, length, diameter, and water depth of piles that would be used to construct the marine terminal. To the extent possible, initial pile installation would be performed using the vibratory technique. Final driving or "proofing" would be done with a hammer, the size of which would be determined at the time of construction.

Table 2.1.1-1

Marine Terminal Pile Summary

Location	Number of Piles	Average Length (feet)	Outside Diameter (inches)	Approximate Water Depth (feet)
Mooring Dolphin East	12	175	42	22
Mooring Dolphin West	12	175	42	22
Breasting Dolphin East	26	256	42	43
Breasting Dolphin West	26	256	42	43
Unloading Platform Main	18	250	60	38
Unloading Platform Grid Deck	6	250	42	25
Trestle South	38	247	60	0
Trestle North	12	249	60	10

To support the terminal marine operations, Oregon LNG would install appropriate navigational aids at the turning basin and berth. In addition, navigation lights would be installed on land and on structures such as the pier. Lighting on the pier would be located or shielded to prevent light from confusing or interfering with navigation on the adjacent waterways.

Dredge Disposal Site

Oregon LNG proposes to use the EPA Deepwater Site, a large offshore dredged material disposal site about 9 nautical miles southwest of the mouth of the Columbia River. Oregon LNG would coordinate the use of the disposal site with the USACE and EPA. A permit under Section 103 of the MPRSA is required to transport dredged material for the purposes of disposal in the ocean. The USACE would work with the EPA to determine if the transported sediment meets the criteria listed in 40 CFR 227 for suitability for ocean dumping. The EPA is ultimately the one responsible for determining if dredged sediment is suitable for ocean dumping. Section 3.3.3 provides additional details on dredging and dredged material placement alternatives, including a map showing the proposed disposal site.

Loading/Unloading and Transfer Facilities

Once moored at the loading berth, dockside personnel would connect the three 16-inch transfer arms and 16-inch vapor return arm to the ship manifolds. Following cool-down of the transfer arms, LNG would be either loaded onto the LNG marine carrier via the in-tank LNG sendout pumps at a rate of 10,000 m^3/hour, or unloaded into the LNG storage tanks via LNG cargo transfer pumps located on the LNG marine carrier at a rate that would maintain LNG storage tank pressure within design operating limits. Each transfer arm would be fitted with powered emergency release coupling valves to protect the

transfer arms and carrier manifold when the transfer arm operating envelope is exceeded and minimize the spill of LNG in case of an unscheduled uncoupling of the transfer arms from the carrier. LNG would be transferred between the transfer platform and the onshore LNG storage tanks by way of a single 32-inch-diameter LNG transfer pipeline with a 6-inch-diameter LNG circulation line linking the transfer arms located on the transfer platform and the onshore LNG storage tanks. Once the load is transferred, the cargo pumps would be shut down and the transfer arms would be drained, purged, and disconnected.

During liquefaction operations when no LNG marine carriers are being loaded, a portion of the LNG from the liquefiers would circulate through the 6-inch-diameter circulation line to the LNG storage tank(s) to keep these piping systems cold. During the regasification mode of operation when the liquefaction facilities are out of service, LNG from the in-tank LNG sendout pumps would be circulated through the same 6-inch-diameter pipeline. The liquefaction trains would not be kept cold during extended periods of nonuse.

Vapor Handling System

The pressure in the LNG marine carrier during unloading would be maintained through a system that allows vapor to flow back from the storage tanks to the carrier. During loading of the LNG marine carrier, the vapor would flow in the reverse direction to the storage tanks. Once transfer activities are completed, but before recirculation, LNG would be drained from the transfer arms to the vapor return knockout drum and back to the origin of the LNG by pressuring with gaseous nitrogen. After the LNG marine carrier has disconnected, the vapor return knockout drum would be drained into the transfer line.

Ambient heat input into the LNG storage tanks would result in vaporization of LNG, allowing the tank to remain at a constant temperature. The resultant vapor, or boil-off gas (BOG), would be removed by the vapor handling system to maintain the tank pressure. When LNG is not being loaded or unloaded, the selected method for vapor handling would vary depending on the amount of BOG generated and the amount of natural gas needed for makeup purposes. When regasification is occurring, the BOG would be routed to the pipeline for sendout. During liquefaction, BOG would be recycled into either the liquefaction feed gas system upstream of initial cooling or into the mixed refrigerant loop.

Vent and Flare Systems

The flare system includes an elevated low pressure flare and a single multipoint ground flare. A dry gas flare and a wet gas flare make up the multipoint ground flare. The dry gas flare is designed to handle dry and sweet natural gas, LNG, propane, and ethane. The wet gas flare is designed to handle hydrocarbon streams that may contain water and/or free liquid hydrocarbons and water. The three flares are equipped with pilots that are fed from the inlet natural gas header to the liquefaction trains. The ground flare would be used to provide for safe disposal of hydrocarbon releases from relief valves and relief valves/devices on all equipment from the pretreatment facility and liquefaction process during unforeseen events and maintenance activities. During normal operations, only pilot gas would be combusted at the ground flare. The elevated flare height would be about 68.5 feet tall and the maximum flame length, conservatively assuming no wind, would be about 150 feet.

The dry gas flare and wet gas flare would be situated inside a thermal radiation fence. The fence would limit the amount of flame visible from outside the fence and also minimize thermal radiation to an acceptable level outside the fence.

The terminal facility was designed with a closed vent/drain system that would allow no venting during normal operations. Pressure safety valves and thermal safety valves within the liquefaction trains

would release into a closed system and ultimately to the dry gas flare. Pressure safety valves within the pretreatment area and discharge from heat exchangers in the liquefaction trains would discharge to a separate closed system that would discharge products to the wet gas flare.

LNG Storage Tanks

LNG would be stored in two 160,000 m^3 full-containment storage tanks at a temperature of -270 °F and maximum internal pressure of 4.3 pounds per square inch gauge (psig). The tanks would be built on an upper reinforced concrete slab that would sit atop seismic isolators on top of an on-ground reinforced concrete slab on foundation piles. The top of the on-ground reinforce concrete tank base would have an elevation of 2.2 feet above the project datum (NAVD88), which is 2.3 feet below mean sea level (msl) while the bottom of the upper reinforced concrete slab would be 1.7 feet above mean sea level, and would be surrounded by a rock armor protected earthen berm to protect from a tsunami and winter storm waves. The earthen berm crest elevation would vary between 22 and 27 feet above the project datum (17.5 feet to 22.5 feet above msl).

The LNG storage tanks would meet the requirements of NFPA 59A and 49 CFR 193. Both storage tanks would have a 9 percent nickel-steel inner container and a secondary pre-stressed concrete outer container, a reinforced concrete domed roof, a reinforced concrete outer container bottom, and an aluminum insulated support deck suspended from the outer container roof over the inner container. Each storage tank would be designed so that both the primary and secondary containers could independently contain LNG. The diameter of the outer containers would be about 270 feet wide and the height to the top of the storage tank domes would be about 190 feet above the tank base or 185.5 feet above msl. The space between the inner and outer container would be filled with expanded Perlite® insulation compacted to reduce long-term settling of the insulation. The outer concrete container would be lined on the inside with carbon steel plates as a barrier to prevent moisture from the atmosphere from reaching the insulation inside the outer container. This liner would also prevent vapor from escaping from inside the tank during normal operations. All piping into and out of the tanks would be from the top. Figure 2.1.1-3 shows the conceptual design of a typical LNG storage tank.

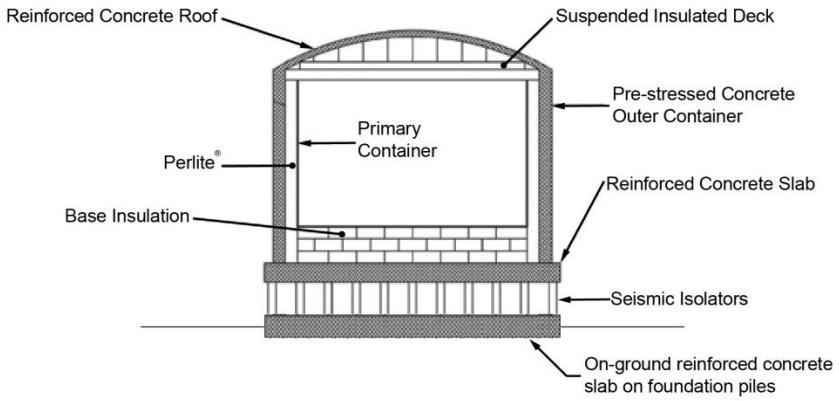


Figure 2.1.1-3: Conceptual Design of LNG Storage Tanks

Feed Gas Pretreatment and Liquefaction Facilities

The liquefaction facilities would consist of two identical liquefaction trains with capacity of 4.5 MTPA each, for an overall nominal liquefaction rate of up to 9.0 MTPA. Each liquefaction train would include a heavy hydrocarbons removal unit and a propane-precooled mixed refrigerant unit.

Natural gas for liquefaction would be received via the pipeline, which terminates on the southeast corner of the terminal. The feed gas would be pretreated prior to liquefaction to remove impurities that have no heating value, have corrosive potential, or would solidify during the liquefaction process. The feed gas would flow to an amine gas sweetening system to remove all CO_2 and the majority of sulfur compounds from the gas. Water would be removed from the feed gas through a series of molecular sieve dryers and mercury would be removed through multiple parallel carbon beds[1]. The sweetened, dry, mercury-free gas would then flow through more filters and finally a pressure control valve to the inlet of the liquefaction units. The dry feed gas would go through several steps of propane precooling then scrub columns before feeding into the main cryogenic heat exchanger. The LNG would then be routed to the storage tanks at 50 psig and -260 °F.

The feed gas pretreatment process would generate wastes, including slop liquids, spent carbon and molecular sieve media, and particulates. Less than 500 gallons per year of slop liquids would be collected and stored in 55-gallon drums and then shipped off site for disposal as appropriate based on waste characterization. Activated carbon used for mercury removal and the molecular sieve media would be replaced about every 5 years. The spent media would be transported to an appropriate disposal or regeneration facility. The total weight of carbon, if completely replaced, would be about 305 tons and the molecular sieve media would have a total weight of approximately 450 tons. Amine particulate, amine carbon, gas particulate, and hot oil filter elements would be infrequently replaced. When replaced, the waste filter elements would be stored in 55-gallon drums prior to shipment off site to the appropriate disposal location. Less than ten 55-gallon drums would be generated per year.

Process cooling would be provided by cooling water, cooled in an evaporative cooling tower. An average of 4.5 million gallons per day of treated water would be required to provide cooling water makeup to the cooling tower and pretreatment facilities.

Regasification Facilities

The terminal would have a natural gas sendout capacity of 0.5 Bscfd and would use a vaporization system consisting of shell and tube heat exchangers. The heat exchangers would employ an ethylene glycol water mixture as an intermediate heat transfer fluid that would be heated via natural gas-fired heaters. Natural gas would be sent out the pipeline at a temperature of 40 °F at the proposed terminal boundary.

Support Facilities

Buildings

The terminal would include the following on-site service buildings:

- main control room;
- platform control room;

[1] Mercury would be removed from the feed gas and accumulated in sulfur-impregnated activated carbon beds, forming mercuric sulfide, which is stable, insoluble, and not classified as hazardous waste.

- administration building;
- maintenance workshop and warehouse building;
- utilities building;
- BOG compressor building; and
- security building.

Pipe Racks

Pipe racks supporting LNG piping would be constructed of a concrete slab supported on piles. Cryogenic process and utility piping, including LNG and natural gas, would be constructed of stainless steel. The use of flanges in cryogenic piping would be minimized. Welded connections would be used except where entry for inspections or maintenance after startup would be anticipated or required.

Fuel Gas and Nitrogen Systems

A system would be installed to supply and distribute natural gas as needed to the fuel burning equipment at the terminal. The primary source of natural gas for the fuel system would be recompressed BOG recovered from the LNG storage tanks. The fuel system would operate at a nominal pressure of 50 psig and would supply natural gas to be burned to warm the heat transfer fluid within the regasification system.

A nitrogen system would be installed to service the unloading arms and vapor return system. Nitrogen would be used to purge pipelines and equipment in preparation for maintenance and for return to service.

Electrical System

The electricity for the terminal would be supplied by a 2-mile-long, 230-kV high-voltage double-circuit power line fed from a new 230-kV substation that would be built near Pacific Power's Warrenton Substation. A new substation would also be built within the Oregon LNG terminal site. The power line and both substations would be nonjurisdictional facilities (see section 2.1.2.2).

Critical instruments that require the most reliable power supplies would remain in service during power failures. Typical supplies would be direct current with dual battery backup, dual uninterruptible power supplies, and dedicated switchboards. Oregon LNG would also install a 2,000 kW diesel-powered standby generator to provide backup power for critical loads when the normal power supply has failed. This generator would be capable of supplying enough power for one in-tank pump (to maintain LNG circulation throughout the terminal for maintenance cooling), terminal emergency lighting (including security lighting), security monitoring and warning systems, emergency communications systems, control systems, one instrument air compressor, the unloading platform, and other necessary auxiliary systems.

Lighting

The terminal would be adequately lit to provide an average of 5 footcandles[2] of lighting at each transfer arm, 5 footcandles at each active access point, and an average of 1 footcandle throughout the remainder of the facility. The metric "footcandles" is a common measure of lighting intensity. A minimum of 0.5 footcandle of lighting would be provided throughout the facility. Lighting along the waterside of the terminal and on the pier would be located or shielded to avoid confusing or interfering

[2] A footcandle is a unit of measure of the intensity of light falling on a surface equal to 1 lumen per square foot. The brightness of 5 footcandles would be similar to a dimly lit hallway.

with navigation on the adjacent waterways. The lighting system would be connected to the emergency power bus to ensure lighting is available for operations and security during loss of off-site power.

Most of the artificial lighting would be located in the plant process area, including atop the storage tanks and along the length of the marine dock unloading area. Other areas that would be illuminated include the facility perimeter, the parking area, and the roadway leading into the terminal. Methods for reducing light impacts would need to comply with safety and security standards for lighting. The lighting design would be the minimum amount of light necessary to complete construction and operation tasks, and all lighting would be directed to work areas in order to minimize stray light. Oregon LNG also would design the terminal lighting to minimize impacts on migratory birds. Also see section 4.1.7.5 for more discussion.

The LNG storage tanks would have a dual lighting system consistent with Federal Aviation Administration (FAA) requirements. The dual-lighting system includes flashing red obstruction lights for nighttime use and medium-intensity flashing white obstruction lights for daytime and twilight use. The use of flashing red obstruction lights at night in lieu of the flashing, medium intensity, white obstruction lighting system is designed to reduce or mitigate nighttime environmental glare concerns in populated areas.

Water System and Wastewater Management

Oregon LNG estimates that water needs at the terminal would be 2.6 billion gallons annually. The bulk of the water would be needed as cooling tower makeup and pretreatment. The water would primarily come from the Columbia River and, depending on the season, reclaimed water from the City of Warrenton's POTW. Water coming from the river would be treated by reverse osmosis to reduce salinity before use as cooling tower makeup. Additional discussion of surface water withdrawal and associated permits is provided in section 4.1.3.2.

During operation, 5.7 million gallons annually would be needed for domestic uses such as irrigation and toilets, and would be supplied by the City of Warrenton. Oregon LNG would construct a new potable water supply pipeline that would connect to an existing City of Warrenton 18-inch-diameter potable water pipeline. The new water supply pipeline would be a nonjurisdictional facility (see section 2.1.2.3).

Wastewater produced by the terminal water treatment system would include the reverse osmosis concentrate, cooling tower blowdown, and filter backwash. These wastewaters would be collected in a sump and pumped to the City of Warrenton POTW outfall via a 16-inch-diameter pipeline, which would be a nonjurisdictional facility (see section 2.1.2.3).

Stormwater that falls onto impervious surfaces in the process areas at the terminal would be conveyed to the stormwater treatment system, which would consist of a 4,000-gpm oily water separator. The capacity of the stormwater treatment system would be 3.6 million gallons, based on a 25-year, 24-hour storm event. Stormwater that falls within the LNG storage tank containment area would be collected in a sump and pumped to the stormwater treatment system. Stormwater that falls within the LNG process area would generally flow into the LNG impoundment tank, where it would flow into a sump and then be pumped to the treatment system. The treated water would then be used as makeup water for the cooling tower. When the volume of the treated water exceeds what is needed for cooling, the excess would be discharged to the POTW outfall. Stormwater from nonprocess areas of the terminal within the berm would be routed to the POTW outfall.

Sanitary waste from domestic use would be collected in building sumps and pumped at a maximum rate of 61 gpm to the City of Warrenton sewage system via a pipeline connected to the City's 6-inch-diameter sewer main located at the intersection of Northeast King Avenue and East Harbor Street/Warrenton-Astoria Highway. The sewer pipeline would be 3 inches in diameter and approximately 4,000 feet in length. It would be installed within the access road right-of-way. Oregon LNG would construct the pipeline and would be responsible for operation and maintenance of the pipeline and pump system.

Firewater System

The terminal firewater system would consist of a freshwater-distributed fire main loop fed via fire pumps from a firewater storage tank. The tank would be filled from the potable water system supplied by the City of Warrenton at a rate of 125 gpm, which would fill the tank in less than 48 hours. The distributed loop would provide firewater to various sprinkler systems, automatic water systems, hydrants, monitors, and other systems as needed.

A river water system would provide deluge fire suppression water to protect the LNG storage tanks in the event they are exposed to heat from an adjacent fire. The deluge system would include an intake located on the Skipanon River, a pump station, and a discharge line. The deluge system intake would include a fish screen designed to meet ODFW and NMFS Northwest Region juvenile fish screen criteria. A 48-inch-diameter suction line would lead from the intake to the pump station. Each of the four diesel engine deluge fire pumps would be tested weekly for at least 30 minutes, and once per year for about 2 hours. A plan and cross sections of the deluge firewater system intake are provided as figures 2a, 2b, and 2c in appendix D.

Safety and Security Systems

A hazard detection and mitigation system would be installed to continuously monitor and alert the terminal operator to hazardous conditions throughout the terminal from fire, combustible gas leaks, and low temperature LNG spills. The terminal would include a fire and gas detection and protection system, including automated detection of an LNG leak or spill, fires, or flammable gas leaks.

A monitoring system would be installed at the terminal to monitor the pier, the fence line, active access points, waters along the terminal, and the terminal interior. Intrusion detection systems would be installed at the perimeter security fence and in all buildings.

Oregon LNG would install a single security fence around the entire perimeter of the onshore terminal facilities in compliance with NFPA 59A. The fence would include two gates at separate locations near the southern portion of the terminal where the access road crosses the property line. Access into and out of the terminal would be controlled by an automated key card badge system for employees and a security guard posted at the main entrance for any visitors.

The security fence would be designed to comply with applicable City of Warrenton Development Code provisions. A typical LNG terminal security fence would include:

- chain link between metal posts spaced about 10 feet apart;
- fence height between 6 to 8 feet above grade with chain link extending 2 feet below grade;
- gates and posts braced back to adjacent line posts with horizontal brace rails and diagonal truss rods;

- barbed or razor wire across the top; and
- warning signs at intervals so that at least one sign is recognizable at night from a distance of 100 feet from any direction that could reasonably be used to approach the enclosure.

Terminal Access

Access to the terminal area would be provided by a new 0.6-mile-long access road as shown in figure 2.1.1-4. The access road would extend from the existing intersection at East Harbor Street and Northeast King Avenue, north across the East Skipanon Peninsula to the terminal site along a 60-foot-wide right-of-way previously platted for Northeast King Avenue.

Oregon LNG would provide a parking lot for construction workers and storage of terminal construction materials on the subleased terminal parcel. No off-site parking or storage for terminal-related activities would be required. Access for workers and construction equipment from East Harbor Street or Hwy 101 would be via the new access road extending from East Harbor Street.

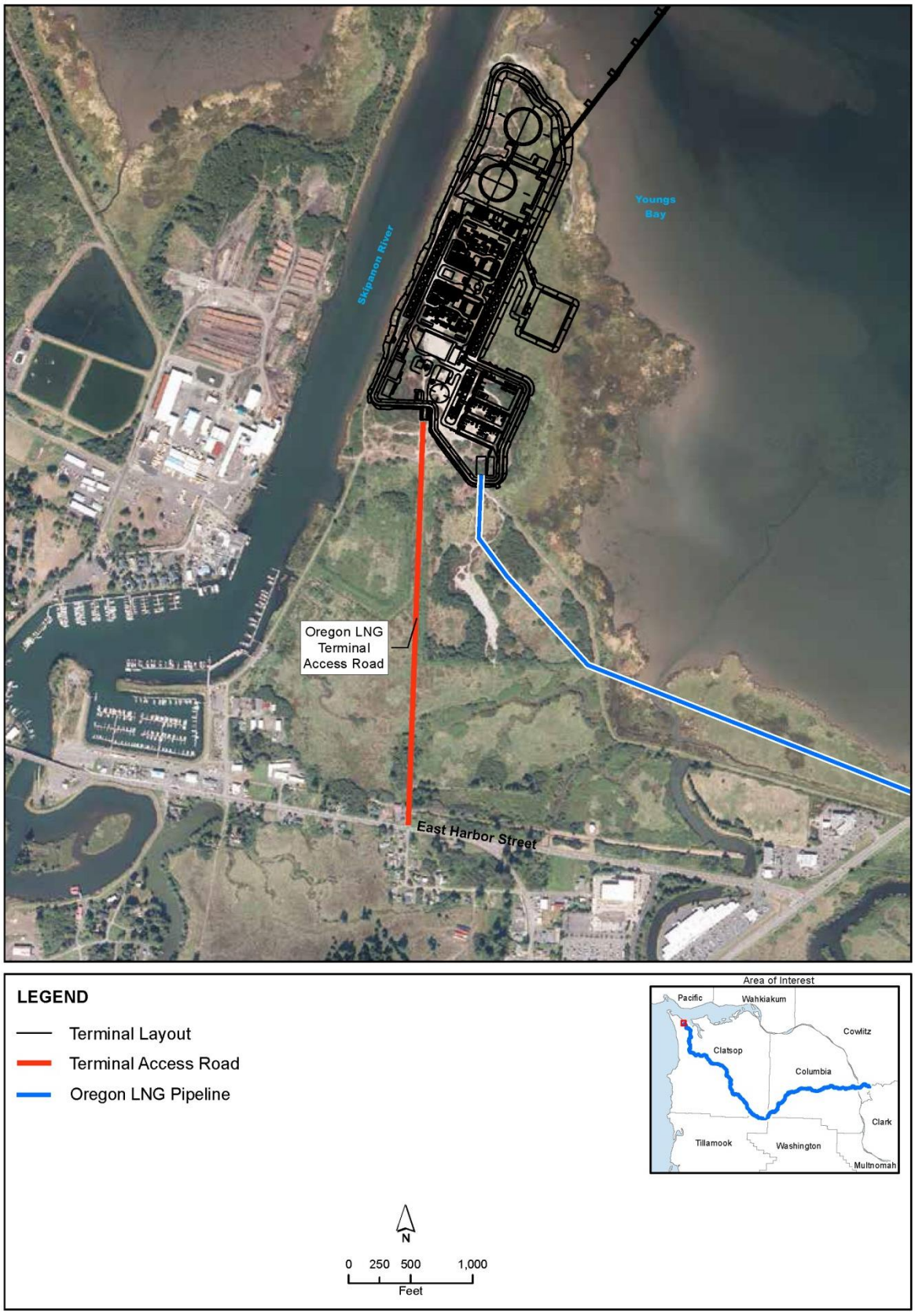


Figure 2.1.1-4: Terminal Access Road

2.1.1.2 Pipeline and Associated Aboveground Facilities

The pipeline portion of the project would include construction and operation of an underground welded steel natural gas pipeline and associated aboveground facilities. These facilities, including additional temporary workspaces (ATWS), are shown on the maps in appendix E1.

Pipeline

The 86.8-mile-long, 36-inch-diameter pipeline would extend from the terminal at Warrenton, Oregon, to an interconnection with the Northwest pipeline system near Woodland, Washington (see figure 1.1-1). The pipeline would be made of carbon steel and would be designed for a capacity of 1.25 Bscfd and a maximum allowable operating pressure (MAOP) of 1,440 psig.

The pipeline would originate at a metering station within the terminal site. The pipeline route would travel southeast, cross Adams Slough and Hwy 101, and run by the west end of the Astoria Airport. The pipeline route would then run 1.5 miles south and east around the edges of Astoria Airport, and cross the Lewis and Clark River at MP 2.8. The route would continue 2.0 miles south across dairy cattle pastures and then cross the Lewis and Clark River twice more at MPs 5.0 and 5.6. The pipeline route would then turn southwest for about 1 mile and enter Weyerhaeuser property at MP 6.5. From this point the route would run southeasterly across the Coast Range on Weyerhaeuser property to MP 33.0, which is near Jewell Junction. From MP 33.4 to MP 33.7, the pipeline route would cross the Nehalem River. Once across the Nehalem River, the pipeline route would generally parallel the 34.5-kV Western Oregon Electric Cooperative, Inc. power line and Hwy 26 to MP 47.5. For most of this section, the alignment would be on private timber company land, or on State of Oregon land administered by the ODF.

From MP 47.5, the pipeline route would turn northeast and cross the North Fork of Wolf Creek at MP 47.6 across a parcel owned by the Oregon Board of Forestry. The route would then continue generally east across Longview Timber Lands crossing several creeks. The route would be generally northeasterly along ridge tops where feasible to avoid wetland areas. The route would enter Longview Fibre land at about MP 56.5, cross Rock Creek at MP 57.7, adjacent private land, and continue up a relatively steep grade on Weyerhaeuser land to about MP 58.3 where the terrain flattens out. At MP 63.2 the pipeline would cross onto land owned by Longview Timberlands and begin a steep descent into the Nehalem River Valley. The pipeline would be configured for a potential future tie-in to the 24-inch-diameter South Mist Extension near MP 63.5.

A horizontal directional drill (HDD) would be used beginning at MP 63.3 to cross the Nehalem River and Hwy 47 heading east. The pipeline route would transition onto ODF land at MP 67.3 and continue on relatively flat terrain, crossing an aboveground BPA power line at MP 67.8. At MP 69.1, the route would cross onto land owned by Longview Timberlands with a short crossing of ODF land from MP 69.7 to MP 70.0 and the Clatskanie River at MP 70.6. The route would then cross the Little Clatskanie River at MP 71.6, several creeks, and about 2 miles of land owned by the City of St. Helens.

The route would cross an aboveground Portland General Electric (PGE) power line right-of-way at MP 77.0 and a parcel of private land between MP 79.7 and MP 80.0 where it would transition onto Knife River Corporation property. Within this property it would cross Hwy 30 and the Portland and Western Railroad right-of-way at MP 80.8 and enter onto a narrow parcel on the east side of Hwy 30 and

the railroad. The compressor station and pig[3] launching and receiving facilities would be built on this parcel. The pipeline would parallel the highway until about MP 81.4, where it would turn east.

The pipeline would cross the Columbia River via an HDD beginning at MP 81.9. On the east side of the river the HDD would exit west of Dike Road. The pipeline would cross the dike and road at MP 82.9 by a trenchless method and then head east across private land to Robinson Road. The pipeline route would cross the road and turn south on the east side of Robinson Road, turning east along the property line dirt road. The route would cross the Burlington Northern Santa Fe railroad right-of-way and turn north at Down River Road to the I-5 right-of-way. The pipeline route would head across I-5 at MP 85.7, turning northeast to cross Old Pacific Highway at MP 85.9 and then southeast across Green Mountain Road. The route would head east, turning south and then east again to follow the property line of City of Woodland land. It would then angle in a northerly direction roughly following property lines and topography to avoid wooded areas until the interconnect with Northwest Pipeline at MP 86.8 west of Insel Road.

Aboveground Facilities

The aboveground facilities would consist of a compressor station, 2 meter stations, 11 MLVs, and 4 pig launchers/receivers. Table 2.1.1-2 lists the proposed aboveground facilities.

Table 2.1.1-2

Aboveground Facilities Associated with the Oregon LNG Pipeline

Facility	Approximate Milepost	County
Compressor Station		
Compressor Station	80.9	Columbia
Meter Stations		
Terminal	0.0	Clatsop
Northwest Pipeline Interconnect	86.8	Cowlitz
Mainline Valves		
Mainline Valve (terminal)	0.0	Clatsop
Mainline Valve	4.7	Clatsop
Mainline Valve	24.3	Clatsop
Mainline Valve	38.8	Clatsop
Mainline Valve	50.2	Columbia
Mainline Valve	61.8	Columbia
Mainline Valve	71.1	Columbia
Mainline Valve (compressor station)	81.0	Columbia
Mainline Valve (compressor station)	81.1	Columbia
Mainline Valve	86.8	Cowlitz
Mainline Valve (Northwest Pipeline interconnect)	86.8	Cowlitz
Pig Launchers/Receivers		
Pig Launcher/Receiver (terminal)	0.0	Clatsop
Pig Launcher/Receiver (compressor station)	81.0	Columbia
Pig Launcher/Receiver (compressor station)	81.1	Columbia
Pig Launcher/Receiver (Northwest Pipeline interconnect)	86.8	Cowlitz

[3] A pipeline "pig" is a device used to clean or inspect the pipeline.

Compressor Station

Oregon LNG would construct a single electrically-driven gas compressor station near MP 80.9. This location would be on Knife River Corporation land just east of Hwy 30 in Columbia County (see figure 1.1-1). A plan of the compressor station is included in appendix E1. Associated with the compressor station would be an electrical substation that would connect to the nearby 115-kV BPA power lines to provide electrical power for the compressor motors. The electrical substation and associated transmission line would be nonjurisdictional facilities (see section 2.1.2).

The compressor station would operate on an as-needed basis as dictated by flow rate and pressure requirements at the delivery point of the pipeline. A compressor building would house the compressor packages and associated auxiliary equipment, instrumentation, and maintenance equipment, and would be designed and constructed to provide sound attenuation to meet noise code requirements.

Meter Stations

Meter stations would be at two locations along the pipeline: one at the terminal and the other on the east end near the Northwest Pipeline interconnect. Both meter stations would measure gas flow from or into the pipeline, depending on flow direction. They would also ensure that natural gas enters the pipeline at a pressure no greater than 1,440 psig. The meter station at the terminal would regulate and measure gas delivered to the pretreatment plant from the vaporization. The meter station at the Northwest Pipeline interconnect would regulate pressure and measure gas into and out of the Northwest Pipeline system.

Mainline Valves

MLVs would be used to segment the pipeline for safety, operation, and maintenance purposes. Oregon LNG would install eleven MLVs. The MLVs would be within the permanent right-of-way on a typical 20-foot by 20-foot site, and would be enclosed by fencing.

Oregon LNG would install MLVs near existing roads to facilitate access, but would avoid locations near populated areas to minimize the effects of occasional blowdown noise and the risk of vandalism. MLV sites would have permanent all-weather access roads.

Pig Launchers and Receivers

Oregon LNG would install four pig launchers/receivers along the pipeline to separate it into two sections with the compressor station in the middle. One pig launcher/receiver would be installed at MP 0.0 at the terminal, one at MP 80.1 before the compressor building, one at MP 81.1 after the compressor building, and one at MP 86.8 before the Northwest Pipeline interconnect. These facilities would allow monitoring of the pipelines using internal inspection tools.

2.1.1.3 Wetland and Habitat Mitigation Sites

To compensate for temporary and permanent impacts on surface waters, wetlands, aquatic resources, essential fish habitat, designated critical habitat and those habitats utilized by threatened and endangered species as well as other terrestrial habitats that would not otherwise be mitigated, Oregon LNG has proposed compensatory mitigation. Compensatory mitigation is identified only after all other forms of impact mitigation (i.e., avoidance, minimization, rectification, and reduction) are considered and, when appropriate, implemented.

Oregon LNG has initiated interaction with various regulatory agencies to collaborate on the development of the compensatory mitigation strategies and approaches. The goal of the proposed

conservation measures would be to compensate for unavoidable impacts on listed species and their habitats, intended to improve the status of the species within the context of their listing or proposal for listing under the ESA. The proposed compensatory mitigation actions are intended to result in no net loss of either individual species or habitat function, and be commensurate with the magnitude and duration of the impacts.

Oregon LNG has identified the following five primary actions to mitigate for expected impacts on listed and proposed species and their habitats, including wetlands:

- enhancement of about 120 acres of estuarine wetland habitat on the Youngs River near its mouth at Youngs Bay, through dike breaching and access channel enhancement and creation;
- removal/replacement of eight road culverts that represent complete barriers to listed salmonids;
- creation and enhancement of wetlands in the floodplain of the Nehalem River;
- long-term protection (through either conservation lease or purchase) of mature riparian habitat along one or more reaches of high-quality salmonid waterbody habitat; and
- habitat acquisition to maintain and restore old-growth habitat for northern spotted owl and marbled murrelet

At this time the proposed compensatory mitigation is conceptual and is based on the input from the FWS, NMFS, and state agencies. However, Oregon LNG has stated that it is committed to implementing the minimum elements of compensatory mitigation measures described in this EIS if FERC authorizes the project. For undefined mitigation actions, such as locations of fish barrier removal, Oregon LNG would organize an interagency Adaptive Management Team consisting of representatives from FWS, NMFS, ODF, ODFW, and WDFW that would review specific mitigation projects prior to implementation to ensure their consistency with the mitigation commitments described in this EIS. To offset agency costs associated with participation in the Adaptive Management Plan, Oregon LNG would provide funding for one full-time equivalent position to be shared among participating agencies. The funding would extend for 5 years from the beginning of construction and offset the agencies' costs for periodic reviews and meetings associated with the project. The Adaptive Management Team is mainly intended to review and advise on mitigation actions but would also be available to provide recommendations in the event of a significant project modification, emergency, or unanticipated effects on fish and wildlife, or their habitats.

For impacts associated with the terminal construction and operation, Oregon LNG would restore or enhance about 140 acres of diked pasture land on the Youngs River near its mouth at Youngs Bay (see figure 2.1.1-5). The riverside parcel is currently used for grazing and protected from flooding by dikes. Oregon LNG intends to breach these dikes to create estuarine wetland habitat and provide access to historic sloughs for listed salmonids and other aquatic species. Oregon LNG would enhance salmonid habitat by creating new off-channel habitat through modification of existing drainage ditches within the property. Channel depths and cross sections would be configured to match typical tidal surge channels found in mature tidal marshes in Youngs Bay. After native freshwater marsh plants recolonize the property, the marsh would provide productive new rearing habitat for juvenile salmon that use Youngs Bay.

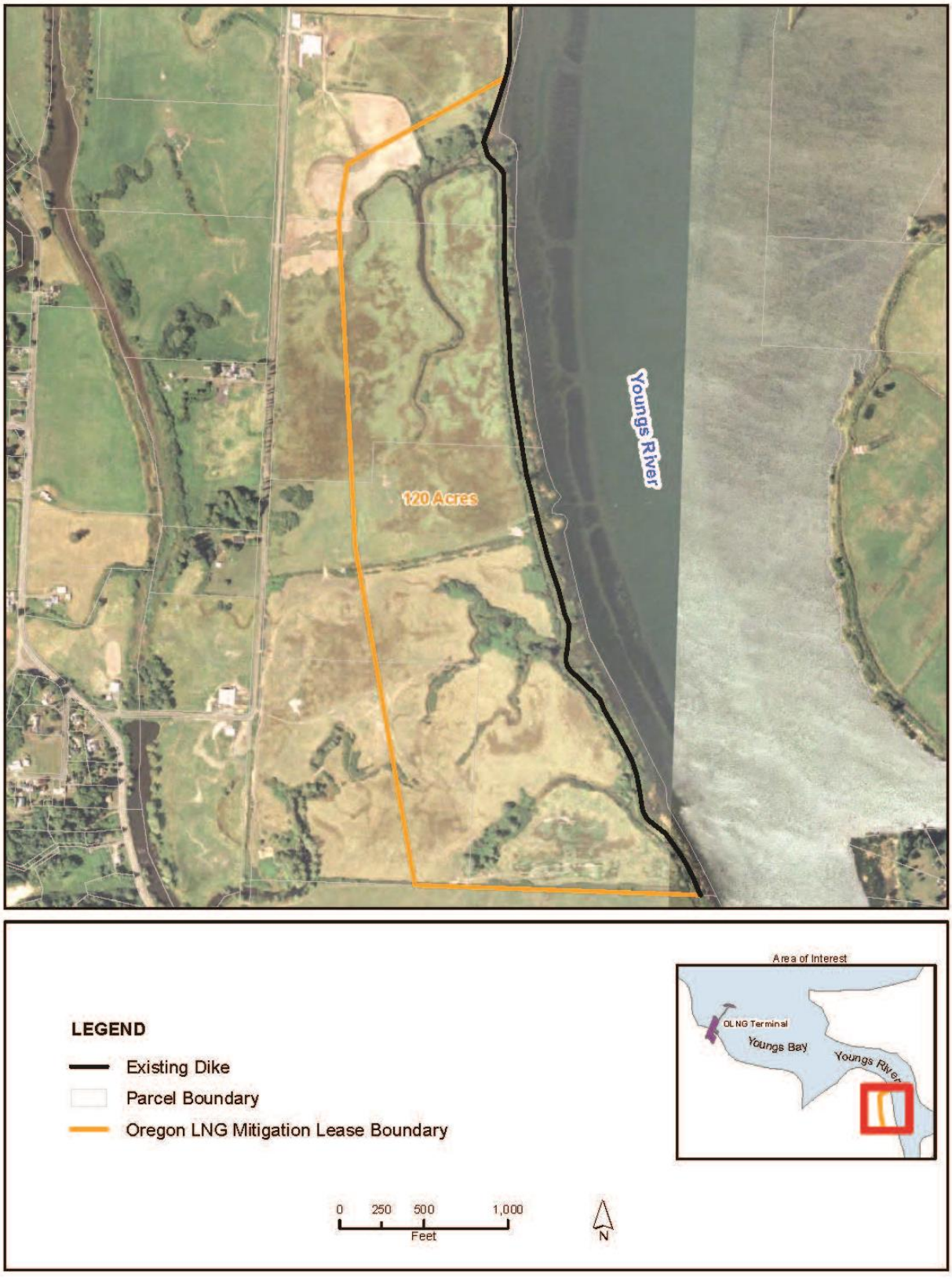


Figure 2.1.1-5: Youngs Bay Mitigation Site

For effects associated with pipeline construction, Oregon LNG intends to remove or replace eight road culverts that currently block adult salmonids migration with new culverts or bridges that meet applicable fish passage criteria, such as ODFW's Stream Simulation protocol and NMFS' fish passage criteria at upgraded waterbody crossings (NMFS, 2008a; ODFW, 2004). Oregon LNG has not yet selected the culverts it would replace or remove but work with its interagency Adaptive Management Team to select sites that have at least 1 mile of quality rearing and spawning habitat conditions upstream of each candidate culvert. For each culvert replacement, Oregon LNG would submit a Section 404 removal/fill joint permit application to ODSL and USACE.

Additional mitigation for impacts on salmonids as well as wetland impacts within the Nehalem and Lower Willamette River Basin would be carried out through the restoration, creation, and enhancement of about 45 acres of floodplain adjacent to the Nehalem River (see figure 2.1.1-6). The property contains a large remnant of river oxbow with an outlet to the Nehalem River (known as the Carmichael property) and pastures currently used for cattle grazing. Mitigation actions would include removal of cattle grazing, removal of reed canary to enhance salmon habitat, wetland creation and enhancement in the floodplain through grading and native plantings, and restoration of native riparian floodplain habitat.

To mitigate for wetland impacts in the Lower Columbia – Clatskanie River Basin in Oregon, Oregon LNG would contribute funding to a fee-in-lieu project such as the proposed Deer Island Conservation Bank. For the Lower Columbia – Clatskanie River basin in Washington, wetland mitigation would consist of the purchase of credits in the Columbia River Wetland Mitigation Bank. The Columbia River Mitigation Bank, which is adjacent to the Vancouver Lake Wildlife Refuge, services the portion of Cowlitz County where the pipeline is proposed.

To mitigate for the long-term loss of large woody debris (LWD) recruitment potential due to vegetation clearing in riparian area at waterbody crossings, Oregon LNG plans to purchase conservation easements of riparian conifer stands to prevent selective cutting of mature trees within 100 feet of the waterbody edge. Locations would be identified within the range of each affected ESU. Easements would be purchased on a 1 to 1 ratio for the amount of riparian conifer stands removed during pipeline construction. Oregon LNG would select riparian mitigation sites that currently lack woody cover or areas where protection of existing riparian vegetation would provide positive ecological benefits. Oregon LNG would seek approval from the Adaptive Management Team for specific riparian mitigation projects to ensure that the proposed action would adequately offset the loss of LWD caused by pipeline construction. Conservation easements at riparian mitigation sites would prevent future commercial timber harvesting and that the riparian areas are managed to enhance riparian and upland conditions. Based on the number of waterbodies crossed with existing riparian vegetation, Oregon LNG would purchase an estimated 2.9 miles of riparian habitat, with the actual amount to be determined during final engineering, which would occur within 2 years of pipeline construction, and to be dependent on site specific conditions at each proposed mitigation site.

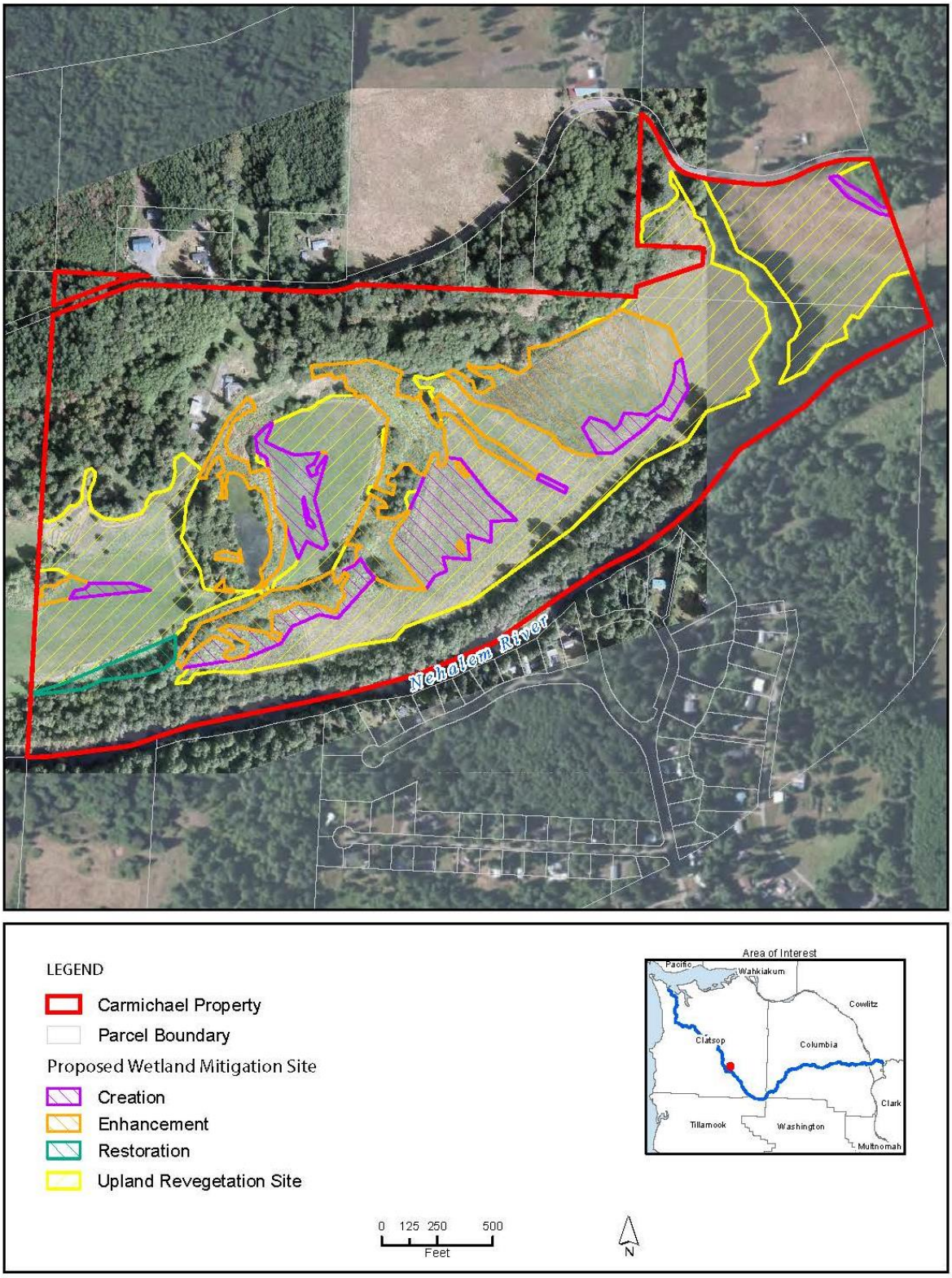


Figure 2.1.1-6: Carmichael Property Mitigation Site

To offset the loss of forest habitat in the Coast Range and associated habitat impacts on federally listed marbled murrelet and northern spotted owl, Oregon LNG would acquire lands to be set aside for protection and enhancement for bird habitat. Based on input from the FWS, Oregon LNG has agreed to acquire and set aside more land than it would impact for pipeline construction. The additional land is intended to mitigate for the temporal loss of habitat as it may take many decades for impacted forest land to recover to preconstruction conditions. See sections 3 and 4 of Oregon LNG's Conceptual Mitigation Plan (appendix F3) for a list of habitat acquisition ratios. Similar to the acquisition of pipeline right-of-way, Oregon LNG would proceed in developing an acquisition plan and negotiating with landowners to enter into agreements to purchase select parcels for conservation if FERC authorizes the project. Management of the parcels would be transferred to an interested conservation organization with conditions for maintaining, enhancing, and restoring habitats.

Compensatory mitigation activities (purchasing property easements and initiating long-term management) would occur concurrently with construction effects. Oregon LNG would create an endowment to fund the construction and future monitoring of the mitigation sites. The amount of the endowment would be determined according to the budget developed as part of the management plan. Endowment funds would be created within the organizational framework of the chosen conservator and would be provided as a down payment at the time of construction and annual contributions from Oregon LNG in years 1 through 10 of operations.

2.1.2 Nonjurisdictional Facilities

In addition to the proposed facilities discussed above, the project would include components that do not fall under FERC's jurisdiction. These include the LNG marine carriers, waterway for LNG marine traffic, terminal wastewater and water lines, new electric transmission lines and substation facilities, and upgrades to existing electrical facilities. Nonjurisdictional facility impacts are addressed with cumulative effects in section 4.3.

2.1.2.1 LNG Marine Carriers and Waterway for LNG Marine Traffic

LNG marine carriers would enter U.S. territorial waters about 12 nautical miles (13.8 statute miles) off the coast of Oregon and proceed an additional 11.5 (statute) miles up the Columbia River in an existing federal navigation channel to the terminal (see figure 2.1.2-1). This route is referred to as the waterway for LNG marine traffic. LNG marine carriers would transit the Columbia River under the navigational control of Columbia River Bar Pilots. The states of Washington and Oregon share jurisdiction and ownership of the Columbia River and its bed, and the 43-foot-deep navigation channel is maintained by the USACE. For most of the distance from the mouth of the Columbia River to Warrenton at RM 11.5, the federal navigation channel is 600 feet wide. Oregon LNG would not make any modifications to the navigation channel in the Columbia River; however, it would construct a turning basin adjacent to the existing navigation channel. No bridges or power lines cross the Columbia River along the route to the terminal.

As described in section 1.4.3, the Coast Guard issued an LOR Analysis for the Oregon LNG Project that includes detailed information on the suitability of the waterway for LNG marine traffic, and on mitigation measures needed to make the waterway suitable for the size and frequency of vessels anticipated at the terminal during operation. More detailed information regarding the Coast Guard's LOR and the safety and security recommendations that the Coast Guard has developed for the Oregon LNG Project, and our recommendations for adopting and incorporating the Coast Guard's recommendations into the design and operation of the Oregon LNG Project, can be found in section 4.1.13.8.

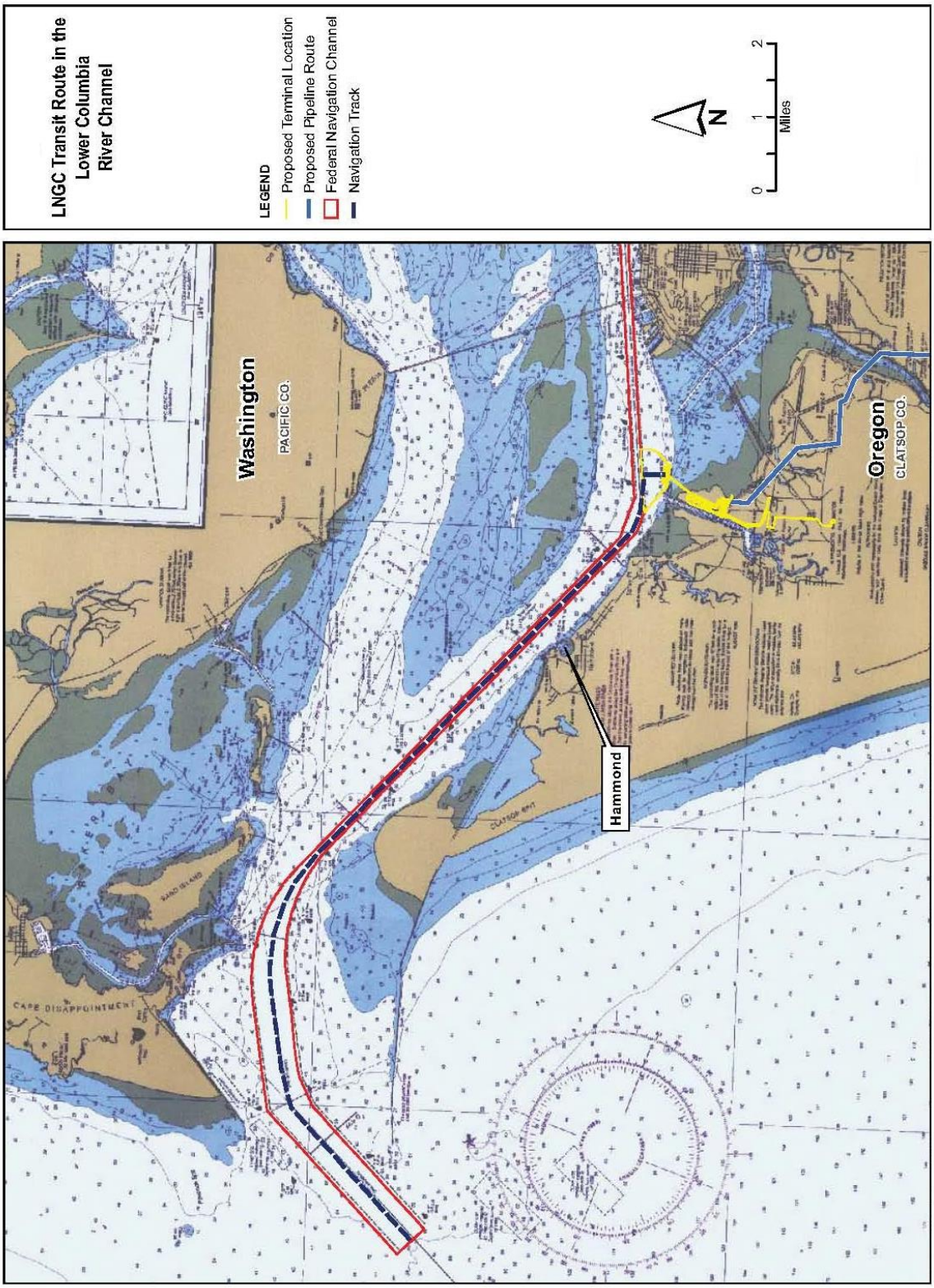


Figure 2.1.2-1: Waterway for LNG Marine Traffic

At the terminal, the LNG marine carriers would be berthed and the LNG would either be loaded for export or unloaded for import. During the export process, ballast water would be discharged into the Columbia River while the carrier is loading LNG at the terminal. Under import mode, ballast water from the Columbia River would be taken onto the ship while the LNG marine carrier is offloading LNG at the terminal. Depending on the size of the LNG marine carrier, ballast water intake/discharge would take between 12 and 16 hours. The LNG marine carriers would also use river water for engine cooling. Cooling water intake and discharge would typically occur for about 21 hours while the LNG marine carrier is docked. Estimated intake rates and volumes of cooling and ballast water, as well as cooling water discharge temperatures are addressed in section 4.1.3.2.

Typically, it would take 24 hours for an LNG marine carrier to dock, unload or load, and depart from the berth. LNG marine carriers would be escorted in the navigation channel by at least two 75-ton or greater static bollard pull/push tractor tugs. All tugs would be provided or contracted by Oregon LNG. A third and fourth tug would be required to assist with turning and mooring (see appendix B1). While unloading of the LNG cargo is underway, all four tugs would remain on station to assist with emergency departure procedures, if needed; and at least two of the tugs remain at the ready in the terminal basin while LNG marine carriers are on the berth to monitor and assist passing vessel traffic in case maneuverability problems occur.

LNG marine carriers would be under the ownership and control of third parties, not Oregon LNG, and would not be regulated by the FERC. The third-party owners and operators of the LNG marine carriers would transport LNG to and from designated ports or customers. We do not have any information about the exact vessels that would be used to transport the LNG from the terminal. However, Oregon LNG anticipates that its terminal would be visited by about 125 LNG marine carriers or less per year with capacities of either 148,000 m^3 or 173,000 m^3. Neither do we know the exact destinations for the LNG cargo, nor the specific routes across the Pacific Ocean to customers that would be taken by LNG vessels, outside of the waterway within 12 miles of the Oregon Coast. Therefore, LNG vessel design and ocean transportation routes outside of the waterway close to shore will not be further analyzed in this EIS.

2.1.2.2 Terminal Electrical Power Supply

To provide adequate electrical supply to the terminal, the following upgrades and new nonjurisdictional facilities would be needed:

- a new 230-kV substation in Warrenton;
- a new substation within the terminal;
- a new double-circuit 230-kV power line between the new 230-kV substation and the terminal (about 2 miles);
- rebuild the existing 230-kV transmission line between the Driscoll and Clatsop Substations (approximately 22 miles);
- upgrades within the Driscoll, Clatsop, and existing Warrenton Substations; and
- rebuild the existing 115-kV transmission line between the Clatsop and Warrenton Substations to 230-kV (approximately 5 miles).

A new 230-kV substation would be built near the existing Warrenton Substation. A new double-circuit 230-kV tubular steel power line would connect the new 230-kV substation to the terminal. The proposed power line alignment would head west from the new 230-kV substation and cross Hwy 101. It would then follow Hwy 101 north to where an existing power distribution line crosses the highway heading north. The power line would turn north, following the existing distribution line, until it crosses

East Harbor Street where it would turn east. The power line would cross Northeast King Avenue and then head north until entering the terminal site. The power line would be collocated with the terminal access road. The proposed alignment of the power line is shown in figure 2.1.2-2.

About a third of the route of the 2-mile-long power line would need to be cleared of trees, most of which would be between Hwy 101 and East Harbor Street. Trees would not be allowed to grow within the 125-foot-wide right-of-way in order to provide safety clearance for the power line, but low growing vegetation would be encouraged. An area of about 250 feet by 250 feet would be permanently disturbed for the new 230-kV substation near the existing Warrenton substation. Table 2.1.2-1 shows estimated disturbance areas for each facility.

The new 230-kV substation and the power line from the substation to the terminal would be permitted, constructed, owned, and maintained by PacifiCorp, which operates as Pacific Power in Oregon. Oregon LNG would negotiate an Engineering Services Agreement with Pacific Power to design the electric transmission line, and Pacific Power would be responsible for the agency approvals. The transmission line would be designed and permitted after the authorization issued for the project. With regard to permitting requirements for the terminal transmission line, electric transmission lines of 230-kV or more in Oregon that are more than 10 miles in length are under the jurisdiction of the Oregon Energy Facility Siting Council. Because the electric transmission line from the substation to the terminal would be less than 10 miles in length, the permitting would be administered through the local jurisdiction, i.e., the City of Warrenton.

A new substation also would be constructed at the terminal. It has not been determined yet whether the substation would be built, owned, and operated by Pacific Power or Oregon LNG. Responsibility for the design, construction, and future ownership and operation of the terminal's substation would be established at a later date once it has been determined whether the substation would also play a role in Warrenton's power distribution system.

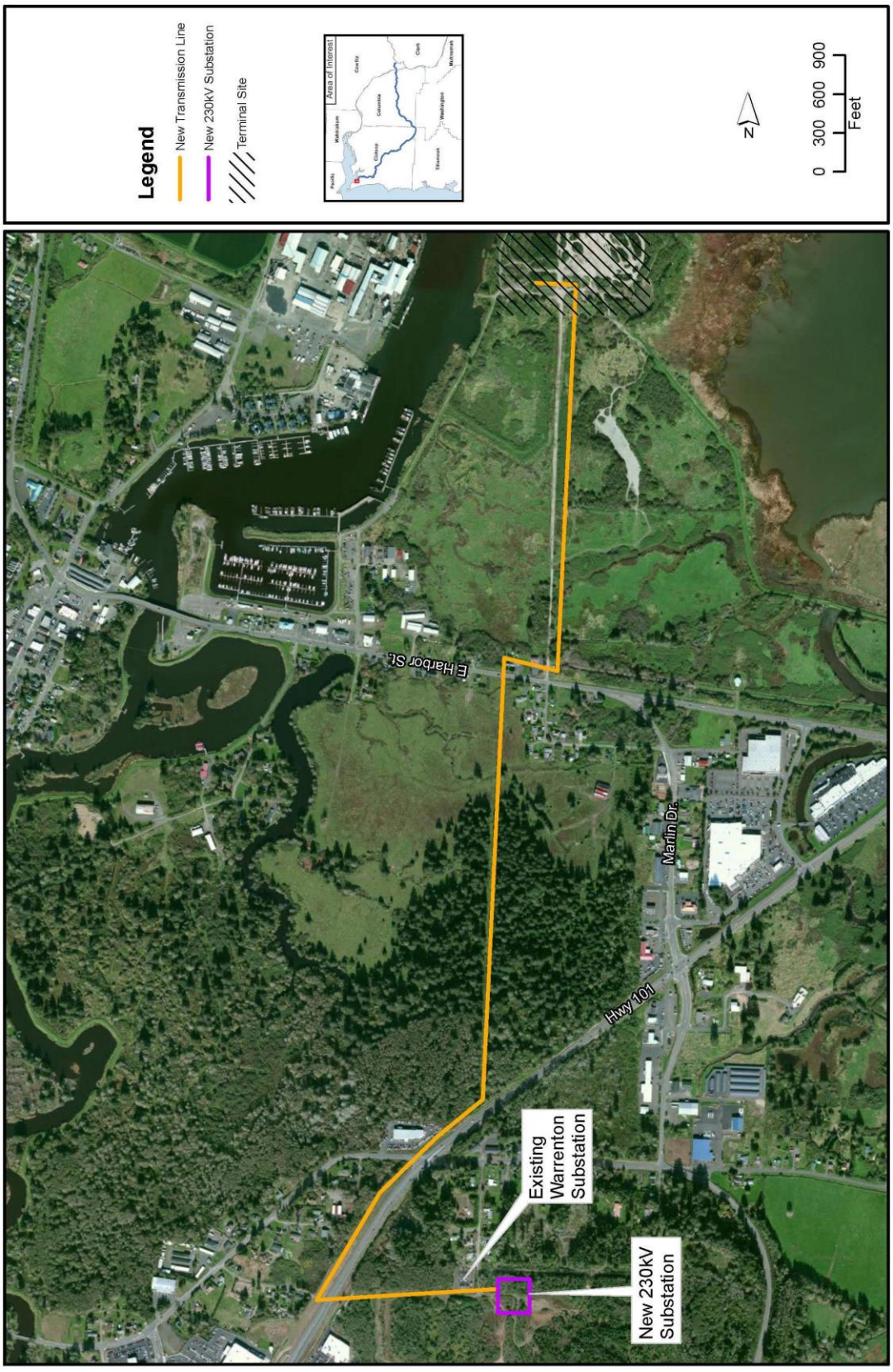


Figure 2.1.2-2: Terminal Electric Transmission Line Route

Table 2.1.2-1

Estimated Power Supply Land Disturbance

Project Feature	Temporary Disturbance (acres)	Permanent Disturbance (acres)	Total Disturbance (acres)
New Power Line from New 230-kV Substation to Terminal			
Work areas [a]	21.0	–	21.0
Access roads	–	1.2	1.2
Tree clearing [b]	–	10.5	10.5
New 230-kV Substation	–	1.4	1.4
Warrenton to Clatsop Transmission Line			
Work areas [a]	48.5	0.1	48.6
Access roads	–	6.6	6.6
Tree clearing [b]	–	27.1	27.1
Clatsop to Driscoll Transmission Line			
Work areas [a]	127.7	2.0	129.7
Access roads	–	33.9 [c]	33.9
Material Yard	20.0	–	20.0
Totals	217.2	82.8	300.0

[a] Includes structure sites, temporary guard structures, and stringing/splicing sites.
[b] Considered permanent disturbance because trees would not be allowed to regrow. Low growing vegetation would be allowed.
[c] Includes 25.9 acres of existing access roads.
Precision lost due to rounding.

The existing transmission lines that serve Warrenton would need to be upgraded to supply adequate power to the terminal and surrounding area. The existing 115-kV transmission line between the Warrenton and Clatsop Substations would need to be replaced by a 230-kV line. The existing transmission line right-of-way is 100 feet wide and would need to be expanded to 125 feet wide. In response to National Park Service (NPS) concerns, where the transmission line passes through the Lewis and Clark National Historic Park, Oregon LNG designed the upgraded 230-kV line so that the right-of-way width would remain at 100 feet on NPS land. The existing 230-kV line between the Clatsop and Driscoll Substations would be rebuilt as an improved 230-kV line. Both lines are shown on figure 2.1.2-3. Construction of these facilities would be done by the owners, either BPA or Pacific Power, depending on the facility. Improvements would also be made to the substations listed; however, all work would be done within the existing previously disturbed yards. Expansions are not anticipated for the existing Warrenton, Clatsop, or Driscoll Substations.

2.1.2.3 Terminal Wastewater and Water Lines

Nonjurisdictional water facilities to service the terminal would include a potable water pipeline, POTW effluent line, wastewater pipeline, and a new POTW effluent pump. Figure 2.1.2-4 shows a map of existing and proposed water and wastewater pipelines. Figures 3a, 3b, and 3c of appendix D show wetlands delineated along the water and wastewater pipeline routes.

The potable water supply and POTW effluent pipelines to the terminal and the wastewater pipeline from the terminal to the POTW outfall would pass under the Skipanon River. HDD would be used to install a 36-inch-diameter high density polyethylene (HDPE) pipe beneath the Skipanon River. The three pipelines (potable water, POTW effluent, and wastewater) would be installed inside the 36-inch HDPE pipe. After installing the pipelines, the HPDE pipe would be filled with grout to address separation requirements between potable and wastewater lines. A cross section of the HDD for the water and wastewater pipelines is provided as figure 4 in appendix D. The potable water line would be about 6,000 feet long, the POTW effluent pipeline to the terminal would be about 6,100 feet long and the wastewater discharge pipeline from the terminal to the POTW would be about 6,300 feet long.

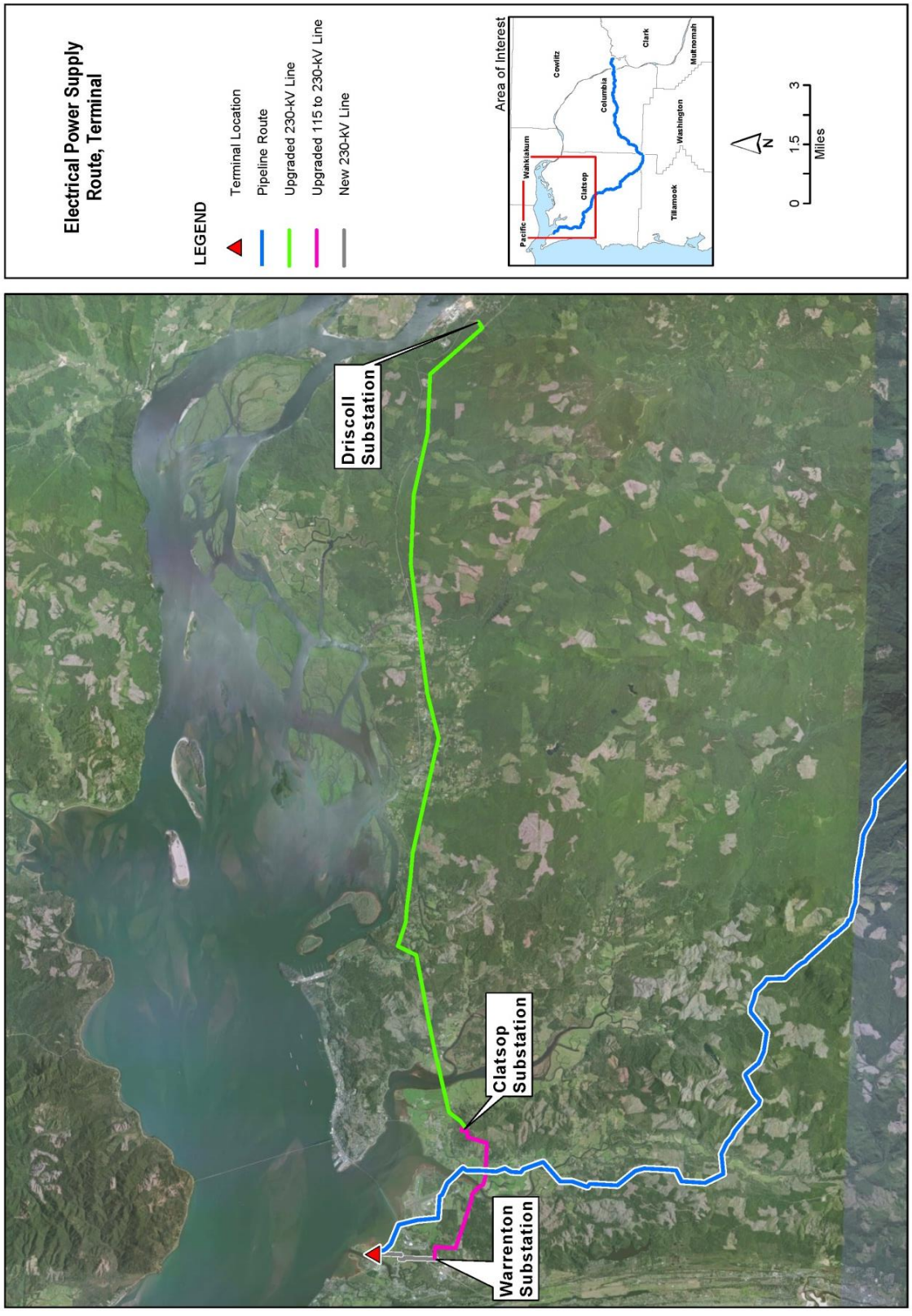


Figure 2.1.2-3: Oregon LNG Electric Power Lines

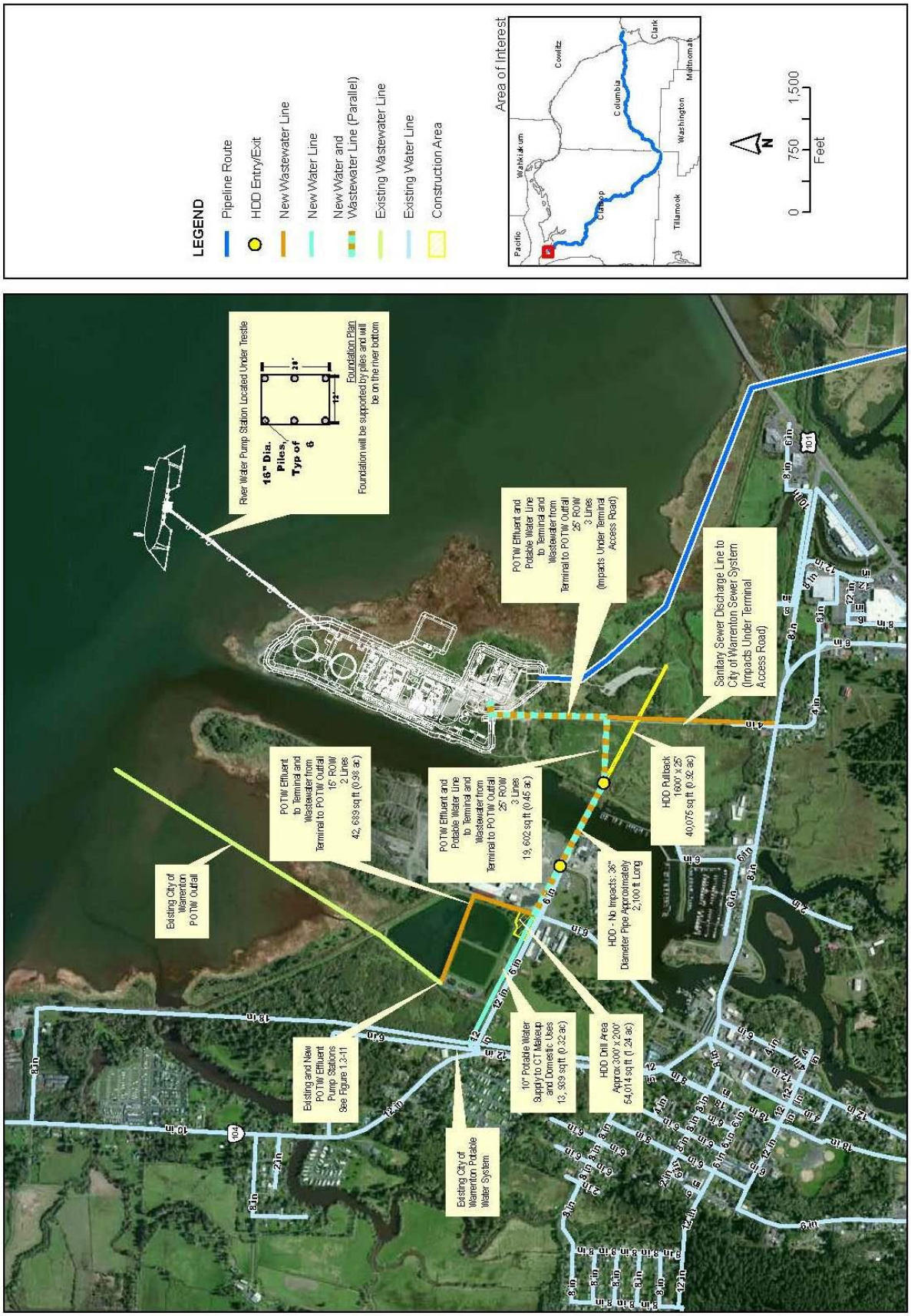


Figure 2.1.2-4: Terminal Water and Wastewater Pipelines

In response to a comment by the ODFW, we requested the Oregon LNG consider alternative HDD crossing locations for the Skipanon River that would avoid wetlands next to the terminal site. Oregon LNG assessed one alternative route approximately 1,150 feet north of the proposed route and a second alternative route approximately 1,550 feet north of the proposed route. Each of these alternatives would impact about 0.5 acre of wetlands compared to about 1.6 acre of wetlands for the proposed route. However, nearly all of the reduction wetland impacts would be on the west side of the Skipanon River rather than next to the terminal site. Both alternatives would have increased impacts on private landowners at the HDD entry. Furthermore, the HDD exit for Alternative B would be within the terminal footprint and would not be compatible with proposed ground improvement in this area. Because neither alternative would significantly reduce impacts on the wetlands next to the terminal site, and both would result in greater impacts on private land, we agree that the proposed route for the water and wastewater pipeline is preferred.

Oregon LNG would permit and construct the terminal water and wastewater pipelines, the new City of Warrenton POTW effluent pump station, and adjustments to the existing diffuser on the existing outfall. Oregon LNG would own and operate water and wastewater systems on the premises of the terminal and the City of Warrenton would own and operate (potentially via a contractor) the water and wastewater pipelines from the terminal to the new City of Warrenton POTW effluent pump station as well as the pump station itself. The City of Warrenton owns and operates the existing outfall and diffuser.

2.1.2.4 Compressor Station Electrical Substation and Transmission Line

The compressor station would operate on an as-needed basis as dictated by flow rate and pressure requirements at the delivery point of the pipeline. The compressor station would require an electrical substation and associated transmission line to provide electrical power for the compressor motors. Oregon LNG would construct the new substation adjacent to the compressor station with input from the Columbia River People's Utility District (CRPUD). The 0.5-mile-long transmission line would connect to a nearby 115-kV BPA power line. The CRPUD would own and operate the electrical facilities.

Oregon LNG has discussed the proposed compressor station and associated substation with the BPA and the CRPUD. Oregon LNG would conduct a system impact study with the BPA to design the transmission line to the substation, and the BPA would be responsible for agency approvals. The transmission line would be designed and permitted after FERC authorization of the Oregon LNG Project. Because the electric transmission line would be less than 230 kV, the permitting and associated environmental review would be administered through the local jurisdiction.

2.1.3 Land Requirements

The Oregon LNG Project would affect a total of 1,427.3 acres during construction and 754.5 acres during operation. Table 2.1.3-1 summarizes the land requirements for the facilities associated with the project.

Table 2.1.3-1

Summary of Land Requirements Associated with Construction and Operation of the Project

Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
Onshore Terminal Facilities		
LNG Storage Tanks/Process Area	71.0	68.9
Access Road [a]	6.1	4.6
	77.1	73.5
Offshore Terminal Facilities		
Turning Basin	135.2	134.7
Pier and Berth	17.1	13.5
	152.3	148.2
Terminal Subtotal	**229.4**	**221.7**
Pipeline Facilities		
Pipeline	1,129.1 [b]	525.3
Compressor Station	18.7	7.0
Contractor and Pipe Storage Yards	47.1	0.0
Aboveground Facilities [c]	0.5	0.5
Access Roads	2.5	0.0
Pipeline Facilities Subtotal	**1,197.9**	**532.8**
Project Total	**1,427.3**	**754.5**

[a] Impact calculations for the access road to the intersection at East Harbor Street include a roundabout design. The actual intersection arrangement would be negotiated with ODOT through a Road Approach Permit application process.

[b] Pipeline right-of-way impacts include additional temporary workspace associated with the construction corridor.

[c] The majority of the aboveground facilities occur within the permanent right-of-way or other existing/proposed aboveground facility limits and are accounted for in other facility totals.

2.1.3.1 Terminal Facilities

Construction of the marine facilities at the terminal pier, berth, and turning basin would affect about 152.3 acres and about 148.2 acres would be affected during operation. Construction of the land-based portion of the terminal, including the access road, would affect about 77.1 acres of the 96-acre terminal parcel. The land-based portion of the terminal would permanently occupy about 73.5 acres, including 68.9 acres for the LNG storage tank and process area and another 4.6 acres for the permanent access road.

2.1.3.2 Pipeline and Associated Aboveground Facilities

Construction of the pipeline and associated aboveground facilities would disturb a total of about 1,197.9 acres of land, including the temporary construction right-of-way, extra workspaces, contractor and pipe storage yards, aboveground facilities, and access roads. About 532.8 acres of the 1,197.9 acres used for construction of the pipeline would be required for operation of the project. The remaining 665.1 acres would be allowed to generally revert to its former use.

The pipeline route would be collocated with existing easements and rights-of-way (e.g., roads, railroads, utility lines) in some areas. About 9.9 miles (11 percent) of the 86.8-mile-long pipeline route would be constructed adjacent to existing right-of-way.

Oregon LNG would use a 100-foot-wide construction right-of-way for the majority of the pipeline route. Additional site-specific areas would be required for extra workspace at sensitive crossings to provide extra space for spoil storage and associated construction activities. Oregon LNG would reduce the construction right-of-way to a width of 75 feet in wetlands. The 75-foot limitation on the construction right-of-way width would not apply to wetlands in actively cultivated or rotated cropland. The typical right-of-way cross sections that Oregon LNG would use for pipeline construction are provided in appendix E2. Following construction, a 50-foot-wide permanent right-of-way would be retained for operation and maintenance of the pipeline.

Oregon LNG would require extra workspaces outside the typical construction right-of-way at locations where additional excavation, soil storage requirements, or equipment management and staging would make it impracticable to carry out all construction operations within the 100-foot-wide corridor. These would include feature crossings (e.g., road, railroad, wetland, waterbody), areas with steep side slopes or severe terrain, areas requiring topsoil segregation, tie-ins to existing pipelines and laterals, and HDD entry and exit points. In addition, Oregon LNG would use six construction staging and storage yards, which would temporarily affect 47.1 acres of land.

Oregon LNG would access the pipeline construction right-of-way and aboveground facilities via 117 existing public and private roads that intersect the right-of-way (see appendix E5). The majority of roads are classified as gravel or dirt roads. Once on the construction right-of-way, construction equipment would stay within approved work limits.

2.1.4 Construction Procedures

This section describes the general procedures proposed by Oregon LNG for construction of the terminal and pipeline facilities. Refer to section 4.1 for more detailed information about proposed construction and restoration procedures as well as additional measures recommended to mitigate environmental impacts.

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, Oregon LNG would design, construct, operate, and maintain the terminal facilities in accordance with DOT's *Liquefied Natural Gas Facilities: Federal Safety Standards* (49 CFR 193). The carrier loading/unloading facilities and any appurtenances between the LNG marine carriers and the last valve immediately before the LNG storage tanks would be required to comply with applicable sections of the Coast Guard regulations in *Waterfront Facilities Handling Liquefied Natural Gas* (33 CFR 127) and Executive Order 10173.

The proposed pipeline facilities would be designed, constructed, operated, and maintained in accordance with DOT regulations in *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards* (49 CFR 192). In addition, Oregon LNG would comply with the siting and maintenance requirements in 18 CFR 380.15 and other applicable federal and state regulations.

Oregon LNG would adopt our *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) (FERC, 2013a) without changes and our *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) (FERC, 2013b) with the approved alternative measures listed in table 4.1.4-5 of section 4.1.4.2.[4] The Plan and Procedures provide baseline mitigation measures for minimizing the extent and duration of disturbances on soils, wetlands, and waterbodies. Collectively these documents are referred to as Oregon LNG's Plan and Procedures in this EIS. Other erosion control measures are

[4] Our Plan and Procedures can be accessed at the FERC's website, http://www.ferc.gov/industries/gas/enviro/plan.pdf and http://www.ferc.gov/industries/gas/enviro/procedures.pdf.

described in Oregon LNG's *Stormwater Pollution Prevention Plan for Construction of the Oregon LNG Terminal and Pipeline, Including Erosion Prevention and Sediment Control Plan; Spill Prevention, Control, and Countermeasures Plan; and Frac-Out Contingency Plan* (SWPPP) (see appendix F1).

Typical construction activities would occur between 7 a.m. and 7 p.m., 5 days per week. During periods of peak construction activity, construction may include longer hours and additional days to efficiently complete a particular construction phase. Extended hours allow construction activities to be completed under a compressed schedule, reducing the total construction days for disruptive activities such as pile driving and dredging.

2.1.4.1 Terminal Facilities

The terminal components and equipment would be brought to the site by truck, rail, or barge. Depending on their sizes, various facility components would arrive in different states of assembly. Some equipment would be self-contained and require no assembly. On-site workshops, staging, and laydown areas would be equipped and sized appropriately to complete the final assembly. No major fabrication of facility components would be anticipated on site.

Site Preparation

Site work at the terminal would begin with clearing and grubbing, followed by rough grading of the entire site to allow for safe passage of construction equipment and materials. During grading, appropriate erosion control measures would be installed, including temporary drainage ditches, catchment ponds, and silt fences. Aggregate (crushed rock) needed for project construction would be sourced from an existing permitted quarry. Concrete would be supplied by an on-site batch plant. All organic materials would be stripped from the ground surface before excavation for structures and placing site fill. These strippings would not be used as fill, but could be stockpiled for reuse during landscaping.

The process and operations area would have a finished grade of +18 feet (North American Vertical Datum [NAVD] 88) which would be achieved by using fill material obtained on site from excavation and ground improvement of the LNG storage area. The LNG storage area would require some cut, or excavation, of material to lower the existing grade to elevation 0 foot (NAVD 88), while the process and operations area would require fill to reach elevation +18 feet (NAVD 88). The total volume of fill material for site grading would be about 550,000 cubic yards. All of the needed fill material is expected to come from on-site sources such as excavating for the storage tanks (110,000 cubic yards) and waste material from the stone columns and cement deep soil mixing (CDSM) ground improvements (450,000 cubic yards). Excess material generated from the CDSM ground improvements would be managed at an off-site location, consistent with applicable requirements.

Because many of the construction activities would overlap with each other, the site would be subdivided into work areas assigned to the contractor and major subcontractors.

Turning Basin and Ship Berth

The first activity in the marine area of the terminal would be dredging, followed by pile driving. Oregon LNG proposes to dredge the turning basin and berth in one 4-month window between June 1 and September 30. Oregon LNG has requested permission to work outside of the ODFW in-water work window of November 1 to February 28 to allow for safe dredge vessel passage across the Columbia River Bar.

Oregon LNG would likely dredge the berth and maneuvering area using a hydraulic hopper dredge. Hydraulic hopper dredges have been used to dredge the federal navigation channel for many years. Hopper dredges are self-propelled seagoing ships with hulls and lines similar to those of a typical oceangoing vessel and are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and other special equipment required to remove material from a channel bottom (CH2M HILL, 2013a). Dredged material is raised by dredge pumps through drag-arms that are pulled along the channel in contact with the channel bottom. The material is discharged into hoppers built in the vessel. Once fully loaded, hopper dredges move to the disposal site to unload before resuming dredging. Unloading is accomplished by opening doors in the bottom of the hoppers and allowing the dredged material to be released to an open-water disposal site. Based on a bottom dump barge capacity of 4,000 cubic yards per barge, a total of 300 barge trips would be needed to transport the 1.2 million cubic yards of dredged material to the placement location.

Oregon LNG would construct the majority of the ship berth structures; including the unloading platform, breasting and mooring dolphins, interconnecting walkways, and the seaward 700 feet of the marine trestle; using equipment based on floating barges. To the extent possible, initial installation of steel cylinder piles would be performed using barge-based vibratory hammers, which would result in reduced underwater and surface noise impacts. Final driving or "proofing" would be done with an impact hammer, the size of which would be determined at the time of construction. Cast-in-place concrete elements would be placed using barge-mounted concrete pumps. Precast concrete elements and structural steel superstructure elements would be transported to the site on barges, and then would be lifted into place using a barge-mounted crane.

For the shoreward 1,400 feet of the marine trestle, the water depth would be too shallow for access by barge-mounted equipment. Therefore, this portion of the trestle would be constructed using the "over-the-top" method. This method uses a rail-mounted crane to lift elements into place and a rail-mounted "low-boy" flatbed deck for materials delivery.

LNG Storage and Support Facilities

Ground Improvement

CDSM is a ground improvement method that would be used to stiffen the ground to be more resistant to soil liquefaction, and to reduce potential settlement of the improved soil. CDSM is a soft soil stabilization method that mixes soft soil with cement slurry to produce soil-cement with higher strength and lower compressibility than the native soil. Oregon LNG proposes to use CDSM beneath the LNG storage tanks and the deluge house adjacent to the Skipanon River. The CDSM would extend 40 feet laterally beyond the outside diameter of the tank foundation slab, 40 feet beyond the slab for the deluge house, and to a depth of 80 feet. The CDSM columns would typically be 2.5 to 5.0 feet in diameter and be laid out in an interlocking grid-type pattern. The drilling and mixing operations would have a low noise level and low vibrations and would not generate dust.

Oregon LNG would control surface water flow at the site to prevent transport of cement particles out of the soil mixing area. The small quantity of water used to clean the batch plant would be collected in a lined pond or container for treatment before it is discharged. Some excess soil-cement spoils would be generated and disposed of on site.

Stone columns would be used for ground improvement beneath other building and equipment foundation slabs and would extend 15 feet laterally beyond the outside footprint of the slabs and 32 feet below the ground surface. Stone columns would also be used beneath the flare and portions of the perimeter barrier earthen berm. This ground improvement technique consists of constructing columns of

dense, crushed stone within the soft soil. Stone columns are typically constructed in a triangular pattern with equal spacing between columns. About 300,000 to 450,000 cubic yards of imported crushed rock would be needed for construction. Figure 5 in appendix D shows the areas of ground improvement.

Oregon LNG would also use driven steel pipe piles to support the LNG tanks, pipe rack/spill containment trough, spill containment basins, ground flare, and building and equipment slab foundations. Piles would be driven open-ended.

Facility Installation

One of the most technical aspects of the project would be installation of the LNG storage tanks and associated process and support facilities because specialized materials and construction techniques are necessary. Temporary construction pads would be completed before mobilization of the LNG storage tank components to serve as a laydown and staging area. Most of the equipment and components would be prefabricated and would require additional assembly, placement, and positioning once on site. Major pieces of construction equipment, including high lift and tower cranes, would be required for the erection of LNG storage tanks and other large components.

Each LNG storage tank would rest on a reinforced concrete slab, which would sit on seismic isolators. The isolators would be on an on-ground reinforced concrete slab, which in turn would rest on foundation piles. The 30-inch-diameter driven steel piles would have a 1.25-inch wall thickness and would be about 280 feet long. The base elevation of the LNG storage tanks would be 0.0 feet (NAVD 88).

The outer walls of the LNG storage tanks would consist of prestressed reinforced concrete with a wall thickness of 2 feet, 8 inches. The outside diameter of the outer containment would be about 270 feet. The outer containment walls would be lined with carbon steel plates that would act as a vapor barrier. A carbon steel prefabricated dome roof structure would be erected on top of the concrete tank outer wall to form a weather-protected space inside the concrete outer tank. Cellular glass, load-bearing insulation would be installed beneath the inner containment, which would be a 9 percent nickel-steel tank. The space between the sidewalls of the inner and outer containments would be filled with expanded Perlite® insulation that would be compacted to reduce settling. Concrete would be poured over the steel dome to form the final roof structure.

There would be no penetrations through the inner or outer containment sidewalls or bottoms. All piping would enter from the top of the tank. Internal components consisting of vapor barrier, in-tank pump columns, instrument wells, bottom and top fill pipes, piping for purging and cool down, access ladders, and tank instrumentation would also be installed. Exterior equipment would include roof platforms, walkways, access stairway, emergency escape ladder, and piping.

A concrete wall would be incorporated around the LNG storage tank bottom slab to separate groundwater from surface water. No permanent dewatering of groundwater would be required to maintain stability of the LNG storage tanks.

The grading inside the earthen berm surrounding the LNG storage tank area would slope from just below the top of the LNG storage tank bottom slab wall at elevation 9.5 feet (NAVD 88) to the toe of the barrier berm at elevation 7.7 feet (NAVD 88). A toe drain system would be constructed at the toe of the earthen berm to collect shallow surface water infiltration and runoff from the area between the crest of the berm and the LNG storage tank bottom slab wall. The toe drain would be sized during final design to handle peak surface water events.

The other facilities such as processing areas, pipe racks, control rooms, utility areas, warehouse, instrument buildings, administrative offices, and a security building would be constructed concurrently with the LNG storage tanks. Foundations and pad areas would be established for each facility, and they would be constructed according to local building code requirements.

An earthen berm with a crest ranging in elevation from +22.0 to 27.0 feet (NAVD 88) would be constructed around the LNG storage tanks and process area to prevent inundation from a tsunami.

Final Grading and Site Restoration

Areas disturbed during construction of the terminal would be finish-graded at an elevation of about 18 feet (NAVD 88) using a layer of fill material. Unless covered by equipment, gravel, or other covering, areas disturbed during construction of the terminal site would be restored in accordance with Oregon LNG's SWPPP (see appendix F1). Following construction activities, pervious soil surfaces would be revegetated. Permanent erosion control seeding would be applied to finish grades for stabilization, and vegetation would be selected for compatibility with site conditions, complementarily with adjacent natural plant communities, and consistency with operations at the terminal.

Upland areas would be covered with the nitrogen-fixing seed mixture recommended by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) for soil stabilization. Seeded surfaces would receive balanced fertilizer and mulch to promote germination. The landscaped buffer would be seeded and planted. For freshwater wetlands, temporary impact areas would be rehabilitated on site after construction. Rehabilitation would initially involve seedbed preparation and control of noxious weeds. Some vegetation would regenerate naturally from the seedbank and vegetative propagules. Supplemental hydroseeding and planting would occur to help establish native and woody species.

Hydrostatic/Pneumatic Testing

The inner container of the LNG storage tanks would be hydrostatically tested in accordance with the requirements of API 620 by filling the tank with water, and then pressurizing the tank. Oregon LNG would obtain the hydrostatic test water for the LNG tanks from the City of Warrenton or the Columbia River. Withdrawal of the hydrostatic test water from the Columbia River would require a water right from the OWRD. All water intakes at the terminal would be screened in accordance with NMFS and ODFW fish screening requirements. River water used for hydrostatic testing would be treated for salinity by reverse osmosis. Intake velocities would depend on the reverse osmosis treatment facility capacity and would be about 600 gpm. About 28 million gallons of water would be required to perform the test. On completion of hydrostatic testing of the first LNG tank, the test water would be transferred to the second tank. After the second tank has been tested, about half of the test water would be conveyed to the raw water storage tank and cooling tower basins for reuse, and half would be discharged to the City of Warrenton POTW.

The outer container of each LNG storage tank would be pneumatically tested at a pressure of 1.25 times the design pressure for 1 hour in accordance with API 620.

Piping systems would be tested in accordance with established codes either hydrostatically or pneumatically, as applicable. In general, cryogenic piping would be tested with dry air or nitrogen at 1.1 times the design pressure. Noncryogenic piping would be tested with water at 1.5 times the design pressure.

2.1.4.2 Pipeline and Associated Aboveground Facilities

Construction of the pipeline facilities would primarily involve standard cross-country pipeline construction techniques. Special construction techniques would be used when constructing the pipelines across wetlands; waterbodies; roads and railroads; utilities; and agricultural, residential, commercial, and industrial areas. Rugged terrain also may require special construction techniques.

General Pipeline Construction Techniques

This section describes the typical steps of cross-country pipeline construction. Standard pipeline construction proceeds in the manner of an outdoor assembly line composed of specific activities that make up the linear construction sequence (see figure 2.1.4-1). These operations collectively include survey and staking of the right-of-way, clearing and grading, trenching, pipe stringing and bending, welding and coating, lowering-in and backfilling, hydrostatic testing, and cleanup. For construction, Oregon LNG would divide the pipeline route into four sections, called "spreads" as shown in table 2.1.4-1.

Table 2.1.4-1

Construction Spreads for the Oregon LNG Pipeline

Project Component	Length (miles)	Mileposts	
		Start	End
Construction Spread 1: Warrenton to Nehalem River	33.0	0.0	33.0
Construction Spread 2: Nehalem River to Highway 6	14.5	33.0	47.5
Construction Spread 3: Highway 6 to Columbia River	34.5	47.5	82.0
Construction Spread 4: Columbia River to tie-in	4.8	82.0	86.8

Survey and Staking

Before construction, Oregon LNG's crews would survey and stake the centerline and exterior boundaries of the construction right-of-way. The exterior boundary stakes would mark the limit of approved disturbance areas and would be maintained throughout the construction period. Utility lines would be located and marked to prevent accidental damage during pipeline construction. Oregon LNG would notify affected landowners, regulatory agencies, and other appropriate stakeholders before surveying and staking the proposed route.

Clearing and Grading

Oregon LNG would clear the right-of-way of large obstacles such as trees, brush, and logs. Timber would be removed when necessary for construction purposes. Timber and other vegetative debris may be chipped for use as erosion-control mulch, or otherwise disposed of in accordance with applicable state and local regulations and landowner agreements. Fences would be cut and braced along the right-of-way and temporary gates would be installed to control livestock and limit public access. The right-of-way would then be graded where necessary to create a reasonably level working surface to allow safe passage of construction equipment and materials. Where applicable (e.g., residential lands, agricultural lands, and certain wetlands) conserved topsoil would be stockpiled along one side of the right-of-way, allowing the other side to be used for access, material transport, and pipe assembly. Oregon LNG would install temporary erosion control measures at this time in accordance with its Plan and Procedures.

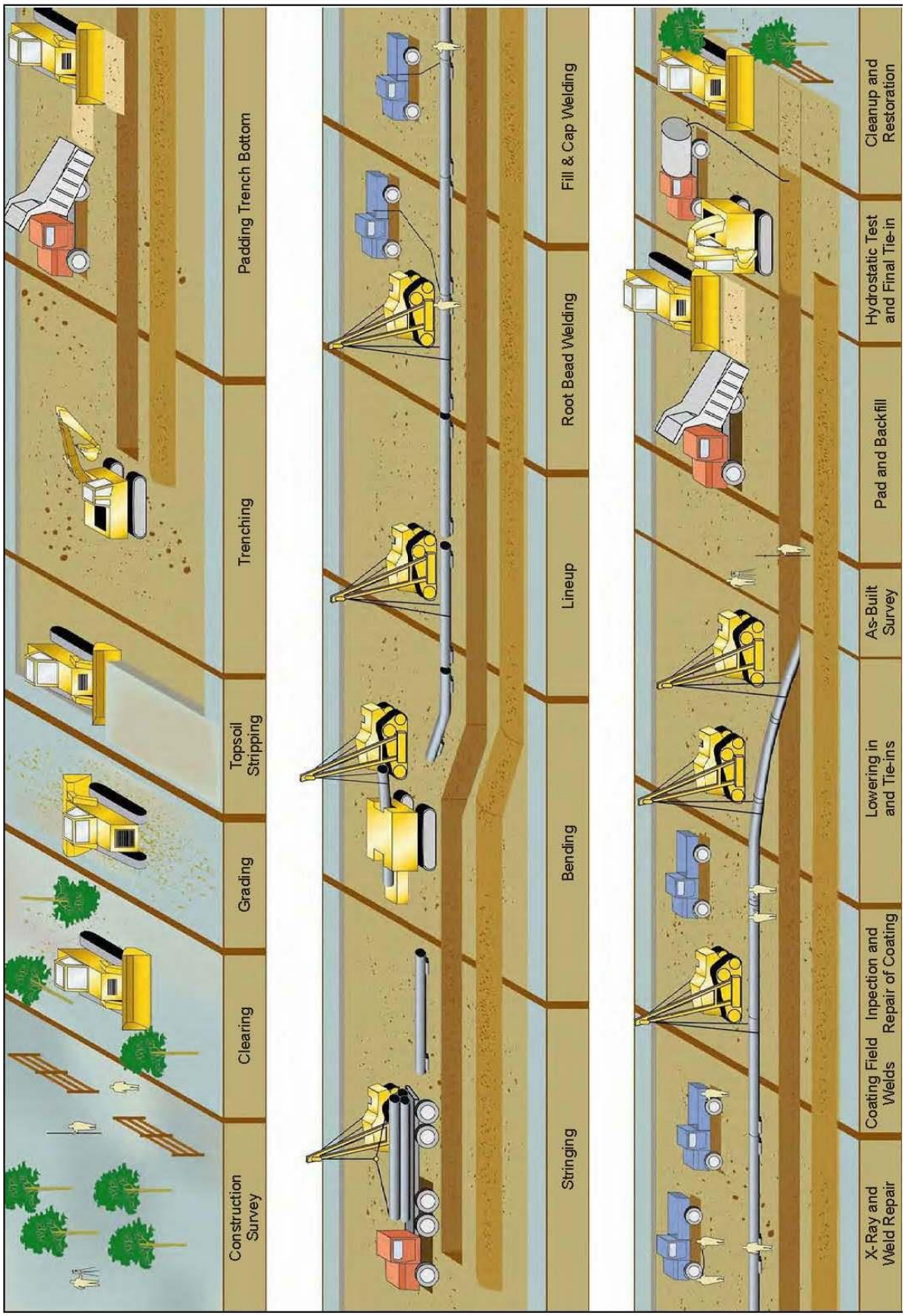


Figure 2.1.4-1: Typical Pipeline Construction Sequence

Trenching

A trenching machine, back-hoe, or similar equipment would be used to excavate a trench in which to install the pipeline. Trenches would typically be excavated to a depth of about 7 feet to provide a minimum 3-foot depth of cover; however, due to specific land uses or landowner agreements, the depth of the trench may vary slightly. The bottom width of the trench would be cut to accommodate the large-diameter pipeline. The width at the top of the trench would vary to allow the side slopes to be adapted to local conditions at the time of construction. The sides of the trench would be sloped for stability and safety.

Spoil material excavated during trenching operations would be temporarily piled to one side of the right-of-way adjacent to the trench. In areas where topsoil stripping is required, the topsoil and subsoil would be stored in separate windrows or piles on the construction right-of-way and would not be allowed to mix.

Stringing and Bending

Either before or after trenching, 40- to 80-foot-long sections (also referred to as joints) of externally coated pipe would be shipped to the pipe storage and contractor yards and then transported to the right-of-way by truck and placed or "strung" along the excavated trench in a single, continuous line, easily accessible to the construction personnel on the working side of the trench, opposite the spoil side. At crossings of waterbodies, wetlands, roadways, and railroads, the amount of pipe required to span the crossing would be stockpiled in temporary staging areas on one or both sides of the crossing.

The pipe would be delivered to the construction right-of-way in straight joints. Some bending of the pipe would be required to allow the pipeline to follow natural grade changes and direction changes of the right-of-way. Selected joints would be bent in the field by track-mounted hydraulic bending machines, as necessary, before welding.

Welding and Coating

After stringing and bending are complete, pipe sections would be placed on temporary supports adjacent to the trench. The ends would be aligned and welded together using multiple passes for a full penetration weld. Only qualified welders would be permitted to perform the welding. To ensure that the assembled pipe meets or exceeds the design strength requirements, Oregon LNG would inspect all welds, both visually and radiographically (i.e., using x-rays), and would make any necessary repairs. Following weld inspection, the previously uncoated ends of the pipe at the welds would be epoxy coated. The coating on the completed pipe section would be inspected and any damaged areas would be repaired.

Pipeline Corrosion Protection and Induced Alternating Current Mitigation

Oregon LNG would install corrosion protection during construction of the pipeline. Short sections of the pipeline would be exposed at the meter stations, pig launching and receiving stations, and compressor station. The aboveground pipeline sections, fittings, and appurtenances would be protected from corrosion using a high performance protective coating, and they would be electrically isolated from the underground pipe and other underground facilities as required.

The corrosion protection system for the buried pipeline would include a high performance protective coating and an impressed-current cathodic protection system. The system would consist of six rectifier stations spaced along the pipeline, each site with access to electrical power. Each station would consist of a rectifier (power source), wiring, and anodes inserted deep into the ground. Additional easement perpendicular to the pipeline would be required at each rectifier station. A drill rig would drill

the holes for placing the deep anodes in the ground beds. Oregon LNG would operate the six stations in unison to protect the pipeline; current would be discharged to the pipeline by way of the deep anodes.

Elevated alternating current (AC) voltages can occur on metallic pipelines that parallel high-voltage power lines or pass near electrical substations. A mitigation system may be required to reduce AC voltages on the pipeline where it parallels a high-voltage power transmission line for 0.2 mile. If required, the induced AC mitigation system would include a combination of electrical grounding components.

Lowering-in and Backfilling

After welding and coating are completed, the pipeline would be lowered into the trench by side-boom tractors and/or back-hoe type equipment. Before lowering the pipeline, the trench would be inspected to ensure it is free of rocks and other debris that could damage the pipeline or the coating.

No construction debris, including wooden supports, welding rods, containers, brush, trees, or refuse of any kind, would be permitted in the backfill. Specially designed backfilling machines would ensure that the subsoil used immediately surrounding the pipeline is free from rocks. Plastic warning tape would be placed above the pipeline and the remaining portion of the trench backfilled by bladed equipment and compacted by wheel rolling. The trench would be backfilled and crowned to about 6 inches above its original elevation to compensate for subsequent settling and/or shrinking of the trench. Where topsoil replacement is required, the topsoil would be spread over topsoil-stripped areas of the permanent right-of-way to bring surfaces up to finish grade.

Hydrostatic Testing

After backfilling, Oregon LNG would hydrostatically test the pipeline in accordance with requirements of pipeline safety regulations in 49 CFR 192 Subpart J, Oregon LNG testing specifications, and applicable permits. This testing would ensure the systems are free from leaks and capable of operating at the design pressure. The testing process involves filling a segment of the pipeline with water and maintaining a prescribed pressure for a specified amount of time. If a leak or break in the line were to occur during testing, Oregon LNG would repair and retest that section of pipe until DOT specifications are met.

A total of about 3.0 million gallons of water would be required for pipeline hydrostatic testing. Oregon LNG would withdraw about 1.5 million gallons from the City of Woodland or the Columbia River at MP 82.0 and another 1.5 million gallons from the Columbia River at RM 11.5 (the terminal location). The water would be supplied via temporary piping connections from the source area or transported by tanker truck. No chemicals would be added to the test water. After completion of the testing, the water would be discharged to the Columbia River at MP 82.0 or RM 11.5. Oregon LNG would analyze the test water before discharge in accordance with its discharge permit. Each segment of the pipeline to be installed by the HDD method would be initially hydrostatically pressure tested separately from the overall pipeline before and after installation in the borehole, then included in the overall pipeline pressure test once all the segments are completed.

After installation, aboveground and below-ground piping for aboveground facilities would be hydrostatically tested prior to operation.

Protection of Forest Lands from Wildfire

Proposed pipeline construction activities would be subject to the wildfire prevention and suppression requirements of ORS Chapter 477 and its associated administrative rules. These requirements include the need to:

- obtain certain permits;
- provide fire prevention equipment on machinery;
- limit or stop work during periods of elevated fire danger;
- provide firefighting tools;
- provide water supplies and pumping equipment;
- provide fire watch personnel;
- suppress wildfires originating from construction activity;
- dispose of debris in a specified manner; and
- accept liability for the state's cost of suppressing wildfires originating from construction activity.

Operation and maintenance activities would be subject to many of these same requirements. In addition, an emergency response plan would be developed for forest lands in case of wildfire caused as a result of construction practices or in the event of a gas leak during pipeline operation.

Cleanup

After a segment of pipeline has been installed, backfilled, and successfully tested, the right-of-way, extra workspaces, and other disturbed areas would be finish graded and the construction debris would be taken to an approved disposal area. Oregon LNG would finish-grade disturbed areas as closely as practical to preconstruction contours. Segregated topsoil would be replaced in residential, agricultural, and wetland areas. Temporary and permanent erosion control measures would be installed at this time. Private and public property, such as fences, gates, drain tiles, driveways, and roads disturbed by the pipeline construction would be restored or repaired.

Revegetation

The restored construction right-of-way, extra workspaces, and other disturbed areas would be revegetated in accordance with Oregon LNG's SWPPP, its Plan, other permit requirements, and site-specific landowner requests. Turf, ornamental shrubs, and other landscaping material would be restored in accordance with individual landowner agreements.

Special Pipeline Construction Techniques

Construction across wetlands, waterbodies, roads and railroads, utilities, agricultural, residential, commercial, and industrial areas, and rugged terrain would require special construction techniques. These techniques are described below.

Wetland Crossings

Oregon LNG would construct its pipeline across wetlands in accordance with its Procedures and applicable permits. A 75-foot-wide construction right-of-way would be maintained in nonagricultural wetlands unless exceptions are required by site conditions, in which case a variance would be sought.

During crossing of dry wetlands where soils are stable enough to support equipment without sinking (e.g., mineral hydric soils), or in wetlands that have already been disturbed to provide sufficient traffic ability, upland construction techniques would be used. Topsoil disturbed by trenching would be segregated from subsoils.

During crossing of saturated wetlands where the soils are too wet (e.g., permanently or semi-permanently saturated) to support pipeline construction equipment, timber mats would be used as necessary to support the construction equipment and minimize impacts to vegetation and minimize soil compaction. Topsoil disturbed by trenching would not be segregated.

Oregon LNG does not anticipate encountering conditions (i.e., permanently or semi-permanently flooded wetlands with standing water) that would require the use of the push/pull technique. If it would be necessary to use push/pull construction techniques, a construction corridor wide enough for only a single tractor to work on timber mats would be used. The trench would be dug and the pipeline would be pulled into place. There would be no passing or working lanes, only room for spoil on each side of the trench with the digging/pulling tractor in the middle.

The HDD construction method described below would be used to cross certain large wetland areas. In general, HDD is limited in application and dependent on critical wetland characteristics, including subsurface lithology, crossing length, burial depth, sediment composition, bank conditions, and access. No vegetation would be cleared between HDD entry and exit points.

During construction, vegetation would be manually cleared throughout the entire 75-foot-wide construction right-of-way. In general, there would be no grubbing and the root systems would be left intact except for a strip 10-foot-wide directly over where the pipe would be installed. Grading and pulling of tree stumps would be limited to the area directly over the trench line unless additional grading or stump removal would be required for worker safety. Buffers would be clearly marked in the field during construction activities. Operation of construction equipment in wetlands would be limited to that needed to dig the trench, fabricate the pipe, install the pipe, backfill the trench, and restore the right-of-way. Temporary erosion and sedimentation control measures would be installed immediately after the initial disturbance of wetland soils.

Following construction, all wetlands would be rehabilitated to preconstruction soil and hydrology conditions, and revegetated. Operational vegetation maintenance activities would preclude forested wetlands in a 30-foot-wide corridor, and shrub-scrub wetlands from a 10-foot-wide corridor centered over the pipeline.

Waterbody Crossings

A total of 184 waterbodies, including 96 perennial, 87 intermittent, and 1 classified by Oregon LNG as perennial/intermittent would be crossed by the pipeline. The waterbodies that would be crossed and the crossing methods that would be used are listed in appendix G1. Oregon LNG would cross all waterbodies in accordance with its Plan and Procedures, as well as applicable permits. Crossing methods for each waterbody were determined based on field surveys, review of fisheries data, and preconsultation meetings with NMFS and the FWS. The waterbody crossing methods that Oregon LNG proposes to use are flume, dry open cut, and HDD.

The waterbody volume and velocity and available backfill materials would be considered in establishing the depth of cover over the pipeline in each waterbody to minimize the potential for scour and the ultimate exposure of the pipeline.

Flume

Oregon LNG would use the flume method to cross flowing perennial or intermittent and ephemeral waterbodies between 0 and 30 feet in width that are coldwater fisheries and perennial waterbodies that may not be fish-bearing but are tributaries to fish-bearing waterbodies. The flume method (see figure 2.1.4-2) is a standard dry waterbody crossing construction method that involves diverting the flow of water across the trenching area through one or more flume pipes placed in the waterbody. The first step in the flume crossing method would involve placing a sufficient number of adequately sized flume pipes in the waterbody to accommodate the highest anticipated flow during construction. Before installing the flume pipe at the waterbody, it would be inspected to ensure it is free of dirt, grease, oil, or other pollutants. The pipe would be steam-cleaned, if necessary, to remove any oil or grease present before placement in the waterbody.

After placing the pipe in the waterbody, sand or pea gravel bags, water bladders, or metal wing deflectors would be placed in the waterbody upstream and downstream of the trench area. These devices would serve to dam the waterbody and divert the water flow through the flume pipes, thereby isolating the water flow from the construction area between the dams. Several measures would be taken to minimize short-term increases in turbidity during dam construction, including: 1) all in-water work would be carried out on foot and no equipment would operate in the streambed; 2) sandbags would be filled with a nonleachable material such as clean, prewashed sand; 3) sandbags would be tied securely before they are installed; and 4) sheets of plastic would be interwoven between the layers of sandbags to ensure an effective seal. Leakage from the dams or subsurface flow from below the waterbody bed may cause water to accumulate in the isolated area. If necessary, the accumulated water would be periodically pumped out and discharged into energy dissipation/sediment filtration devices, such as a geotextile filter bag or straw bale structure, or into well-vegetated areas away from the water's edge.

Track hoes on both banks of the waterbody would excavate a trench under the flume pipe in the dewatered streambed. Spoil excavated from the waterbody trench would be placed or stored a minimum of 25 feet from the edge of the waterbody. Once the trench is excavated, the prefabricated segment of pipe would be installed beneath the flume pipes. The trench would then be backfilled with native spoil from the waterbody bed. Immediately following pipe installation and backfilling, and before removing the dams and flume pipes and returning flow to the waterbody channel, the streambanks would be reestablished to approximate preconstruction contours and stabilized. The top 12 inches of substrate would be segregated during each crossing and returned. If additional material is needed, matching material would be utilized.

Erosion and sediment control measures would be installed across the construction right-of-way to reduce streambank and upland erosion and sediment transport into the waterbody. Sediment barriers, such as silt fence and/or straw bales or drivable berms would be maintained across the right-of-way at all waterbody approaches until permanent vegetation is established. After backfilling and major grading work are complete, any drivable berms would be removed and the ground surface returned to original contours. If a sediment control device is still needed at a location where a drivable berm was removed, a temporary sediment control device such as silt fencing would be installed. Equipment bridges would be removed when construction and restoration are completed.

If no fish are present in the waterbody, the crossing method may be modified with a dam and pump arrangement. This method is similar to the flume crossing method except that pumps and hoses would be used instead of flumes to move water across the construction work area. Pumps would be set up at the upstream dam with the discharge line routed through the construction area to discharge water immediately downstream of the downstream dam. An energy-dissipation device at the discharge location prevents scouring of the streambed.

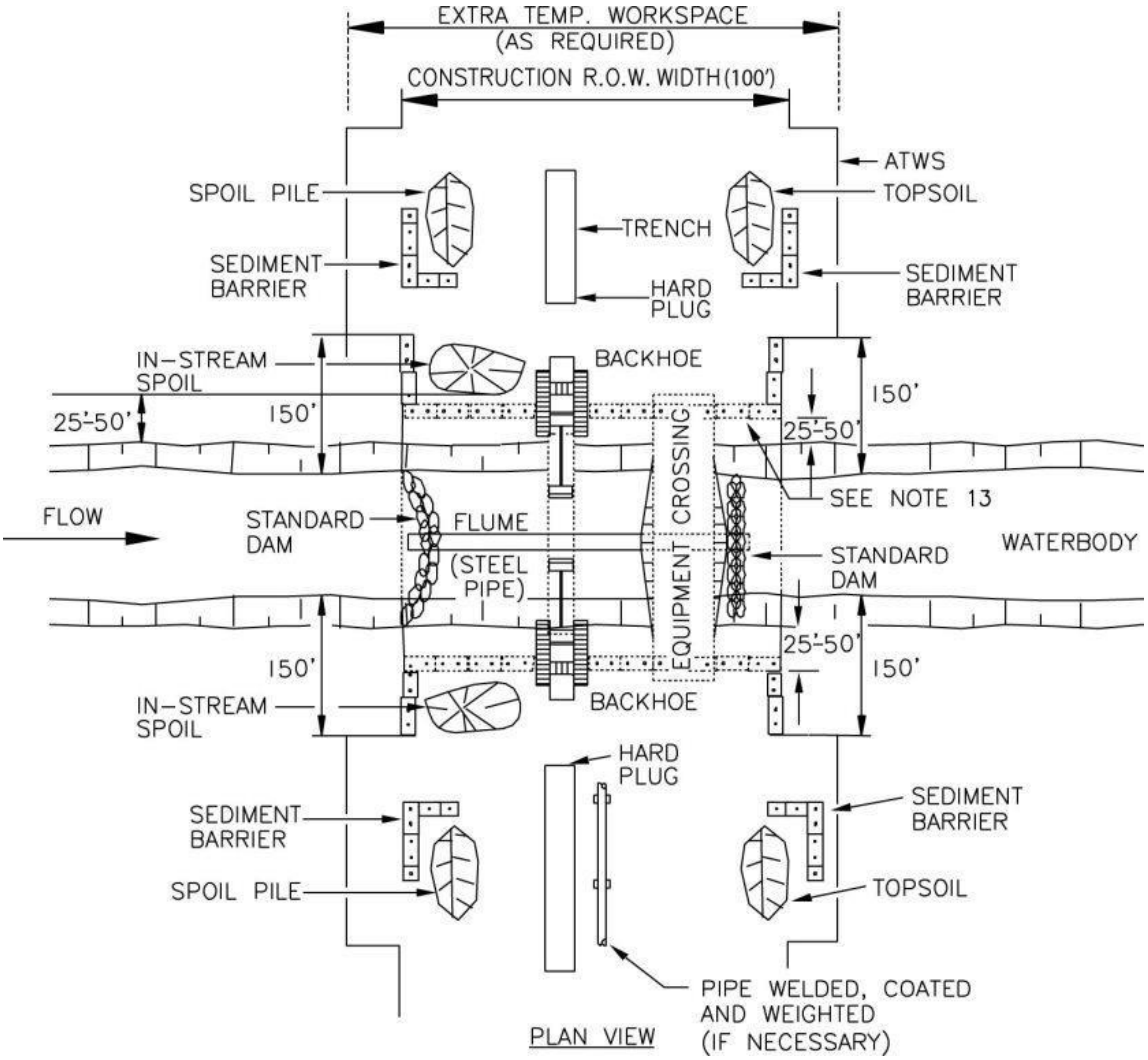


Figure 2.1.4-2: Flume Waterbody Crossing Method

Open-Cut Trench

This method would be used to cross intermittent and ephemeral waterbodies that are not fish-bearing and to cross fish-bearing intermittent or ephemeral waterbodies if dry at the time of construction. Perennial waterbodies that are minor, non-fish-bearing, and not a direct tributary to a fish-bearing waterbody may also be crossed by this method. Figure 2.1.4-3 shows the details of a typical open-cut trenched crossing method.

The top 12 inches of substrate would be segregated for each crossing and returned. If additional material is needed, matching material would be used. Oregon LNG would install erosion and sediment control measures across the construction right-of-way to reduce streambank and upland erosion and sediment transport into the waterbody. Sediment barriers, such as silt fence and/or straw bales or drivable berms would be maintained across the right-of-way at all waterbody approaches until permanent vegetation is established. After backfilling and major grading are complete, Oregon LNG would remove any drivable berms; restore the original ground surface contours; and install temporary sediment control devices such as silt fencing, as needed. Equipment bridges would be removed when construction and restoration are completed.

Additionally, Oregon LNG would follow these measures included in its Procedures:

- limit the use of the equipment operating in the waterbody to only the needed equipment;
- complete trenching and backfilling within 24 continuous hours for minor waterbodies and 48 hours for intermediate waterbodies;
- return the waterbody to its preconstruction contours;
- stabilize channel banks and install temporary sediment barriers within 24 hours after completing the crossing; and
- revegetate disturbed riparian areas.

Horizontal Directional Drilling

Oregon LNG would cross selected wetlands, waterbodies, dikes, and roads using the HDD construction method. The HDD technique involves drilling a pilot hole under the resource to be crossed, then enlarging that hole through successive reamings until the hole is large enough to accommodate the pipe. Throughout the process of drilling and enlarging the hole, a slurry made of naturally occurring nontoxic materials, such as bentonite clay and water, is circulated through the drilling tools to lubricate the drill bit, remove drill cuttings, and hold the hole open. This slurry is referred to as drilling mud. Pipe sections are staged and welded together to form a segment long enough to span the entire crossing (the pull string) along the construction work area on the exit side of the HDD crossing and then pulled back through the drilled hole. Figure 2.1.4-4 shows a conceptual HDD waterbody crossing.

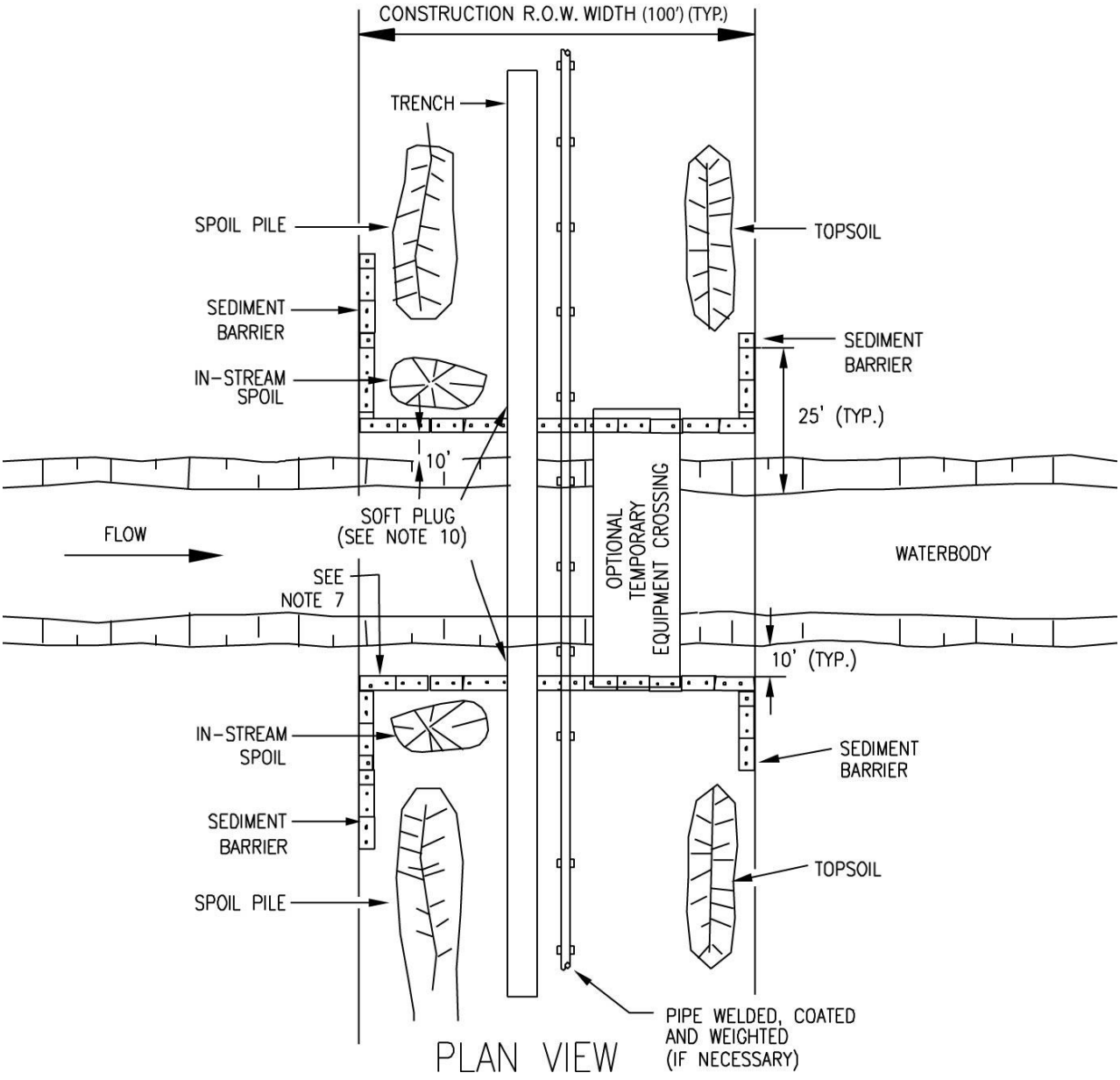


Figure 2.1.4-3: Open-cut Waterbody Crossing Method

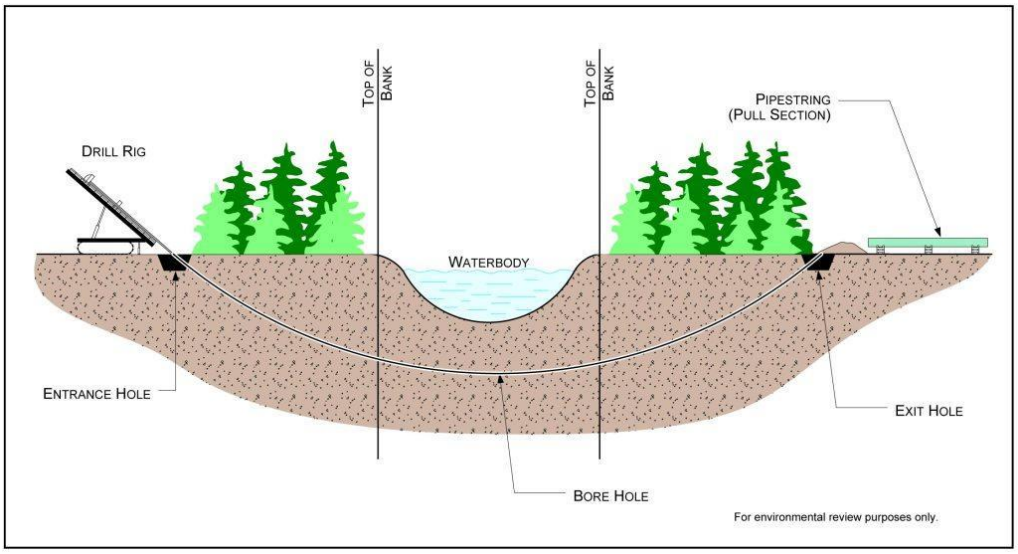


Figure 2.1.4-4: Conceptual Horizontal Directional Drill Waterbody Crossing

Table 2.1.4-2 lists the HDD crossing locations proposed for the Oregon LNG Project.

Table 2.1.4-2

Horizontal Directional Drilling Locations for Oregon LNG Pipeline

HDD Location	Milepost		Approximate Crossing Length (feet)
	Start	End	
Levee at MP 0.3	0.3	0.6	1,450
Hwy 101 and Adair Slough at MP 1.0	0.9	1.2	1,480
Lewis and Clark River at MP 3.0	2.8	3.4	2,950
Lewis and Clark River at MP 5.0	5.0	5.5	2,450
Lewis and Clark River at MP 5.5	5.6	6.0	2,100
Lewis and Clark River at MP 11.0	10.9	11.2	1,320
Nehalem River at MP 33.5	33.3	33.7	2,010
Hwy 26 at MP 41.0	40.9	41.3	1,910
Hwy 26 at MP 43.5	43.1	43.6	2,920
Rock Creek at MP 57.5	57.5	58.1	3,000
Nehalem River at MP 64.0	63.6	64.3	3,370
Columbia River at MP 82.5	81.9	82.8	5,030

The HDD method avoids direct impacts on waterbodies but HDD operations potentially pose a risk to wetlands and waterbodies through inadvertent releases of drilling fluid. An inadvertent release occurs when the drilling fluid is transmitted beyond the borehole through fractured bedrock and sands. The drilling fluid may then enter a wetland or waterbody. Oregon LNG's contingency plan for inadvertent releases (see appendix F1) provides specific preventive and mitigative measures to be used by Oregon LNG and its contractors during HDD installation. For example, Oregon LNG has indicated that the ratio of the water to bentonite mixture would be adjusted to match the conditions of the subsurface. The pressure levels would be set as low as possible, and they would be closely monitored to ensure that the pressure on the drilling fluid is set to match the formation. The contingency plan for inadvertent

releases is a preliminary plan, and more specific procedures would be developed during final design for each location based on site-specific conditions.

Conventional Bore Method

The conventional bore method is similar to the HDD method in that the pipeline is installed beneath a feature without surface disturbance to the feature during the crossing. The bore method differs in that the path of the pipeline across the feature is straight rather than curved. Also, the maximum length of a bore (hundreds of feet) is much less than the maximum length of an HDD borehole (thousands of feet). Bores are frequently used at paved road and railroad crossings and are not a common crossing method for waterbodies primarily because of the difficulty in managing groundwater during the installation. Oregon LNG would use a bore to cross the dike on the east side of the Columbia River in Cowlitz County, Washington.

Boring requires excavation of pits on each side of the feature. Boring operations require relatively large work areas, and well points or pumping for continuous dewatering operations, and may require continuous spoil/slurry processing throughout construction of the crossing. During a standard boring operation, spoil from the bore would be carried into the pit as the crossing is being completed and then removed by track hoes to provide room for the pipe to be welded and eventually pulled through the borehole. The operator for the boring machine, welders, and several laborers would work in the bore pit. Trench boxes or sheet piling may be used to support the pit walls and help cut off groundwater inflows. Dewatering systems using deep wells or well points are frequently employed. The specific type of bore (e.g., jack and bore, slick bore, hammer bore) that would be used in a given area depends on the construction site characteristics, the type of soils present, and the contractor's familiarity with available methods.

Roadway and Railroad Crossings

Oregon LNG would use the HDD or bore method to cross most paved roadways and railroads along the pipeline route. Both of these methods would proceed as discussed above. Additional temporary workspace would be used at these crossings to accommodate the increased amount of spoil resulting from the need to excavate a deeper trench. Unsurfaced roads with limited traffic may be trenched after appropriate consultation with affected counties or agreement by owners in accordance with existing regulations. After construction, these roads and driveways would be restored. If an open-cut road crossing requires extensive construction time, Oregon LNG would make provisions for temporary detours or other measures to allow safe traffic flow during construction.

The pipeline would be buried to a depth of 4 to 5 feet below road surfaces or ditch line and would be designed to withstand anticipated external loadings. ODOT has a design requirement that pipelines running parallel to the highway within the right-of-way be installed with a minimum cover of 10 feet. Oregon LNG would work with ODOT to get "special acceptance of a lesser amount," because placing the pipe at this depth would increase impacts from the extra construction right-of-way width and ATWS required to handle the extra spoil and to safely work within and along the pipe trench.

Utility Crossings

Because of the relatively large size of the proposed pipeline and the soil cover and separation requirements, Oregon LNG would cross under most other pipelines and utilities. Oregon LNG would use the HDD or bore method to cross pipelines and utility lines along the route of the pipeline. Additional temporary workspace would be used at these crossings to accommodate the increased amount of spoil resulting from the need to excavate a deeper trench, and to prevent spoil and construction equipment from being placed over the existing pipelines. Oregon LNG has committed to following established

notification and construction protocols so that existing pipelines and utilities are not damaged during construction of its pipeline.

Agricultural Areas

Oregon LNG would conserve topsoil in active croplands, pastures, and hayfields in accordance with its Plan and Procedures and Agricultural Impact Mitigation Plan (see appendix F2), unless the landowner requests otherwise. Topsoil typically would be stripped over the pipeline trench and the adjacent subsoil storage area. In these agricultural areas, Oregon LNG would segregate topsoil down to the lower limit of the soils "A" horizon or to a depth of 24 inches, whichever is less. During construction in areas where the topsoil is segregated, the stripped topsoil would be stored separately to reduce further disturbance. The stripped topsoil would not be allowed to mix with trench spoil, cut-and-fill materials, rock, construction debris, excavated materials, or other subsoil. Following backfilling, grading, and subsoil decompaction, the stripped topsoil would be returned to its original position.

Residential Areas

Oregon LNG's proposed construction work area (i.e., construction right-of-way and additional work areas) would be within 50 feet of two residences. The locations of these residences and Oregon LNG's site-specific residential construction plans are discussed in detail in section 4.1.9. In general, where residences are within 50 feet of the edge of the construction work area, Oregon LNG would reduce the construction workspace to the extent practicable to minimize inconvenience to property owners. Oregon LNG would segregate a maximum of 12 inches of topsoil in the unpaved portions of residential areas, unless the landowner requests otherwise.

After construction, the property would be restored as requested by the landowner, provided it would not interfere with Oregon LNG's standards regarding right-of-way restoration and maintenance and would be compatible with existing regulations. Property restoration would be in accordance with any agreements between Oregon LNG and individual landowners.

Rugged Terrain

Portions of the pipeline route would cross rugged terrain, consisting of steep slopes and rolling terrain that would require the use of cross-right-of-way leveling construction techniques to provide safe working conditions. Oregon LNG would cut material from the uphill side of the construction right-of-way and use the removed material to fill the downhill side of the construction right-of-way, providing a safe and level surface for travel lanes and equipment operation, also referred to as side-hill construction. The ditch would then be excavated from the newly graded right-of-way. In general, Oregon LNG has determined that an extra 50 feet of extra workspace would be needed at most locations where this technique would be used. Following pipeline installation and trench backfilling, the removed material would be replaced and slopes restored to original contours. Steep slopes may also require the installation of special erosion control measures, including trench breakers, slope breakers, interception dikes, and erosion control mats to prevent the movement of disturbed soil off the right-of-way. Oregon LNG would stabilize slopes in accordance with its Plan.

Blasting

Although the pipeline would cross shallow igneous and sedimentary rock, Oregon LNG does not anticipate using blasting for construction of the project. Most areas crossed by the pipeline contain unconsolidated sediments or soft sedimentary rock that can be excavated with conventional track hoe methods. Areas containing fractured, faulted, or weathered metamorphic or volcanic rocks generally can be excavated with ripping, and harder rocks can be excavated using a rock hammer that is attached to a track hoe to break up the rock. Prior to construction, Oregon LNG would conduct a geotechnical

investigation to better identify locations where bedrock could be encountered and to obtain information on the hardness and competency of the rock.

Associated Aboveground Facilities

Construction of the aboveground facilities associated with the pipeline would occur concurrently with construction of the pipeline, but by separate crews. Construction of the meter stations, MLVs, compressor station, and pig launching and receiving facilities would begin with clearing and grading the sites and leveling and compacting the soils for the placement of foundations. Fences would be constructed around the sites. Prefabricated sections of pipe and other equipment would be assembled and welded, if necessary, on site. New reinforced concrete foundations would be installed for the new metering equipment, pigging facilities, and buildings. Forms would be set, rebar installed, and the concrete poured and cured in accordance with applicable industry standards. Backfill would be compacted in place, and excess soil would be used elsewhere or distributed around the site to improve grade.

Noise abatement equipment and emission control technology would be installed as necessary. Aboveground and belowground piping would be installed and hydrostatically tested before operation. Metering equipment would be delivered to the site by truck, unloaded using cranes, front-end loaders, or both, and positioned on the foundations, leveled, grouted where necessary, and secured with anchor bolts. After installation, all controls and safety equipment and systems, including emergency shutdown, relief valves, and gas and fire detection equipment, would be checked and tested, before being placed in service. Roads and parking areas would be constructed using gravel fill. Once construction is complete, the disturbed areas of the sites that are not covered with foundations or gravel would be finish-graded and seeded.

2.1.5 Construction Schedule

No work would begin until all required permits and approvals are in place. Oregon LNG indicates that it would require about 48 months to complete design and construct the proposed facilities. Construction of the pipeline and associated aboveground facilities would take about 18 months, including 9 months for the compressor station. Construction of the terminal facilities would take about 41 months. The schedule for start of construction is dependent on Oregon LNG receiving necessary authorizations and permits. Operations would begin about 4 years after the start of construction.

2.1.6 Environmental Compliance Inspection and Mitigation Monitoring

In preparing construction drawings and specifications for the project, Oregon LNG would incorporate mitigation measures identified in its application as well as requirements of federal, state, and local agencies. Contractors would also be provided copies of and be trained in applicable environmental permits. Oregon LNG would conduct training for its construction personnel regarding proper field implementation of its Plan and Procedures, SWPPP, and other mitigation measures. Environmental training would be conducted before and during construction.

Oregon LNG would be represented on each pipeline construction spread by a Chief Inspector, who would be responsible for quality assurance and compliance with mitigation measures, other applicable regulatory requirements, and company specifications. The Chief Inspector would be assisted by one or more craft inspectors and three or more Environmental Inspectors (EI) per spread during construction of the pipeline. The EIs would have stop-work authority and would report directly to the Chief Inspector and Oregon LNG's Environmental Project Manager. The EIs responsibilities are outlined

in Oregon LNG's Plan and Procedures, and include overseeing compliance with: 1) the environmental conditions of FERC's Order, 2) the mitigation measures proposed by Oregon LNG (as approved and/or modified by FERC's Order), 3) stipulations of other environmental permits and approvals, and 4) environmental requirements in landowner right-of-way agreements. The EIs would also verify that construction limits and sensitive areas are marked and maintain compliance records.

In addition, FERC staff would conduct periodic inspections to monitor the project for compliance with the Commission's environmental conditions and project mitigation measures proposed by Oregon LNG or required by the regulatory agencies. Oregon LNG has indicated that it would fund third-party environmental compliance monitoring during construction. The third-party compliance monitors would represent FERC and would be on-site daily during project construction and restoration.

Finally, other federal, state, and local agencies with jurisdiction or permitting authorities would conduct oversight inspections and monitoring to the extent deemed necessary by those agencies to meet their regulatory responsibilities.

2.1.7 Operation and Maintenance Procedures

2.1.7.1 Terminal Facilities

Oregon LNG would operate and maintain its terminal facilities in compliance with 49 CFR 193 Subparts F and G and Chapter 11 of NFPA 59A, 33 CFR 127, and other applicable federal and state regulations. Before beginning operation of the terminal, Oregon LNG would prepare and submit operation and maintenance manuals that address specific procedures for the safe operation and maintenance of the LNG storage and processing facilities. Oregon LNG would also prepare an operations manual that addresses specific procedures for the safe operation of the ship loading/unloading facilities in accordance with 33 CFR 127.305. Operating procedures would address normal operations as well as safe startup, shutdown, and emergency conditions. Oregon LNG would develop a Terminal Security Plan in accordance with 33 CFR 105 and 49 CFR 193. This plan would describe access control, security inspections and patrols, liaisons with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning systems.

All operations and maintenance personnel at the terminal would be trained to properly and safely perform their assignments. The terminal operators would be trained in LNG safety, cryogenic operations, and the proper operation of respective terminal control equipment. The operators would be required to meet all the training requirements of the DOT, Coast Guard, and other applicable regulatory entities. Operating personnel would be on duty at the terminal 24 hours per day, 7 days per week. A full-time dedicated berth operator would be present at the unloading and loading platform area or platform control room during unloading and loading operations.

Oregon LNG would maintain a full-time maintenance staff to perform routine maintenance and minor overhauls at the terminal. Major overhauls and major maintenance activities would be handled by trained and qualified contract personnel.

Maintenance dredging of the berth and turning basin would be expected every 3 years with a volume of about 300,000 cubic yards per dredging event. During project operation, Oregon LNG would determine the need for maintenance dredging by monitoring sedimentation of the turning basin. Dredging activities would occur 24 hours per day during the seasonal dredging period. Assuming the same rate of dredging proposed for the initial dredging of the turning basin (i.e., 1.2 million cubic yards in about 4 months), we estimate 30 days would be required per maintenance dredging event.

2.1.7.2 Pipeline and Associated Aboveground Facilities

The pipeline and associated aboveground facilities would be operated and maintained in accordance with 49 CFR 192, as required by the DOT. Oregon LNG would develop an emergency response plan for the pipeline to address procedures to be followed in the event of an emergency along the pipeline. This plan would include training of employees on emergency procedures, establishing liaisons with appropriate fire, police, and other community officials, and informing the public on how to identify and report an emergency condition along the pipeline route. Section 4.1.13.10 presents a discussion of the DOT's safety regulations and requirements for natural gas pipelines and describes how these requirements would be met by Oregon LNG.

Oregon LNG would inspect the pipeline regularly by aerial patrols or on-the-ground personnel to observe general right-of-way conditions and to identify any indications of soil erosion that may expose the pipe, stressed vegetation that may indicate a leak in the line, damage to erosion-control structures, unauthorized encroachment onto the right-of-way, and other conditions that could present a safety hazard or require preventive maintenance or repairs. All inspections would be in accordance with DOT standards. Appropriate responses to conditions observed during the periodic inspections would be taken as necessary.

The aboveground facilities would be inspected at intervals that meet DOT requirements. Pipeline personnel would perform routine checks of the facilities, including calibration of equipment and instrumentation, inspection of critical components, and scheduled and routine maintenance of equipment. Safety equipment, such as pressure-relief devices, fire detection and suppression systems, and gas detection systems, would be tested for proper operation. Corrective actions would be taken for any identified problem.

The natural gas in the pipeline would not be odorized. Although distribution pipelines are required to be odorized, transmission pipelines are not, as described in 49 CFR 192.625, "Odorization of Gas." This regulation states that a transmission pipeline is only required to be odorized in Class 3 and Class 4 locations, unless at least 50 percent of the length of the pipeline downstream from the Class 3 and Class 4 locations is in a Class 1 or Class 2 location. More than 50 percent of the length of the Oregon LNG pipeline is in a Class 1 or Class 2 location and is therefore not subject to odorization of gas.

2.1.8 Future Plans and Abandonment

Oregon LNG states that the terminal has a minimum life expectancy of 60 years. Oregon LNG has a 65-year lease for the terminal that began in 2004. Any future abandonment would be subject to the appropriate environmental and nonenvironmental review based on federal, state, and local regulations in effect at that time.

We received comments asking that Oregon LNG provide bonds to cover construction mishaps or retirement of facilities. In June 2009, Oregon LNG filed with FERC an MOU it had completed with the ODE to address safety issues, financial arrangements and future retirement or abandonment of the import facilities. The 2009 MOU is being replaced with two stand-alone MOUs for the import/export project. One MOU was completed August 15, 2014 and addresses development of an emergency planning and preparedness program for the terminal (see appendix C2). The second MOU is expected to address carbon dioxide (CO_2) emissions and financial obligations for facility retirement.

The pipeline would be configured for a potential interconnection with the 24-inch-diameter NW Natural South Mist Pipeline Extension (South Mist Extension) near MP 63.5. If the tie-in facilities were

implemented, they would include isolation block valves and a meter station. The potential future interconnect with the South Mist Extension is not part of the Oregon LNG Project, and no future project is defined to-date. Before any expansion of its facilities, Oregon LNG would be required to seek the appropriate authorization from FERC. FERC would conduct a separate environmental analysis under NEPA before authorizing an expansion of Oregon LNG's facilities.

2.2 WASHINGTON EXPANSION PROJECT

Northwest proposes to expand the capacity of its existing natural gas transmission facilities along the I-5 corridor between Woodland and Sumas, Washington. Northwest would accomplish the expansion by constructing and operating 140.6 miles of 36-inch-diameter loop in 10 noncontiguous segments adding compression facilities to five existing compressor stations. Northwest would also upgrade metering facilities and other associated support facilities and abandon compressor equipment and a meter station by removal. An overview map of the project is shown on figure 1.2-1.

2.2.1 Project Components

2.2.1.1 Pipeline Facilities

The existing Northwest Pipeline between Sumas and Woodland consists of a contiguous 30-inch-diameter pipeline and eight noncontiguous 36-inch-diameter loops that were constructed as part of the Capacity Replacement Project in 2006 and the Evergreen Expansion Project in 2003. The eight existing 36-inch-diameter loops were mostly constructed in a common right-of-way with the 30-inch-diameter pipeline. The common right-of-way also includes an abandoned 26-inch-diameter pipeline that has been partially removed.

In most cases, the WEP pipeline would be installed parallel to the 30-inch-diameter pipeline in areas where the existing 36-inch-diameter pipeline is not present. The majority of the pipeline would be installed within the trench of the existing, previously abandoned 26-inch-diameter pipeline, which would be removed. The proposed loops are listed from south to north in table 2.2.1-1. Maps showing the loops and existing access roads that would be used during construction are provided in appendix I1.

The pipeline would be designed for a capacity of 750,000 Dth/d and a MAOP of 960 psig.

Following construction of the new 36-inch-diameter loops for the WEP, there would still be gaps in Northwest's 36-inch-diameter pipeline. One gap would be north of the Chehalis Compressor Station where installation of the 36-inch-diameter pipeline is not necessary to meet minimum flow and pressure requirements. A second gap would occur at the Green and White Rivers as a result of geotechnical and topographical risks identified on previous Northwest projects. To compensate for this gap in the system, Northwest would add more compression at existing compressor stations as part of the WEP. Finally, at the Skagit River, the Mt. Vernon North A Loop would not cross the river but would tie into the existing 30-inch-diameter pipeline using the existing aerial span.

From south to north, the following sections provide additional details for each of the ten proposed loops.

Table 2.2.1-1

WEP Loops

Loop	County	Milepost Range by County	Length (Miles) [a]
Woodland	Cowlitz	1244.3 – 1279.3	35.1
	Lewis	1279.3 – 1289.5	10.2
Woodland Loop Subtotal			*45.3*
Chehalis	Lewis	1291.3 – 1307.2	15.9
	Thurston	1307.2 – 1315.6	8.4
Chehalis Loop Subtotal			*24.3*
Sumner South	Pierce	1338.0 – 1351.8	13.8
Sumner North A	King	1356.9 – 1363.9	7.0
Sumner North B	King	1370.9 – 1381.9	11.0
Snohomish	Snohomish	1393.8 – 1409.4	15.6
Mt. Vernon South	Skagit	1435.7 – 1440.2	4.5
Mt. Vernon North A	Skagit	1440.2 – 1445.0	4.8
Mt. Vernon North B	Skagit	1453.5 – 1461.9	2.9
	Whatcom	1456.4 – 1461.9	5.5
Mt. Vernon North B Loop Subtotal			*8.4*
Sumas	Whatcom	1478.6 – 1484.5	5.9
Project Total			**140.6**

[a] Due to rounding, differences between mileposts may not equal length.

Woodland Loop

This 45.3-mile-long loop begins at the interconnection with the Oregon LNG pipeline in Woodland and terminates at the Chehalis Compressor Station, crossing both Cowlitz and Lewis Counties. For most of this route, the loop would be installed in the same trench of the abandoned 26-inch-diameter pipeline parallel and to the west of the existing 30-inch-diameter pipeline. From the interconnection, the route would head north through rugged terrain on Green Mountain. To cross the Kalama River at MP 1253.4,[5] the abandoned 26-inch-diameter pipeline would be removed from the aerial span and the supports would be retrofitted to hold the new 36-inch-diameter pipeline. North of the Kalama River, the route would go through more steep slopes before entering the floodplain of the Coweeman River and crossing the river at MP 1260.5. Continuing north, the pipeline would cross hilly terrain roughly parallel to I-5 and would pass to the east of Castle Rock, continuing through steep slope areas and side slopes. The route would cross under SR 504 and continue north to the Toutle River floodplain. The loop would diverge from the existing right-of-way at MP 1274.2 and cross the Toutle River at MP 1274.4. The alignment would rejoin the existing right-of-way at MP 1275.9, cross steep terrain along Wilkes Hills, and enter into Lewis County. The route would cross under the Cowlitz River at MP 1282.5 and proceed north through 6 miles of relatively flat topography until reaching the Chehalis Compressor Station.

[5] Mileposts are based on the WEP 36-inch-diameter pipeline with initial takeoff reference points for each loop from the existing 30-inch-diameter pipeline.

Chehalis Loop

The route of this 24.3-mile-long loop would begin south of Koontz Road, about 2 miles north of the Chehalis Compressor Station, and end at the existing 36-inch-diameter loop about 0.5 mile north of the Deschutes River and 0.2 mile south of Vail Loop Road SE, travelling through Lewis and Thurston Counties. For most of the Chehalis Loop, the pipeline would be installed in the abandoned 26-inch-diameter pipeline trench on the west side of the existing 30-inch-diameter pipeline.

Near MP 1293.9, just south of Pier Road, the route would diverge from the 26-inch-diameter pipeline trench and existing right-of-way to position for crossing the Newaukum River at MP 1294.1 and rejoin the right-of-way just to the north of the river. The loop would diverge from the 26-inch-diameter pipeline trench twice within mile 1309. Just south of the Skookumchuck River, the route would diverge farther to the west of the existing right-of-way and cross the river at MP 1309.4 before resuming the pipeline alignment within the existing right-of-way. At Skookumchuck Road, the loop would leave the 26-inch-diameter pipeline alignment and turn east to parallel the road and 30-inch-diameter pipeline for about 0.3 miles before crossing to the east side of the existing 30-inch-diameter pipeline where the alignment of both pipelines would turn to the northeast and continue parallel to a BPA transmission line right-of-way until rejoining the 26-inch-diameter pipeline alignment on the west side of the BPA right-of-way. The route would generally follow the BPA right-of-way over steep terrain in the area of Vail Mountain. After descending the mountain area, the pipeline would cross under the Deschutes River at MP 1315.1 before ending at the start of the existing 36-inch-diameter pipeline in Ruth Prairie near the end of 160th Lane SE.

Sumner South Loop

The 13.8-mile-long Sumner South Loop would be located in Pierce County, beginning near the Boeing facility in Fredrickson and terminating at the Sumner Compressor Station. From the tie-in with the existing 36-inch-diameter pipeline, the loop would be installed in the abandoned 26-inch-diameter pipeline trench for the majority of the route. Before crossing 176th St E, Puyallup, Washington, the loop route would leave the 26-inch-diameter pipeline alignment for about 600 feet before reconverging and continuing northeasterly. Before reaching the Puyallup River, the loop would diverge from the existing 30-inch-diameter pipeline and abandoned 26-inch-diameter pipeline right-of-way and cross the river at MP 1348.0. On the north side of the river the loop would converge again with the other pipelines and continue within the 26-inch-diameter pipeline trench until diverging again where the 30-inch-diameter pipeline crosses SR 410. The route would continue along the south side of SR 410 for about 800 feet and then cross to the north side, reconverge with the 30-inch-diameter pipeline, and return to the trench of the 26-inch-diameter pipeline. The alignment would continue to the northeast before ending at the Sumner Compressor Station. The route for this loop would pass through wooded and agricultural areas as well as stretches of dense residential and industrial development.

Sumner North Loop A

This 7.0-mile-long loop would be located in King County between the Green River and the existing 36-inch-diameter Evergreen Covington Loop. The route would begin at Green Valley Road in the City of Auburn, north of the Green River. The loop would be installed west of the existing 30-inch-diameter pipeline within the 26-inch-diameter pipeline trench, except for north of Cranmar Creek and south of SR 516 where the loop would remain on the west side of the 30-inch-diameter pipeline and not follow the 26-inch-diameter trench in order to avoid crossing the 30-inch-diameter pipeline twice within about 400 feet. The loop traverses varied terrain while crossing a mixture of residential and natural areas. About 1 mile north of SR 516, the loop would cross to the east side of the 30-inch-diameter pipeline and

terminate at MP 1363.9 where it would tie into the existing 36-inch-diameter loop. The loop would terminate about one-half mile south of SR 18 and southwest of Cedar Creek Park in Covington.

Sumner North Loop B

This 11.0-mile-long loop in King County would begin about 600 feet north of SE 156th Street in the City of Issaquah, and terminate about 1,000 feet north of NE 8th Street in the City of Sammamish. For most of the loop, the new 36-inch-diameter pipeline would be installed in the trench of the abandoned 26-inch-diameter pipeline. Exceptions to this placement would be near SE 103rd Street at MP 1374.2, where the loop would stay on the west side of the 30-inch-diameter pipeline to avoid crossing it twice within about 400 feet, and at Queen's Bog and the unnamed bog at MP 1381.4, where more separation from the 30-inch-diameter pipeline would be needed. The loop would skirt the Tiger Mountain State Forest, cross I-90 at MP 1376.1 and continue north through a mixture of residential and natural areas.

Snohomish Loop

This 15.6-mile-long loop in Snohomish County would begin at the Snohomish Compressor Station west of Echo Lake and terminate near the area of Machias. The new pipeline would be installed in the abandoned 26-inch-diameter pipeline trench for most of this loop. The exceptions to this placement would be north of SR 522 to cross the Snohomish River at MP 1397.6, between MP 1404.2 and 1405.1 where the loop would stay on the west side of the 30-inch-diameter pipeline to avoid crossovers, and at the end of the loop (MP 1409.4) in order to tie into the existing 36-inch-diameter loop. The loop would pass through a mixture of residential, wooded and agricultural areas. At MP 1402.9 the loop would cross SR 2; it would also cross the Pilchuck River at MP 1407.8 and end just north of Meridian Street, in the City of Snohomish.

Mt. Vernon South Loop

This 4.5-mile-long loop in Skagit County would begin at Lake Cavanaugh Road in the City of Mt. Vernon, and terminate at the Mt. Vernon Compressor Station at the end of Lange Road. The pipeline would be installed in the abandoned 26-inch-diameter pipeline trench on the west side of the existing 30- and 36-inch-diameter pipelines. All three pipelines would be in the same right-of-way except for about 0.7 miles east of the Montborne area where the loop would split to the west of the other two pipelines to avoid steep side slopes. The loop would leave the trench of the 26-inch-diameter pipeline for about 800 feet at MP 1439.0 to avoid crossing the other pipelines. The route would pass through wooded areas and large parcel residential areas. No major waterbodies would be crossed as part of this loop.

Mt. Vernon North Loop A

This 4.8-mile-long loop in Skagit County would begin at the Mt. Vernon Compressor Station and terminate on the north side of the Skagit River. The pipeline would be installed in the abandoned 26-inch-diameter pipeline trench on the west side of the existing 30-inch-diameter pipeline. The loop would tie into the existing 30-inch-diameter pipeline on either side of the Skagit River at MP 1444.9. A short length of new pipeline would be installed on the north side of the Skagit River between the 30-inch-diameter pipeline tie-in and the existing 36-inch-diameter loop. The majority of the route would cross forested land of varied topography.

Mt. Vernon North Loop B

This 8.4-mile-long loop in Skagit and Whatcom Counties would begin south of Duvall Drive in the valley between Anderson Mountain to the west and Lyman Hill to the east and terminate on the south

side of Mosquito Lake Road east of the town of Acme. About 800 feet from the beginning of the loop, the pipeline would be installed in the abandoned 26-inch-diameter pipeline trench, which is primarily on the west side of the existing 30-inch-diameter pipeline. North of Rothenbuhler Road the loop would leave the 26-inch-diameter pipeline trench and the existing right-of-way to cross the South Fork Nooksack River at MP 1461.6. North of the river, the alignment would reconverge with the existing right-of-way and tie into the existing 36-inch-diameter loop. The route would pass through wooded and agricultural lands in varied topography.

Sumas Loop

This 5.9-mile-long loop in Whatcom County would begin adjacent to the Lynden Meter Station on Leibrant Road and terminate at the Sumas Compressor Station. The pipeline would be installed in the abandoned 26-inch-diameter pipeline trench for most of the loop except where the existing 36-inch-diameter pipeline is already occupying that location. Except for about 300 feet, the route for the loop would be within the existing right-of-way. The southern half of the route would cross wooded, hilly terrain and the northern half of the route would extend through mostly agricultural land. No major waterbodies would be crossed by this loop.

2.2.1.2 Aboveground Facilities

New aboveground facilities associated with the pipeline would consist of modifications and upgrades at five compressor stations, a new receipt meter station facility inside the existing, fenced Sumas Compressor Station yard, 25 MLVs, and 10 pig launchers and receivers. Northwest would also abandon by removal two compressor units at the Sumner Compressor Station, four reciprocating engines at the Sumas Compressor Station; and the Sumas Meter Station. Table 2.2.1-2 lists the locations of the proposed aboveground facilities.

Table 2.2.1-2

New Aboveground Facilities Associated with the WEP

Facility	Milepost	County
Compressor Station Modifications		
Chehalis Compressor Station	1289.5	Lewis
Sumner Compressor Station	1351.8	Pierce
Snohomish Compressor Station	1393.8	Snohomish
Mt. Vernon Compressor Station	1440.2	Skagit
Sumas Compressor Station	1484.5	Whatcom
Meter Station		
Sumas Receipt Meter Station	1484.5	Whatcom
Mainline Valves		
Woodland Loop		
MLV	1244.3	Cowlitz
MLV	1246.9	Cowlitz
MLV	1255.8	Cowlitz
MLV	1262.6	Cowlitz
MLV	1269.6	Cowlitz
MLV	1280.3	Lewis
MLV	1289.5	Lewis
Chehalis Loop		
MLV	1291.3	Lewis
MLV	1295.6	Lewis
MLV	1309.8	Thurston

Table 2.2.1-2

New Aboveground Facilities Associated with the WEP

Facility	Milepost	County
Sumner South Loop		
MLV	1343.6	Pierce
MLV	1346.9	Pierce
Sumner North A Loop		
MLV	1356.9	King
MLV	1358.0	King
Sumner North B Loop		
MLV	1379.2	King
Snohomish Loop		
MLV	1394.0	Snohomish
MLV	1398.0	Snohomish
MLV	1405.2	Snohomish
Mt. Vernon South Loop		
MLV	1435.7	Skagit
MLV	1440.1	Skagit
Mt. Vernon North A Loop		
MLV	1440.2	Skagit
MLV	1444.8	Skagit
Mt. Vernon North B Loop		
MLV	1456.6	Skagit
Sumas Loop		
MLV	1478.6	Whatcom
MLV	1484.5	Whatcom
Pig Launchers/Receivers		
Woodland Loop		
Pig Launcher/Receiver	1244.3	Cowlitz
Pig Launcher/Receiver	1289.5	Cowlitz
Chehalis Loop		
Pig Launcher/Receiver	1291.3	Lewis
Sumner North A Loop		
Pig Launcher/Receiver	1356.9	King
Snohomish Loop		
Pig Launcher/Receiver	1394.0	Snohomish
Mt. Vernon South Loop		
Pig Launcher/Receiver	1435.7	Skagit
Pig Launcher/Receiver	1440.1	Skagit
Mt. Vernon North A Loop		
Pig Launcher/Receiver	1440.2	Skagit
Sumas Loop		
Pig Launcher/Receiver	1478.6	Whatcom
Pig Launcher/Receiver	1484.5	Whatcom

As part of the pipeline construction, Northwest would remove 14 existing MLVs and remove or relocate 12 existing pig launchers/receivers, as shown in table 2.2.1-3.

Table 2.2.1-3

Existing Aboveground Facilities Removed or Relocated During the WEP

Facility	Milepost	County
Mainline Valves		
Woodland Loop		
26-inch-diameter MLV - Removed	1247.7	Cowlitz
26-inch-diameter MLV - Removed	1264.0	Cowlitz
26-inch-diameter MLV - Removed	1280.3	Lewis
26-inch-diameter MLV - Removed	1289.5	Lewis
Chehalis Loop		
26-inch-diameter MLV - Removed	1295.6	Lewis
26-inch-diameter MLV - Removed	1309.8	Thurston
Sumner South Loop		
26-inch-diameter MLV - Removed	1339.2	Pierce
26-inch-diameter MLV - Removed	1351.7	Pierce
26-inch-diameter MLV - Removed	1351.8	Pierce
Sumner North A Loop		
26-inch-diameter MLV - Removed	1361.6	King
Snohomish Loop		
26-inch-diameter MLV - Removed	1394.0	Snohomish
26-inch-diameter MLV - Removed	1405.2	Snohomish
Mt. Vernon North A Loop		
26-inch-diameter MLV - Removed	1440.2	Skagit
Mt. Vernon North B Loop		
26-inch-diameter MLV - Removed	1456.6	Skagit
Pig Launchers/Receivers		
Chehalis Loop		
36-inch-diameter Pig Launcher/Receiver - Relocated	1315.6	Thurston
Sumner South Loop		
36-inch-diameter Pig Launcher/Receiver - Relocated	1338.0	Pierce
36-inch-diameter Pig Launcher/Receiver - Relocated	1351.8	Pierce
Sumner North A Loop		
36-inch-diameter Pig Launcher/Receiver - Relocated	1363.9	King
Sumner North B Loop		
36-inch-diameter Pig Launcher/Receiver - Relocated	1370.9	King
36-inch-diameter Pig Launcher/Receiver - Removed	1381.9	King
Snohomish Loop		
26-inch-diameter Pig Launcher/Receiver - Removed	1394.0	Snohomish
36-inch-diameter Pig Launcher/Receiver - Relocated	1409.4	Snohomish
Mt. Vernon North A Loop		
26-inch-diameter Pig Launcher/Receiver - Removed	1440.2	Skagit
36-inch-diameter Pig Launcher/Receiver - Removed	1445.0	Skagit
Mt. Vernon North B Loop		
36-inch-diameter Pig Launcher/Receiver - Relocated	1453.5	Skagit
36-inch-diameter Pig Launcher/Receiver - Relocated	1461.9	Whatcom

Compressor Station Modifications

Northwest would modify five of its existing compressor stations to increase compression. All new facilities would be within the existing fenced station footprint.

At each compressor station, Northwest would modify the existing station buildings and piping and install: new valves and valve buildings, gas aftercoolers, one 3.5-million British thermal units per hour natural gas fired boiler, and one 500-horsepower natural gas fired generator for emergency use. New equipment installed specific to each compressor station would include:

- ***Chehalis Compressor Station—Lewis County.*** Northwest would modify the existing Chehalis Compressor Station at MP 1289.5 by installing a new Taurus 60 compressor to increase compression by about 7,700 horsepower.
- ***Sumner Compressor Station—Pierce County.*** Northwest would modify the existing Sumner Compressor Station at MP 1351.8 by removing two existing compressors as described in the following section, and by installing two new Titan 130 compressors in the same footprint. The new compressors would supply a total of about 41,000 horsepower.
- ***Snohomish Compressor Station—Snohomish County.*** A new Mars 100 compressor, providing about 15,000 horsepower of compression, would be installed at the existing Snohomish Compressor Station at MP 1393.8.
- ***Mt. Vernon Compressor Station—Skagit County.*** Northwest would install a new Mars 100 compressor to provide an additional 15,000 horsepower to the existing Mt. Vernon Compressor Station at MP 1440.2.
- ***Sumas Compressor Station—Whatcom County.*** Northwest would modify the existing Sumas Compressor Station at MP 1484.5 by abandoning by removal four existing compressors and replacing them with two new compressors: one Titan 250 with about 30,000 horsepower, and one Mars 100 with about 15,000 horsepower.

Northwest would abandon by removal equipment at two existing compressor stations, as follows:

- ***Sumner Compressor Station—Pierce County.*** Northwest would remove two existing Mars 90 compressors and would installing two new compressors in the same footprint, as described above.
- ***Sumas Compressor Station—Whatcom County.*** Northwest would abandon by removal four existing Ingersoll Rand reciprocating engines.

Meter Station

Northwest would decommission and remove its existing Sumas Receipt Meter Station and construct a new receipt meter station facility to regulate pressure and measure all natural gas flowing through Northwest's pipeline system as it crosses the border, including the new incremental volumes that would be associated with the WEP. The new meter station would consist of 36-inch-diameter inlet and outlet piping and one building housing nine 12-inch ultrasonic meters, two 48-inch headers, and related appurtenances. The new meter station building would be inside the existing, fenced Sumas Compressor Station yard.

Mainline Valves

MLVs would be used to segment the pipeline for safety, operation, and maintenance purposes. The WEP would install 25 new MLVs as shown in table 2.2.1-2 and would abandon by removal 14 MLVs as listed in table 2.2.1-3. Most new MLVs would be located in or adjacent to existing Northwest valve, meter, or compression facilities. At new valve sites adjacent to existing facilities, the existing operational footprint would be increased as required to accommodate the new valve.

Pig Launchers and Receivers

As shown in table 2.2.1-2, Northwest would construct 10 new 36-inch-diameter pig launchers/receivers. These facilities would allow monitoring of the pipelines using internal inspection tools. An MLV would be installed at each new pig launcher/receiver site. Northwest would also remove two 26-inch-diameter and two 36-inch-diameter pig launchers/receivers, and would relocate eight 36-inch-diameter pig launchers/receivers, as listed in table 2.2.1-3. At locations where the WEP would tie into the existing 36-inch-diameter pipeline, the launcher/receiver barrel would be removed and relocated, and the existing MLV would remain in place with minor modifications necessary to connect the existing and new lines.

Access Roads

For construction and operation of the pipeline and associated aboveground facilities, Northwest has identified existing public and private roads to use for access. The majority of these access roads are currently used by Northwest to operate and maintain the existing pipeline and facilities. Northwest does not anticipate making improvements to any of these access roads.

Contractor and Pipe Storage Yards

Northwest has identified four areas, depicted on maps in appendix I1, that would be used for contractor and pipe storage during construction of the WEP. These areas are currently being used for pipeline operations or pipe storage. If additional areas for contractor and pipe storage or rail ports are needed, Northwest would attempt to identify sites close to the construction areas with existing industrial land uses that have been previously graded and graveled.

2.2.2 Land Requirements

Construction of the pipeline and associated aboveground facilities for the WEP would disturb a total of about 2,051.6 acres of land, including the temporary construction right-of-way, ATWS, and contractor and pipe storage yards. No new access roads would be required for the WEP. About 1267.1 acres of the total used for construction of the pipeline would be required for operation of the project. The remaining 784.5 acres would be allowed to revert to its former use (see table 2.2.2-1).

Table 2.2.2-1

Summary of Land Requirements Associated with Construction and Operation of the WEP

Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
Pipeline Facilities [a]		
Woodland Loop	622.6	403.7
Chehalis Loop	340.6	209.1
Sumner South Loop	195.6	113.3
Sumner North A Loop	85.8	61.8
Sumner North B Loop	131.5	99.2
Snohomish Loop	208.2	133.1
Mt. Vernon South Loop	70.7	41.1
Mt Vernon North A Loop	62.4	43.0
Mt. Vernon North B Loop	106.9	65.6
Sumas Loop	135.9	47.8
Pipeline Facilities Subtotal	*1960.2*	*1217.7*
Compressor Stations	59.1 [b]	49.4
Contractor and Pipe Storage Yards	32.3	0.0
Project Total	**2,051.6**	**1267.1**

[a] Pipeline right-of-way acres include ATWS.
[b] Includes acreage for the entire compressor station parcel although construction would be within the existing fenced area.

The pipeline route would be collocated with existing easements and rights-of-way in most areas. About 132 miles (94 percent) of the 140.6 miles of pipeline segments would be constructed within Northwest's existing right-of-way. Areas where the WEP would be constructed outside of the existing right-of-way are shown in table 2.2.2-2. Northwest would remove its previously abandoned 26-inch-diameter pipeline and place the new 36-inch-diameter pipeline in the same trench for 126.4 miles, or about 90 percent of the WEP.

Table 2.2.2-2

Summary of the WEP Locations Outside Existing Northwest Right-of-way

	Milepost			
Loop	**From**	**To**	**Length (miles)**	**Notes**
Woodland Loop				
	1258.9	1259.0	0.1	
	1260.2	1260.4	0.1	
	1262.2	1262.2	<0.1	
	1262.4	1262.5	0.1	
	1262.55	1262.58	<0.1	
	1269.5	1269.6	0.1	
	1274.2	1275.9	1.7	Toutle River Crossing
	1277.8	1278.2	0.3	
	1282.3	1282.4	0.1	
	1282.4	1282.6	0.2	Cowlitz River Crossing
	1282.6	1282.7	0.1	
	1286.4	1286.8	0.4	

Table 2.2.2-2

Summary of the WEP Locations Outside Existing Northwest Right-of-way

Loop	Milepost From	To	Length (miles)	Notes
Chehalis Loop				
	1293.9	1294.3	0.3	Newaukum River Crossing
	1294.5	1294.5	<0.1	
	1295.4	1295.4	<0.1	
	1309.3	1309.4	0.1	Skookumchuck River Crossing
	1309.8	1310.5	0.7	
	1311.5	1311.9	0.4	
Sumner South Loop				
	1339.1	1339.2	0.1	Tacoma South Meter Station
	1347.7	1348.0	0.3	Puyallup River Crossing
	1349.1	1349.3	0.2	
Sumner North A Loop				
	1362.7	1362.8	0.1	
Sumner North B Loop				
	1374.2	1374.3	<0.1	
	1379.1	1379.1	0.1	Queen's Bog Crossing
	1381.3	1381.5	0.2	Unnamed Bog Crossing
Snohomish Loop				
	1393.8	1393.9	<0.1	
	1397.1	1397.9	0.9	Snohomish River Crossing
	1404.4	1404.8	0.4	
	1404.9	1404.9	<0.1	
	1405.0	1405.1	0.2	
Mt. Vernon South Loop				
	1437.2	1437.4	0.2	
	1439.0	1439.2	0.2	
	1440.1	1440.1	<0.1	
Mt. Vernon North B Loop				
	1453.7	1453.7	<0.1	
	1461.4	1461.9	0.5	South Fork Nooksack River Crossing
Sumas Loop				
	1478.6	1478.6	<0.1	
	1479.0	1479.0	<0.1	
	1479.3	1479.5	0.2	
	1480.0	1480.0	<0.1	
	1480.9	1481.1	0.2	
	1481.7	1481.8	0.1	
	1483.1	1483.1	0.1	
Total			**8.7**	

Northwest would use a 95-foot-wide construction right-of-way for the majority of the pipeline route. The construction right-of-way would typically overlap Northwest's existing maintained right-of-way, which is typically 75 feet wide and contains an abandoned 26-inch-diameter, an existing 30-inch-

diameter, and in some instances, an existing 36-inch-diameter pipeline. Additional temporary construction right-of-way would be added adjacent to the permanent right-of-way to support construction efforts. In some areas, Northwest would use a construction right-of-way width of 60, 75, 85, or 115 feet. The 115-foot-wide construction right-of-way would be used to accommodate special circumstances, such as avoiding a pipeline crossover. Additional site-specific areas would be required for extra workspace at sensitive crossings to provide extra space for spoil storage and associated construction activities. As required by its Procedures, Northwest would reduce the construction right-of-way to a width of 75 feet in wetlands except in certain areas where requested and approved. The typical right-of-way cross sections that Northwest would use for pipeline construction and a table of the mileposts where each would apply are provided in appendix I2. Following construction, for the majority of the pipeline a 75-foot-wide permanent right-of-way would be retained for operation and maintenance. At some locations, such as where the WEP deviates from the existing Northwest Pipeline right-of-way, the permanent right-of-way would be less than 75 feet wide.

In addition, Northwest would use four construction staging and storage yards which would temporarily affect 32.3 acres of land. These yards are Northwest properties currently used as storage and work yards.

Construction for the compressor station modifications would occur within the existing, previously disturbed, fenced-in compressor station yard. Staging may occur within the compressor station parcels but outside the existing fence line. Acquisition of land or expansion of existing station yards would not be required at any of the modified compressor stations.

2.2.3 Construction Procedures

Northwest would construct the pipeline and aboveground facilities following industry-accepted practices and procedures, as further described in this section. Relevant state and federal regulations pertaining to pipeline facility construction and operation were previously discussed in section 2.1.4. Northwest would adopt our Plan with the approved alternative measures described in section 4.2.2.4. Northwest would adopt our Procedures with the approved alternative measures described in section 4.2.4.4. Collectively these plans are referred to as Northwest's Plan and Procedures in this EIS and describe the baseline mitigation measures for minimizing the extent and duration of disturbances on soils, wetlands, and waterbodies. These include guidelines for installing sediment barriers, trench breakers, and slope breakers. In addition, Northwest has prepared a project specific *Erosion Control and Revegetation Plan* (ECRP) (see appendix J1) and spill plans for oil and hazardous materials to reduce construction impacts.

2.2.3.1 General Pipeline Construction Procedures

This section describes the general procedures proposed by Northwest for construction of the pipeline facilities. Refer to section 4.2 for more detailed information about proposed construction and restoration procedures as well as additional measures recommended to mitigate environmental impacts. Northwest would follow the typical pipeline construction sequence shown in figure 2.1.4-1.

Surveying and Staking

Before construction, Northwest's crews would survey and stake the centerline and exterior boundaries of the construction right-of-way, including additional temporary workspaces. The exterior boundary stakes would mark the limit of approved disturbance areas and would be maintained throughout the construction period. Utility lines would be located and marked to prevent accidental damage during

pipeline construction. Northwest would also survey and stake centerlines and elevations of drainage systems and highway and railroad crossings. Northwest would notify affected landowners, regulatory agencies, and other appropriate stakeholders before surveying and staking the proposed route.

Clearing and Grading

Northwest would clear the right-of-way of large obstacles such as trees, brush, and logs. Timber would be removed when necessary for construction purposes. Timber and other vegetative debris may be chipped for use as erosion-control mulch, or otherwise disposed of in accordance with applicable state and local regulations and landowner agreements. Fences would be cut and braced along the right-of-way and temporary gates would be installed to control livestock and limit public access. The right-of-way would then be graded where necessary to create a reasonably level working surface to allow safe passage of construction equipment and materials.

Northwest would remove timber in some large, forested areas within 1 year prior to the start of construction. The construction right-of-way would be cleared of timber using standard logging practices. Merchantable timber would be cut, bucked into appropriate lengths, and removed from the right-of-way according to landowner agreements. Nonmerchantable logs and slash would be salvaged on the edge of the construction right-of-way and would be scattered across the right-of-way after seeding, where feasible. Northwest expects that various logging methods may be necessary to efficiently remove timber from the right-of-way, depending on the specific location. Ground-based skidding and cable logging methods would likely be the standard method. Where material disposal is necessary, federal, state, and local regulations would be followed.

Temporary erosion controls would be installed immediately after vegetation clearing and would be maintained throughout construction and reinstalled, as necessary, until replaced by permanent erosion controls or until restoration is completed.

26-inch-Diameter Pipeline Removal and Trenching

In areas where the existing, 26-inch-diameter pipeline would be removed, the trench would be excavated using track-hoes or similar equipment. Once the 26-inch-diameter pipeline is exposed, the trench would be excavated wider at strategic locations along the trench to safely allow welders to enter the trench and cut the pipeline for removal. After the pipeline is cut, the 26-inch-diameter pipeline sections would be removed from the trench with side booms or track-hoes and carried to load out areas where the pipe would be hauled to an approved scrap or recycling facility.

Northwest found in past projects that asbestos and other hazardous materials are present in some segments of the 26-inch-diameter pipeline coating. Once the pipeline is initially excavated, Northwest would determine if the external coating requires abatement. If abatement is required, Northwest would handle the pipeline in accordance with applicable regulations during pipeline removal, transport, and storage, and would separate the coating from the pipe prior to its ultimate reuse or sale.

In locations where the new pipeline would not be located in the 26-inch-diameter pipeline trench, it would be necessary to excavate a new trench with a track-mounted backhoe or similar equipment. The bottom of the trench would be excavated at least 12 inches wider than the diameter of the pipeline. For installation of the new, 36-inch-diameter pipeline, the depth of the trench would be sufficient to allow for a minimum depth of cover over the pipeline of 36 inches and 24 inches in areas of consolidated rock where 36 inches is not feasible.

Stringing and Bending

Steel pipe for the pipeline would be procured in 40- to 80-foot lengths, or joints, protected with an epoxy coating applied at the factory (the beveled ends would be left uncoated for welding), and shipped to pipe storage yards. The individual joints would be transported to the right-of-way by stringing trucks and placed along the excavated trench in a single, continuous line on the working side of the trench. At river crossings, the pipe required to cross the river would be stockpiled in ATWS on one or both banks of the river.

Some bending of the pipe would be required to allow the pipeline to follow natural grade changes and direction changes of the right-of-way. Selected joints would be field bent by track-mounted hydraulic bending machines, as necessary, prior to lineup and welding.

Welding and Coating Field Welds

Following stringing and bending, the pipe joints would be placed on temporary supports, adjacent to the trench. The ends would be carefully aligned and welded together using multiple passes, which would provide for a full penetration weld. Only qualified welders would be permitted to perform the welding. In certain areas with limited working room, continuous stringing of the pipe may not be possible. In such areas, three to four joint sections would be welded together at designated areas and carried down the right-of-way to be lowered into the trench.

Following welding, the uncoated ends of the pipe joints would be cleaned and epoxy coated. The coating on the remainder of the completed pipeline section would be inspected and any damaged areas repaired. To ensure that the assembled pipeline would meet or exceed the design strength requirements, 100 percent of welds would be visually inspected and nondestructively tested using radiographic (X-ray) or other approved test methods, in accordance with API standards. Welds displaying defects would be repaired or cut out and rewelded.

Lowering-in and Backfilling

The completed section of pipeline would be lifted off the temporary supports and lowered into the trench by side-boom tractors. Prior to lowering the pipeline, the trench would be inspected to ensure that it is free of rocks and other debris that could damage the pipe or the coating and that the pipeline and trench configurations are compatible. In congested residential areas, different techniques may be used with smaller crews to limit impact on landowners.

Northwest would install trench plugs consistent with the requirements of its Plan, Procedures, and ECRP (see appendix J1). Trench plugs would be used to avoid draining wetlands or waterbodies and to prevent potential subsurface erosion.

After the pipeline is lowered into the trench, the trench would be backfilled. Previously excavated materials would be pushed back into the trench using bladed equipment or backhoes. Where the previously excavated material contains large rocks or other materials that could damage the pipeline and coating, clean fill or protective wraps would be placed around the pipe before backfilling. Following backfilling in rangeland or other specified areas, and in consultation with the landowner(s), a small crown may be left to account for any future soil settling that might occur, except in wetlands where no crowns would be used.

Hydrostatic Test and Final Tie In

The pipeline and other high-pressure piping components would be hydrostatically tested for a minimum of 8 hours in accordance with U.S. DOT 49 CFR 192 prior to being placed in service. Any leaks detected would be repaired and the segment retested. When discharged, the test water would be released through an energy-dissipating device and a sediment control structure as required by applicable regulations.

Topography and the availability of test water would determine the length of each test segment. Anticipated hydrostatic test water sources and volumes for pipeline testing are discussed in detail in section 4.2.3.2. Hydrostatic test water for compressor stations would be obtained from nearby municipalities or available water onsite. No chemicals would be added to the hydrostatic test water. Once a segment of pipeline has been successfully tested and dried, the test cap and manifold would be removed, and the segment would be connected to the remainder of the pipeline. Northwest would implement the measures in its Plan and Procedures regarding hydrostatic testing as well as any requirements established in state or local permits.

Cleanup and Restoration

After a segment of pipeline has been installed, backfilled, and successfully tested, the construction right-of-way, ATWS, and other disturbed areas would be graded and the construction debris would be disposed of properly. Detailed restoration and revegetation techniques are provided in the ECRP (see appendix J1) as well as Northwest's Plan and Procedures. These measures address such items as soil decompaction, topsoil replacement, rock removal, seeding, noxious weed control, and restoration monitoring.

2.2.3.2 Special Pipeline Construction Procedures

Topographic and geologic conditions, development, and other circumstances would require Northwest to implement special construction techniques at various locations along the route. Special construction techniques include various wetland and waterbody crossing methods, varying depth of cover, techniques to address restricted right-of-way widths, or other considerations to address site-specific conditions. These practices are typical for the pipeline industry. Northwest has identified several areas that would require special construction techniques. These techniques and the site conditions for which they would be required are generally described below.

Wetland Crossings

Northwest would cross delineated wetlands in accordance with federal, state, and local permits as well as its Plan and Procedures. A list of all wetlands that would be crossed by the WEP and pertinent information for each wetland is provided in appendix K1.

When crossing wetlands that are dry at the time of construction, a 75-foot-wide construction right-of-way would be maintained and upland construction techniques would be used. Topsoil would be segregated from over the trench line and would be replaced back to the original horizon and elevation. Plants and the seed bank in topsoil would promote reestablishment of wetland vegetation. Pipeline stringing and fabrication would occur either within the wetland adjacent to the trench or adjacent to the wetland in an ATWS. Fabrication in wetlands would require coating of field joints but would not include application of concrete coating in the wetland. Northwest would follow its Plan, Procedures, and ECRP

(see appendix J1), which limits concrete-coating activities within 100 feet of a wetland or waterbody boundary.

When crossing saturated wetlands, a 75-foot-wide construction right-of-way would also be maintained unless an 85-foot-wide construction right-of-way has been authorized as described in section 4.2.4.4. In saturated wetlands construction equipment would work on mats to minimize impacts from rutting and soil mixing. Low ground weight equipment may also be used in these areas to minimize wetland construction impacts. Construction would proceed as in dry wetlands except topsoil segregation (from subsoil horizons) would not be feasible under saturated conditions. Under saturated soil conditions, it is generally not feasible/practical to segregate topsoil because the saturated topsoil and subsoil materials have low strength and do not readily stack. Pipeline stringing and fabrication in saturated wetlands may occur within the wetland adjacent to the trench or adjacent to the wetland in an ATWS.

An alternate saturated wetland method is the push/pull method which uses an open trench that is allowed to fill with water to float the pipeline into place with aid from floating devices and a winch. Once in place, flotation is removed and the pipeline sinks into the bottom of the trench. The trench would be backfilled using native material excavated from the trench. Trench dewatering would be used, as needed, to prevent sediment laden water from spilling over the top of the trench. Water from dewatering activities would be pumped into a dewatering structure in an approved upland area and allowed to infiltrate back into the ground. Northwest is proposing to use this technique in the Queen's Bog and the unnamed bog, both located in the Sumner North B Loop.

Vegetation clearing in wetlands would be limited to trees and shrubs, which would be cut flush with the surface of the ground and removed from the wetland. To avoid excessive disruption of wetland soils and the native seed and rootstock within the wetland soils, stump removal, grading, topsoil segregation, and excavation would be limited to the area immediately over the trench line. A limited amount of stump removal and grading may be conducted in outside of the trench line if dictated by safety-related concerns.

Waterbody Crossings

Waterbody crossings would include: major rivers, perennial, intermittent, and ephemeral waterbodies, and upland ditches. Intermittent waterbodies or ditches would typically be dry at the time of construction based on the summer construction schedule. A total of 271 waterbodies, including 161 perennial, 73 intermittent, and 37 ephemeral, would be crossed by the pipeline. The waterbodies that would be crossed and the crossing methods that would be used are listed in appendix K1. Northwest would cross waterbodies in accordance with federal, state, and local permits, and its Plan and Procedures. Northwest proposes to cross waterbodies using dry open-cut, wet open-cut, spans and trenchless methods, all of which are generally described below. Additional details regarding waterbody crossings, including for specific waterbodies, are provided in section 4.2. Construction methods in combination with its Procedures are designed to maintain water flow and minimize changes in waterbody flow characteristics.

Dry Open-cut

The dry open-cut method would be used on waterbodies that would be dry at the time of construction as well as in conjunction with the flume or dam-and-pump methods which redirect the water around the work area.

The flume method would typically be used to cross small to intermediate flowing waterbodies that are either fish-bearing or nonfish-bearing. The open-cut flume technique involves diversion of stream flow into one or more carefully positioned pipes of suitable diameter to convey the entire flow of

the waterbody and ensures that flow rate and volume are not interrupted. Once the pipes are in place, diversion dams are installed on either side of the work area. A typical flume crossing is shown in figure 2.1.4-2.

The dam-and-pump method may be used on waterbodies as an alternative to fluming. With the dam-and-pump method, streamflow would be diverted around the work area by pumping water through hoses over or around the construction work area. The goal of this technique is to create a relatively "dry" work area to reduce the transportation of heavy sediment loads and turbidity downstream of the crossing. Dispersion pads, such as rock aprons, would be used downstream to prevent scour. A typical dam-and-pump crossing is shown in figure 2.2.3-1.

Wet Open-cut

The wet open-cut method involves trench excavation, pipeline installation, and backfilling in a waterbody without controlling or diverting streamflow (i.e., the waterbody would flow through the work area throughout the construction period). Northwest proposes to use the wet open-cut method on the Toutle River because other methods are not feasible, as further discussed in section 4.2.3.2.

The area where the Toutle River crossing would occur has a relatively slow current. Because the flow velocity is low, sediments disturbed during the construction phase would be expected to settle quickly. If necessary, a portion of the river flow would be diverted around the work area to further reduce the potential for sediment transport. The trench would be dug with a dragline bucket or large excavators. The excavated material would be placed in holding areas on both sides of the river.

The pipeline would be fabricated on shore and pulled into the prepared trench after the trench has been excavated to the required design depth. If the mainline has been installed up to this point, the crossing line would be welded into the mainline. If the mainline has not already been installed, the ends would be left with temporary caps installed about 20 feet away from the riverbank to prevent water from entering the pipeline. This method would allow the trench to be backfilled so that the pipeline segment crossing the waterbody could be tied into the mainline at a later time. After pipeline burial depth is verified, the stockpiled materials would be placed back into the trench and the surface would be armored with gravel. The banks would be returned to their original contour and stabilized, and riparian zones would be replanted in the disturbed area over the trench.

Span

Northwest proposes to span several waterbodies. The Kalama River (MP 1253.4) would be an aerial span. The abandoned 26-inch-diameter pipeline would be removed from the existing support structure and the structure would be retrofitted to hold the new 36-inch-diameter pipeline. There would also be four crossings that the pipeline would span without the use of additional supporting structures. These waterbodies are currently spanned by the existing 30-inch-diameter pipeline. Spanned crossings are proposed for Covington Creek (MP 1359.6), East Fork Issaquah Creek (MP 1376.1), Elliot Creek (MP 1396.7), and an unnamed ephemeral waterbody at MP 1266.8.

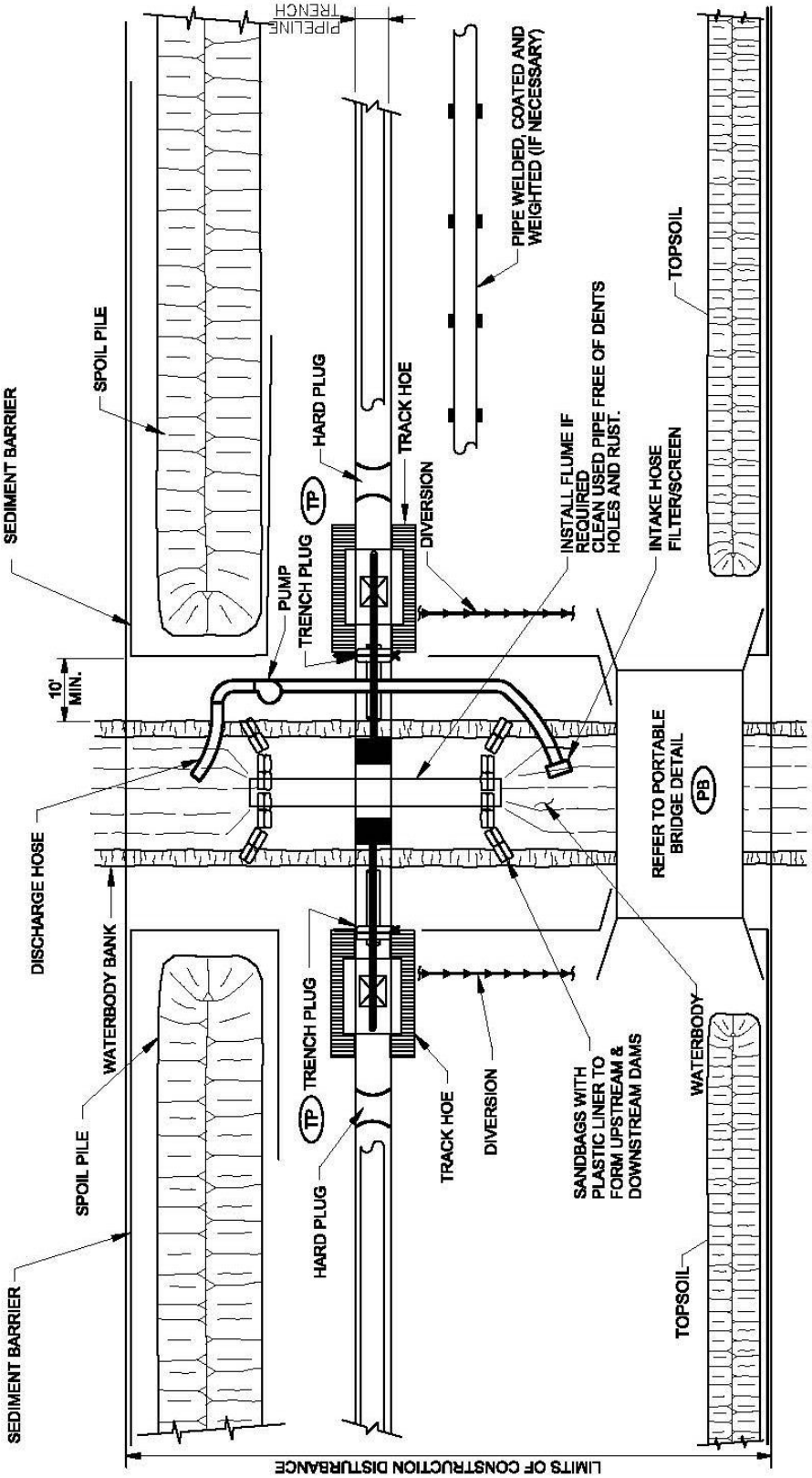


Figure 2.2.3-1: Dam-and-pump Method Typical

Trenchless Methods

HDD or the direct pipe method would be used for crossing major waterbodies (wider than 100 feet) when feasible without a high potential for inadvertent release of drilling fluid. As shown in table 2.2.3-1, the HDD method is proposed for crossing the Cowlitz, Newaukum, and South Fork Nooksack Rivers and either the HDD or direct pipe method is proposed for crossing the Puyallup and Snohomish Rivers.

Table 2.2.3-1

Horizontal Directional Drilling or Direct Pipe Crossings for the WEP

Waterbody	Milepost		Crossing Length (feet)
	Begin	End	
Cowlitz River [a]	1281.9	1282.2	2,000
Newaukum River [a]	1294.0	1294.3	1,500
Puyallup River [b]	1347.8	1348.1	1,750
Snohomish River [b]	1397.4	1397.9	2,500
South Fork Nooksack River [a]	1461.4	1461.7	1,780

[a] HDD is proposed.
[a] Either HDD or direct pipe installation method is proposed.

The HDD process involves boring under a feature and pulling the pipeline into place through the borehole that has been reamed to accommodate the diameter of the pipeline. This process has three main phases: pilot-hole drilling, subsequent reaming passes, and pipeline pullback (see section 2.1.4.2 for additional details). As described in section 2.1.4.2, the HDD method carries the risk of an inadvertent release of drilling fluid. Northwest has prepared a Horizontal Directional Drilling Monitoring and Contingency Plan that includes corrective measures to address an inadvertent release.

The direct pipe method combines the more established methods of microtunneling and HDD. Similar to pipe jacking, soil or rock would be removed by a slurry microtunneling machine at the same time that pipeline is pushed into the ground. However, unlike traditional microtunneling, the direct pipe method incorporates a steerable cutterhead located at the tunnel face. Cuttings would be mixed with the slurry in an excavation chamber and then pumped through the pipeline to a separation plant at the entrance point of the tunnel. Cuttings would be separated from the drilling slurry and disposed of offsite and the drilling slurry reused. Similar to HDD installation, the pipeline to be installed would generally be welded and pressure tested before installation. This operation would occur in an ATWS similar to the pullback area required for the HDD installation method.

A conventional bore is proposed for the Cranmar Creek crossing because of its close proximity to a railroad crossing at MP 1362.7. No other conventional bore crossings of waterbodies are proposed, because use of this method beneath a waterbody is challenging due to the limited ability of horizontal bore equipment to control hydrostatic forces acting on the face of the bore.

Road and Railroad Crossings

Construction of the pipeline across major paved highways and railroads, along which traffic cannot be interrupted, would usually be accomplished by boring under the roadbed (conventional bore). If an open-cut road requires extensive construction time, provisions would be made for detours or other

measures to permit traffic flow during construction. The pipeline would be buried to a depth of at least 5 feet below the road surface and would be designed to withstand anticipated external loadings.

Residential Areas

Northwest's proposed construction work area would be within 50 feet of 740 residences. In areas where the construction work area would be within 50 feet of a residence, Northwest would restrict the construction right-of-way to the existing permanent right-of-way if practicable to minimize inconvenience to property owners. Northwest has prepared site-specific residential construction plans for about 440 residences within 25 feet of the construction work area. These plans are shown on 135 sheets in appendix I6. Stove piping would be the primary construction method use through densely populated areas. Northwest would use steel plates to cover open trenches, fencing to mark work areas, and store spoils in ATWS where tight areas do not allow for storage on the right-of-way.

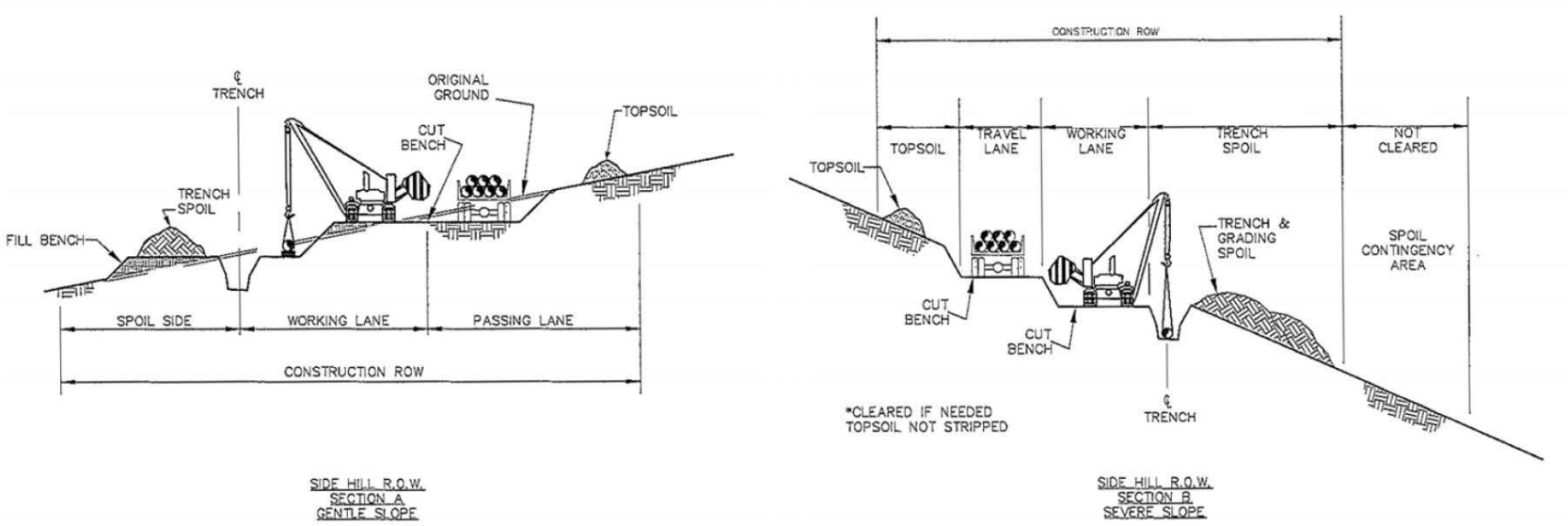
If construction requires the removal of private property features, such as gates or fences, the landowner or tenant would be notified prior to the action. Existing residential septic systems would be identified during the land acquisition phase. Measures would be taken to avoid septic systems, such that other mitigation measures would not be necessary. Following completion of construction, the property would be restored in accordance with its Plan, Procedures, and landowner stipulations. Residential areas and general mitigation measures for residences within 50 feet of disturbance are identified in section 4.2.9.1.

Agricultural Areas

Northwest would segregate topsoil in actively cultivated and rotated cropland, improved pasture, nonsaturated wetlands, and residential areas. A maximum of 12 inches of topsoil would be segregated from over the trench in these areas, and in other areas at the specific request of the landowner. The topsoil would be stored in separate windrows on the construction right-of-way or in a manner to ensure separation of the topsoil from the subsoil. Where topsoil is less than 12 inches deep, the actual depth of the topsoil would be removed and segregated as directed by the EI. The depth of the trench would vary with land use and the stability of the soil, but it would be sufficiently deep to allow for at least 3 feet of cover on top of the pipeline.

Rugged Terrain

Portions of the WEP would cross rugged terrain, consisting of steep slopes and ridgetops that would require the use of cross-right-of-way leveling construction techniques to provide safe working conditions. Northwest would cut material from the uphill side of the construction right-of-way and use the removed material to fill the downhill side of the construction right-of-way, providing a safe and level surface for travel lanes and equipment operation, also referred to as side-hill construction. The trench would then be excavated from the newly graded right-of-way. The amount of extra workspace that would be needed would be a function of the percent side slope (see figure 2.2.3-2). Following pipeline installation and trench backfilling, the removed material would be replaced and slopes restored to original contours. Steep slopes may also require the installation of special erosion control measures, including trench breakers, slope breakers, interception dikes, and erosion control mats to prevent the movement of disturbed soil off the right-of-way. Northwest would stabilize slopes in accordance with its Plan, Procedures, and ECRP (see appendix J1).



NOTES:

1. STRIP AND STOCKPILE TOPSOIL WHERE GRADING IS REQUIRED.

2. TOPSOIL SHALL BE STOCKPILED UPHILL (AS SHOWN) UNLESS OTHERWISE APPROVED BY THE COMPANY. KEEP TOPSOIL PILE CLEAN OF ALL CONSTRUCTION DEBRIS. MAINTAIN SEPARATION BETWEEN TOPSOIL, GRADING SPOIL AND TRENCH SPOIL PILES.

3. LEAVE GAPS IN TOPSOIL AND SPOIL PILES AT OBVIOUS DRAINAGES. DO NOT PUSH TOPSOIL OR SPOIL INTO CREEKS OR WETLANDS. DO NOT USE TOPSOIL FOR PADDING.

4. WHERE SIDE HILL SECTION IS OF SEVERE GRADE, ONLY A SINGLE COMBINED WORKING LANE AND TRAVEL LANE SHALL BE CONSTRUCTED. WHERE REQUIRED, PIPE LINE-UP, WELDING AND JOINT COATING SHALL BE PERFORMED AT AN ADJACENT AREA AND THE LINE INSTALLED AS A "DRAG SECTION."

5. IN AREAS WHERE PERMANENT ROW IS NOT LEFT AS ACCESS, SURFACE SHALL BE RESTORED TO NEAR ORIGINAL LINE, GRADE AND CROSS SLOPE UPON COMPLETION OF CONSTRUCTION. THE FINISHED SURFACE SHALL HAVE WATER BARS INSTALLED, SLOPE MATTING PLACED, RESEEDING AND RE-VEGETATION WORK DONE WHEN STATED IN OTHER PROJECT REQUIREMENTS OR ORDERED BY THE COMPANY.

Figure 2.2.3-2: Typical Side Slope Construction

In places where ridgetop construction would be required, ridgetops may not be restored to preconstruction conditions, but would be graded to shed water and would be left sufficiently flat to allow for periodic monitoring, and maintenance, if required. The flatter slopes at the ridgetops would avoid the potential erosion of more significant backfill that would be associated with fills placed to reconstruct the original ridge tops.

Hard Rock

Bedrock would be encountered in localized areas during construction of the WEP based on experience from installation of the existing gas pipelines within the right-of-way. Based on past experience, Northwest anticipates that blasting would not be necessary and that bedrock would be excavated using rock saws or other specialized excavation equipment and techniques (such as breaking using hydraulic hammers or expansive grouts). In the event unrippable subsurface rock is encountered, blasting for trench excavation may be necessary. In these areas, blasting would be performed under the supervision of an individual(s) having current blasting licenses as required by state and local agencies, and according to a site specific blasting plan that would be developed prior to any blasting. Care would be taken to prevent damage to underground structures (e.g., cables, conduits, and pipelines) or to springs, water wells, or other water sources. Blasting mats or soil cover would be used as necessary to prevent the scattering of loose rock. Blasting would be conducted during daylight hours and would not begin until occupants of nearby buildings, stores, residences, places of business, and farms have been notified.

2.2.3.3 Aboveground Facilities Construction Procedures

Construction of the aboveground facilities would follow industry-accepted practices and procedures. Construction activities at the compressor stations, including storage of construction materials and equipment, would be confined within the existing compressor station property. Debris and wastes generated from the construction and retirement of existing facilities would be disposed of appropriately. Surface areas disturbed would be timely restored. No special construction methods would be required for the station modifications. The facilities would be constructed over a period up to 9 months in duration.

Excavation would be performed as necessary to accommodate the new reinforced concrete foundation for the new compressors. Forms would be set, rebar installed, and the concrete poured and cured in accordance with applicable standards. Concrete pours would be randomly sampled to verify compliance with minimum strength requirements. Backfill would be compacted in place, and excess soil would be used elsewhere or distributed around the site.

The compressors, piping, and other equipment would be shipped to the site by truck. The compressors would be offloaded using cranes. The equipment would then be positioned on the foundation, leveled, grouted, and secured with anchor bolts.

Welders and welding procedures would be qualified in accordance with API standards or the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. Welds in large-diameter gas piping systems would be X-rayed (or other nondestructive testing method) to ensure compliance with code requirements.

The installation of the pig launchers/receivers and MLVs would meet the same standards and requirements established for the compressor station modifications and pipeline construction. Prior to placing aboveground facilities into service, Northwest would hydrostatically test components following applicable federal, state, and local requirements. In addition, controls and safety equipment and systems would be calibrated and tested.

2.2.4 Construction Schedule

No work would begin until all required permits and approvals are in place. During 2017, Northwest would install trenchless crossings, such as HDD or direct pipe, of major waterbodies listed in table 2.2.3-1. This schedule would allow for sufficient time to pursue permits for alternative crossing locations or methods to cross these rivers in the event that trenchless installation methods are unsuccessful. An alternate crossing method or trenchless crossing at an alternate location would then be completed in 2018 during the WEP pipeline construction.

In 2017, Northwest would also conduct clearing in some large forested areas on the Woodland Loop, Chehalis Loop, and in some select other locations ahead of the WEP pipeline construction to minimize overall workspace, ATWS requirements, and impacts to landowners. ATWS requirements would be minimized by proposing a multiple-year construction schedule because the same work areas that would be used to stage right-of-way logging activities and provide timber storage and decking space in 2017 could be used for pipeline construction activities in 2018. Timber removal concurrent with pipeline construction would require additional ATWS to work safely and efficiently, and potential clearing delays could force construction activities into the winter rainy season, which increases the potential for erosion and safety hazards.

Northwest anticipates initiating the compression work at the five existing compressor stations in the fourth quarter of 2017. Pipeline and compression work would be completed and the facilities would be placed in service in the fourth quarter of 2018.

2.2.5 Environmental Compliance Inspection and Mitigation Monitoring

Northwest would include implementation details in a set of "approved for construction" Alignment Sheets, as well as other construction drawings and specifications. The construction contractors would install facilities according to Northwest specifications and the Environmental Construction Drawing Package. To specifically support the application of proper field construction methods, Construction Alignment Sheets would be prepared incorporating provisions of its Plan and Procedures. Northwest conducts annual training for its EIs in proper field implementation of its Plan and Procedures as well as other mitigation measures. The inspectors for this project would be drawn from Northwest's inspector pool. Training for field construction personnel and contractors' personnel would be conducted prior to and during construction.

Northwest would also implement a third-party compliance monitoring program. The third-party compliance monitors would represent FERC and would be on-site daily during project construction and restoration.

For purposes of quality assurance and compliance with mitigation measures, other applicable regulatory requirements, and Northwest's specifications, Northwest would be represented on each spread by the Chief Inspector. One or more Craft Inspectors and at least one EI would assist the Chief Inspector. The EI's duties would be consistent with those contained in paragraph III.B (Responsibilities of the EI) of Northwest's Plan and Procedures. The EI would be:

- responsible for monitoring and documenting compliance with mitigative measures required by FERC and any other grants, permits, certificates, or other authorizing documents;

- responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract or any other authorizing document;
- empowered to order correction of acts that violate the environmental conditions imposed by FERC, or any other authorizing agency;
- a full-time position separate from other activity inspectors; and
- responsible for maintaining status reports and training records.

The Environmental Construction Drawing Package would be distributed to Inspectors and to contractors' supervisory personnel. If a contractor's performance is unsatisfactory, the terms of the contract would allow for work stoppage and would require the contractor to begin remedial work.

Northwest's Engineering and Construction Department would be responsible for designing and constructing certificated facilities in compliance with regulatory and nonregulatory requirements and agreements. If technical or management assistance is required, the responsible Northwest Chief Inspector would request assistance from the appropriate company department or division. Northwest's Operations Department would be responsible for long-term maintenance of the WEP. Various Northwest departments would be responsible for regulatory compliance.

Northwest's Land and Natural Resources Department would serve as the point of contact for questions relating to environmental permits and landowner-related issues.

2.2.6 Operation, Maintenance, and Safety Controls

2.2.6.1 Pipeline Facilities

Operational activity on the pipeline would be limited primarily to maintenance of the right-of-way and inspection, repair, and cleaning of the pipeline. Periodic aerial and ground inspections by pipeline personnel would identify soil erosion that may expose the pipeline, dead vegetation that may indicate a leak in the line, conditions of the vegetative cover and erosion control measures, unauthorized encroachment on the right-of-way (such as building and other substantial structures), and other conditions that could present a safety hazard or require preventative maintenance or repairs. Appropriate responses to conditions observed during inspection would be taken as necessary.

In accordance with 49 CFR 192, the pipeline system would have a cathodic protection system to protect it where minute defects may develop in the pipeline coating. Cathodic protection is not included as part of the WEP. Northwest would assess the needs for additional cathodic protection for the 36-inch-diameter loops within 1 year after the pipeline installation and would collocate cathodic protection components with existing systems where practical; however, new locations for anode beds and rectifiers may be required.

Northwest would operate its system, including the WEP, in compliance with the requirements of 49 CFR 192.625, "Odorization of Gas," which states that a line (Northwest's system including the WEP in this case) need not be odorized if at least 50 percent of the length of a line is in a Class 1 or Class 2 location. More than 50 percent of Northwest's system, including the WEP, is in a Class 1 or 2 location and is therefore not subject to odorization of gas.

Vegetation on the permanent right-of-way would be maintained by mowing, cutting, and trimming. The right-of-way would be allowed to revegetate; however, large brush and trees would be

periodically removed. Trees or deep-rooted shrubs that could damage the pipeline's protective coating, obscure periodic surveillance, or interfere with potential repairs and would not be allowed. The frequency of the vegetation maintenance would depend on the vegetation growth rate. Vegetation maintenance would not normally be required in agricultural or grazing areas.

The pipeline facilities would be clearly marked at line-of-sight intervals and at crossings of roads, railroads, and other key points. The markers would clearly indicate the presence of the pipeline and provide a telephone number and address where a company representative could be reached in the event of an emergency or prior to any excavation in the area of the pipeline by a third party. Northwest participates in One-Call systems.

2.2.6.2 Compressor Stations

Compressor station crews would perform maintenance of the new and existing equipment. Station personnel would perform routine checks of the facilities including calibration of equipment and instrumentation, inspection of critical components, testing of safety equipment, and scheduled and routine maintenance of equipment. Northwest would take corrective actions for any identified problem.

The existing compressor stations are equipped with combustible gas and fire detection alarm systems and an emergency shutdown system that would be expanded to include the new equipment. The compressor station is also equipped with relief valves or pressure protection devices to protect the station piping from overpressure if station or unit control systems failed. A telemetry system would notify personnel locally and at the gas control headquarters in Salt Lake City, Utah of the activation of safety systems and alarms, in turn, the gas control headquarters would instruct maintenance personnel to investigate and take proper corrective actions.

3.0 ALTERNATIVES

To adhere to the CEQ regulations for complying with the NEPA (at 40 CFR Part 1502.14), the EIS must evaluate reasonable alternatives. This EIS compares the environmental impacts of the proposed action against a range of alternatives.

Each of the cooperating agencies with obligations under NEPA can use this alternatives analysis as part of their decision making process. Individual agencies would ensure consistency with their own administrative procedures prior to accepting the recommendations in this EIS.

In accordance with the NEPA and Commission policy, we have evaluated a number of alternatives to the Oregon LNG Project and to the WEP to determine if any are reasonable and environmentally preferable to Oregon LNG's and Northwest's proposed actions. Alternatives considered, which are described in more detail below, include the No Action alternative, system alternatives, LNG terminal alternatives, pipeline route alternatives, and aboveground facilities alternatives.

Alternatives were evaluated against the purpose and objectives of the projects, as described in section 1.3. Oregon LNG's primary objective is to facilitate the export of Canadian-sourced natural gas (and to a lesser extent, the export of U.S.-sourced gas from the Rocky Mountain region) to foreign markets and isolated U.S. markets in need of supply, including Hawaii and coastal Alaskan communities. Should the current market conditions of natural gas oversupply change in the future, the project facilities would be used for importing and revaporizing foreign-sourced LNG for consumption in U.S. markets. Because the Oregon LNG terminal is anticipated to operate primarily in export mode for the foreseeable future if it is authorized, our alternatives analysis has focused on the primary objective of export operations.

Northwest's primary objective is to provide 750,000 Dth/d of incremental transportation capacity on Northwest's existing system from the natural gas supply hub at Sumas to Oregon LNG's pipeline.

The FERC's evaluation criteria for selecting alternatives include whether they:

- are technically and economically feasible, reasonable, and practical;
- offer a significant environmental advantage over the proposed action; and
- have the ability to meet the objectives of the projects.

With respect to the first criterion, it is important to recognize that not all conceivable alternatives are technically and economically feasible and practical. Some alternatives may be impracticable because they are unavailable and/or incapable of being implemented after taking into consideration costs, existing technologies, and the overall project purpose. We do not design LNG terminal and natural gas pipeline projects. Rather, companies propose and design projects in response to market conditions. In turn, we analyze these proposals and identify and disclose a reasonable range of alternatives. In conducting this analysis, it is important to recognize the environmental advantages and disadvantages of the proposed actions in order to focus the analysis on reasonable alternatives that may reduce impacts and offer a significant environmental advantage. A detailed discussion of the environmental consequences of the projects (both adverse and beneficial) is included in section 4.

An important consideration in assessing pipeline route alternatives is that the pipeline must be constructible and safe. In most cases we used desktop data for comparisons, including U.S. Geological Survey (USGS) topographic quadrangle maps, aerial photography, National Wetlands Inventory (NWI)

maps, site file searches, and literature reviews. However, in some cases, where a previously proposed route is now an alternative, Oregon LNG or Northwest may have conducted on-the-ground environmental surveys. While the raw data were collected by Oregon LNG, FERC staff and cooperating agencies performed the alternatives analyses, which included validation of data supplied by Oregon LNG.

The narrative below explains why a particular alternative was found to be environmentally preferable. In conducting a reasonable analysis, we considered environmental advantages and disadvantages, and focused the assessment on those alternatives that may minimize impacts on specific resources. In general, a smaller footprint or shorter pipeline is better. One mile of a 95- or 100-foot-wide corridor would impact about 12 acres. Other elements that may influence the selection of an alternative included the avoidance of historic properties or habitat for federally-listed threatened or endangered species, reduction of crossings of waterbodies or wetlands, minimization of impacts on the lower Columbia River, avoidance of geological hazards, distances from residences, lessening of forest clearing, or impacts on agricultural land and specialty crops. In some cases, there were tradeoffs between environmental resources identified during the alternatives analysis, as minimization of impacts on one suite of resources had to be compared to increased impacts on a different set of resources.

We considered a range of alternatives in light of each project's objectives, feasibility, and environmental consequences. Each alternative was considered until it became clear that the alternative would not satisfy one or more of the evaluation criteria.

3.1 NO ACTION

If the Commission denies Oregon LNG's application (the No Action Alternative), the objectives of the proposed project would not be met and the resource impacts, including short- and long-term and permanent impacts, disclosed in this EIS would not occur. However, the selection of the No Action Alternative could result in the use or expansion of other existing or proposed LNG facilities and associated interstate natural gas pipeline systems, or in the construction of new infrastructure to meet the objectives of Oregon LNG's project (to export LNG to global markets or import LNG to provide natural gas to markets in the Pacific Northwest should market conditions be favorable). In section 3.3, we examine natural gas and LNG system alternatives. Any expansion of existing systems or construction of new facilities would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the Oregon LNG Project. Because the primary purpose and need for the WEP is to provide natural gas for the Oregon LNG terminal, if the No Action Alternative were selected for the Oregon LNG Project, the WEP would likely not be constructed as currently proposed.

If the No Action Alternative is selected by the Commission for the WEP, Northwest's proposed facilities would not be constructed, and the short- and long-term and permanent environmental impacts from the project would not occur. In addition, if the No Action Alternative is selected, the stated objectives of Northwest's proposal would not be met. The No Action Alternative would eliminate this natural gas supply for the Oregon LNG Project (if authorized), causing Oregon LNG to either pursue other means of obtaining natural gas supply, which would require construction of additional pipeline facilities, or not to construct the Oregon LNG Project.

The No Action Alternative would not provide the potential economic benefits associated with the proposed projects, including increased jobs, secondary spending, and tax revenues as discussed in sections 4.1.10 and 4.2.10.

Commenters have suggested that the Oregon LNG Project could be replaced by renewable energy resources alternatives. Renewable energy resources include, but are not limited to, wind power, solar

power, tidal power, and hydropower. All of these alternatives represent alternative means of producing electrical power. Because the project's primary purpose is to prepare natural gas for export to foreign and domestic markets, the development or use of renewable energy technology would not be a reasonable alternative to the proposed action.

3.2 SYSTEM ALTERNATIVES

System alternatives would make use of other existing, modified or proposed LNG facilities and/or pipeline systems to meet the stated objectives of the proposed projects. A system alternative would make it unnecessary to construct all or part of the proposed projects; however, some modifications or additions to another existing system may be necessary to meet the projects' purpose and need. Such modifications or additions would result in environmental impacts that could be less than, similar to, or greater than those associated with construction of the proposed projects. The purpose of identifying and evaluating system alternatives is to determine whether potential environmental impacts associated with the construction and operation of the proposed facilities could be avoided or reduced while still meeting the basic objectives of the projects.

As explained in section 1.3, Oregon LNG states that the primary purpose of the Oregon LNG Project is to facilitate the export of Canadian-sourced natural gas (and to a lesser extent, the export of U.S.-sourced gas from the Rocky Mountain region) to foreign markets as well as facilitate the availability of such gas supplies for delivery to Pacific Northwest markets, including the Portland metropolitan area. The Oregon LNG Project would also enable the delivery of gas to isolated U.S. markets in need of supply, including Hawaii and coastal Alaskan communities. The Oregon LNG Project would also serve as a peaking gas resource to help manage regional demand. Should the current market conditions of natural gas oversupply change in the future, the project facilities would be used for importing and revaporizing foreign-sourced LNG for consumption in U.S. markets. The liquefaction facilities would consist of two identical liquefaction trains with capacity of 4.5 MTPA each, for an overall liquefaction rate of up to 9.0 MTPA. LNG would be stored in two 160,000 m^3 full-containment storage tanks. The pipeline would have a capacity of 1.25 Bscfd and a MAOP of 1,440 psig.

Northwest states that the purpose of the WEP would be to provide 750,000 Dth/d of incremental transportation capacity on its existing system from the natural gas supply hub at Sumas to Oregon LNG's pipeline. Northwest also anticipates that the WEP could serve other natural gas markets in Washington to address the needs of other interested consumers. Northwest further indicates that the combination of the WEP and the Oregon LNG Project would provide international customers in the Pacific Rim and regional customers in the Pacific Northwest access to natural gas supplies from western Canadian supply basins, in addition to alternate U.S. domestic sources.

Any system alternative would need to accommodate the services that would be provided by the Oregon LNG Project and the WEP as well as the services proposed by another pending project or the services provided by existing facilities.

3.2.1 Existing Pipelines

A pipeline system alternative could not replace the liquefaction and export functions of the Oregon LNG terminal, but it could potentially replace all or portions of the Oregon LNG pipeline and the WEP. Existing pipeline system alternatives would involve the use of all or portions of other natural gas transmission systems in lieu of constructing the Oregon LNG pipeline and the WEP. Existing natural gas pipelines in Oregon include jurisdictional interstate transportation systems operated by Northwest and Gas Transmission Northwest (GTN). These existing pipelines are illustrated on figure 3.2.1-1.

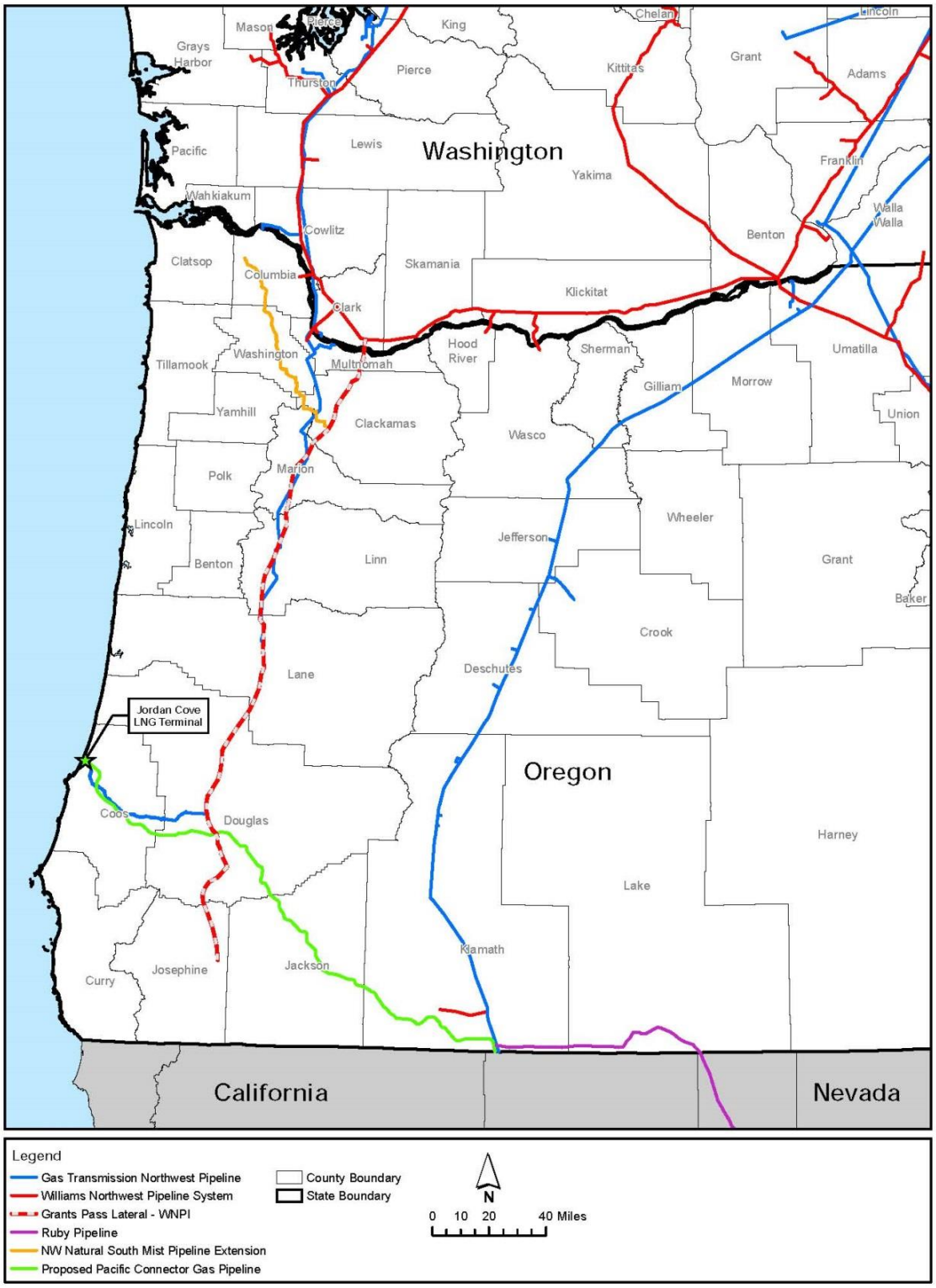


Figure 3.2.1-1: Pipeline Systems in the Pacific Northwest

The 3,900-mile-long bidirectional Northwest natural gas transmission system crosses the states of Washington, Oregon, Idaho, Wyoming, Utah, and Colorado. This system provides access to British Columbia, Alberta, Rocky Mountain, and San Juan Basin natural gas supplies. The Northwest system has a peak design capacity of 3.9 million dekatherms/day (Williams Northwest Pipeline, 2014). The Oregon LNG pipeline would connect to the Northwest pipeline near Woodland, Washington, as part of the Oregon LNG Project, and the WEP includes expansion of the Northwest system. The Northwest pipeline could not itself replace the Oregon LNG pipeline because its nearest location to the terminal is about 50 miles away.

TransCanada's GTN system includes 1,353 miles of pipeline beginning at Kingsgate, British Columbia, traversing through northern Idaho, southeastern Washington, and central Oregon, and terminating near Malin, Oregon, where it interconnects with Tuscarora Gas Transmission Company's (Tuscarora) pipeline to Nevada and Pacific Gas and Electric Company's (PG&E) pipeline system in California. Natural gas for the GTN system originates primarily from western Canadian supplies; although it can receive Rocky Mountain gas through interconnections with Northwest near Spokane and Palouse, Washington, and Stanfield, Oregon. The GTN system can transport over 2.7 Bcf/d (GTN, 2014).

The Ruby pipeline, owned and operated by Kinder Morgan, Inc., extends about 680 miles from a point near Opal, Wyoming, to Malin, Oregon. The 42-inch-diameter pipeline, placed into service in July 2011, has a capacity of about 1.5 Bcf/d at an operating pressure of 1,440 psig. The purpose of the pipeline is to transport Rocky Mountain gas to markets in southern Oregon, northern Nevada, and northern California. Ruby interconnects with Tuscarora and PG&E at Malin.

The Ruby pipeline ends near the southern border of Oregon. The GTN pipeline is routed through the northeast and central part of Oregon and is about 170 miles from the terminal at its closest point. The purpose of the Oregon LNG pipeline and the WEP is to supply natural gas to the Oregon LNG terminal for liquefaction when the terminal is operating as an export facility and to connect the LNG terminal to Pacific Northwest markets (including the Portland metropolitan area) when it is operating as an import facility. Given the distances to the proposed terminal, any expansions of the GTN or Ruby pipelines to northwest Oregon would have greater environmental impacts than the Oregon LNG pipeline. Furthermore, the Ruby pipeline does not transport natural gas from British Columbia. Therefore, we do not consider these pipeline systems to be reasonable system alternatives to the projects.

NW Natural's South Mist Feeder pipeline connects the Mist Underground Natural Gas storage facility with the distribution system serving the Portland metro area. The 16-inch-diameter South Mist Feeder pipeline travels south from Mist, Oregon, across the Tualatin Mountains and enters Washington County, Oregon, before traveling southeast until it reaches the northwest corner of the Portland urban growth boundary. A 24-inch-diameter pipeline parallels the 16-inch-diameter pipeline for about 30 miles within the same corridor from the Mist storage facility to the Bacona Blowdown Station, south of the Washington and Columbia County border.

From the Bacona Blowdown Station, the 24-inch-diameter South Mist pipeline extension continues 62 miles south to the Williams Pipeline Gate Station northwest of Molalla, Oregon. The South Mist pipeline extension provides a means of balancing gas supplies with demand. Although the South Mist pipeline facilities are closer to the terminal than the GTN and Ruby pipelines, as currently designed, they could not provide adequate capacity to meet the projects' purpose and a larger diameter pipeline lateral and additional compression may be needed (see figure 3.2.1-1).

Next we considered system alternatives that could replace only the WEP. Because Northwest is the sole provider of interstate natural gas in the western Washington area, there are no other companies or existing interstate or intrastate natural gas pipeline systems that could meet Oregon LNG's delivery requirements without constructing new transmission facilities. In order for an alternative pipeline system to replace the WEP, new facilities would need to be planned, permitted, constructed, and placed in service. To serve the same market as the WEP, a new natural gas transmission system would likely require the construction of between 260 and 300 miles of new pipeline along with compression and related infrastructure to interconnect with the Oregon LNG pipeline in Woodland, Washington. Based on length alone, such a project would result in significantly greater environmental impacts than expanding the facilities in the proposed action. Therefore, the use of an alternative pipeline system to replace the WEP was eliminated from further consideration.

The following alternatives consider modifications to Northwest's current system to meet the objectives of the WEP.

3.2.1.1 Replace Northwest's Existing Pipeline with Larger Diameter Pipeline

Northwest currently operates a 30-inch-diameter pipeline between Washougal and Sumas, Washington. One system alternative would be to replace the existing 30-inch-diameter pipeline with a larger-diameter pipeline to carry the additional natural gas requested for the Oregon LNG Project, rather than constructing the 10 segments of looping pipeline that are proposed for the WEP. However, removal of the existing 30-inch-diameter pipeline and the installation of a larger-diameter pipeline in the same trench could not be done without significant loss of service to Northwest's existing shippers because the 30-inch-diameter pipeline is the only operational pipeline in numerous segments of the corridor between Woodland and Sumas. Because use of this alternative would result in adverse effects on Northwest customers due to loss of service, and would not reduce environmental impacts, we do not find this alternative to be preferable to the WEP.

3.2.1.2 Return Northwest's Abandoned Pipeline to Service

As described in section 2.2.1, the Northwest system between Woodland and Sumas consists of an abandoned-in-place 26-inch-diameter pipeline that has been partially removed, a contiguous 30-inch-diameter pipeline, and a noncontiguous 36-inch-diameter loop line (which would be extended by the WEP). These three pipelines are mostly installed within a common right-of-way. Another system alternative would be to return the abandoned 26-inch-diameter pipeline to service.

Northwest abandoned its 26-inch-diameter, 809 psig MAOP pipeline between Washougal and Sumas as part of its Capacity Replacement Project (Docket No. CP05-32) in response to an amended Corrected Action Order issued by the PHMSA Office of Pipeline Safety (OPS) subsequent to two pipeline failures. The Corrected Action Order required Northwest: (i) to immediately reduce the operating pressure on its 26-inch-diameter pipeline in the Washougal to Sumas corridor until subsequent testing justified temporary removal of the pressure restriction, and (ii) to permanently abandon its 26-inch-diameter pipeline in the Washougal to Sumas corridor over a 3- to 10-year period, with installation of replacement facilities as necessary to meet future capacity requirements.

In order to replace the design capacity of the 26-inch-diameter Washougal to Sumas pipeline, FERC issued a Certificate of Public Convenience and Necessity for the Capacity Replacement Project authorizing Northwest to abandon the 26-inch-diameter pipeline and construct and operate about 79.5 miles of 36-inch-diameter pipeline, in four segments, in addition to other facilities.

In its Capacity Replacement Project certificate application, Northwest stated "abandonment of most of the pipeline in place leaves open the possibility of a future project to rehabilitate and return portions of the pipeline to service, if new technology becomes available that could economically prove the integrity of the 26-inch-diameter pipeline to OPS's satisfaction." Upon further investigation in recent years, Northwest determined that it would not be practical to return the remaining abandoned 26-inch-diameter pipeline to service. First, the operation of a 26-inch-diameter pipeline would not provide the required incremental transportation capacity. Second, there is uncertainty regarding what remediation efforts would be required on the abandoned 26-inch-diameter pipeline segments to bring them back into operation and what the ultimate MAOP would be for those segments. The WEP's 36-inch-diameter pipeline is being designed for a MAOP of 960 psig. If the abandoned 26-inch-diameter pipeline was returned to service, it could not operate at a pressure higher than 809 psig, due to its current condition.

Because of the inadequate MAOP and uncertain integrity of the 26-inch pipeline, we did not further consider this alternative.

3.2.1.3 Remove the Abandoned Pipeline and Place the New Pipeline in the Same Trench for the Entire Length of the WEP

We asked Northwest to evaluate a system alternative in which the abandoned 26-inch-diameter pipeline would be removed for the entire length of the WEP and the new 36-inch-diameter pipeline would be installed in the same trench. We also received a comment requesting analysis of this alternative. This alternative would be very similar to the proposed project. Based on our review, it is practicable to remove the abandoned 26-inch-diameter pipeline and place the new 36-inch-diameter pipeline in the same trench for about 126.4 miles, or about 90 percent of the WEP. Northwest would not install the WEP in the 26-inch-diameter pipeline trench at certain wetland and waterbody crossings to minimize disturbance and at certain locations to avoid residential areas and pipeline crossovers that require additional workspace requirements. We concur that Northwest would install the new 36-inch-diameter pipeline in the trench of the abandoned 26-inch-diameter pipeline to the extent that is practicable to minimize environmental impacts.

In conclusion, we did not find any existing pipeline systems that could be considered reasonable, feasible, or practicable alternatives to the proposed projects or a part of the proposed projects.

3.2.2 Existing and Proposed LNG Facilities

We considered if other existing or proposed LNG facilities could replace all or part of the Oregon LNG Project and the WEP.

3.2.2.1 Existing LNG Terminals

There are a number of existing and proposed LNG terminals on the East and Gulf Coasts of the United States. However, we do not consider any of the LNG terminals on the East Coast or Gulf Coast to be reasonable or practicable alternatives to the Oregon LNG Project, because their locations would not satisfy the project's main objectives. LNG marine carriers taking cargos from LNG export terminals along the East Coast and Gulf of Mexico would have substantially longer and less direct routes to Asian markets than would LNG vessels loading at the Oregon LNG terminal. For example, the distance from the Gulf Coast to Shanghai via the Panama Canal is about 4,000 miles longer than the distance between the Oregon Coast and Shanghai, and the voyage currently takes 63 days compared to 16 days from the West Coast to Shanghai. Furthermore, Oregon LNG proposes to export natural gas acquired primarily

from western Canada and, to a lesser extent, Rocky Mountain sources through its interconnection to the Northwest system at Woodland, Washington.

There is only one existing LNG export terminal on the West Coast of North America: the plant on the Kenai Peninsula Borough, Alaska. This facility was constructed in 1969 and was being operated by ConocoPhillips Natural Gas Corporation and Marathon Oil Company to export LNG primarily to Japanese markets. It was shut down in 2012 due to declining natural gas reserves and wellhead deliverability in the Cook Inlet region. In 2014, ConocoPhillips resumed operations at the Kenai LNG plant when more gas became available and after it received authorizations from DOE to export LNG to FTA nations and non-FTA nations for 2 years. Collectively, these authorizations allow export of the equivalent of 40 billion cubic feet (Bcf) of LNG over a 2-year period.

Because of its remote location, the Kenai LNG terminal cannot currently access other sources of natural gas outside of the Cook Inlet region. Moreover, the Kenai LNG terminal does not have sufficient capacity, which would require considerable expansion to serve the broader Asian markets that would be served by the Oregon LNG Project. As a result, we conclude that the Kenai LNG export terminal could not meet the objectives of the project.

3.2.2.2 Existing LNG Storage Facilities in the Pacific Northwest

The Commission received comments regarding alternatives that involved upgrading an existing facility rather than construction of the proposed project. Four LNG storage facilities currently exist in the Pacific Northwest. These are peak shaving plants that liquefy natural gas, store it as LNG, and then vaporize the LNG back into natural gas for use during periods of peak demand. These facilities do not add new supplies of natural gas to the region, but rather act as storage facilities, using existing supplies, to even out the discrepancies created by varying seasonal demands.

In Oregon, NW Natural owns and operates two peak shaving LNG storage plants. One is in Portland, and has a 28,000 m^3 tank with a vaporization capacity of 600 MMcf/d. The other is in Newport and has a 48,000 m^3 tank and a vaporization capacity of 1.0 Bcf/d. In Washington, Northwest owns and operates a peak shaving LNG storage plant in Plymouth with a liquefaction capacity of 19.7 MMcf/d, a storage capacity of 60,000 m^3, and a vaporization capacity of 300 MMcf/d. In Gig Harbor, Washington, Puget Sound Energy operates a small LNG peak shaving plant with a storage capacity of 31 Bcf, and a maximum withdrawal rate of 3 Bcf/d.

We assessed the possibility of converting one of the existing peak shaving LNG storage plants into an LNG import and export terminal as a system alternative to the proposed project. The Northwest Plymouth, Washington peak shaving plant is on the Columbia River, but is upriver of several dams, and so it would not be accessible to LNG vessels. The Puget Sound Energy peak shaving plant at Gig Harbor, Washington, is about 1 mile from the harbor and would not be accessible to LNG vessels.

NW Natural's Portland, Oregon peak shaving plant is on the Willamette River and would potentially be accessible to LNG vessels. However, the waterway for LNG marine transit would be over 100 miles long and go past a number of bridges. The terminal facilities would be within 5 miles of downtown Portland.

The NW Natural Newport, Oregon peak shaving plant is on the coast. The port of Newport is relatively small, with channel depths ranging from 20 to 30 feet. The port at Newport could not accommodate LNG vessels without extensive dredging, which would have accompanying environmental impacts. Therefore, we conclude that converting any of the existing peak shaving LNG storage plants in

the Pacific Northwest into an LNG import and export terminal would not be practicable and would not provide a significant environmental advantage over the proposed project.

3.2.2.3 Proposed LNG Export Terminals on the West Coast of North America

In September 2014, Alaska LNG filed a request with FERC to begin the environmental and safety review needed for federal authorization to build its project (Docket No. PF14-21-000). The project sponsors are North Slope producers ExxonMobil, ConocoPhillips, and BP, as well as pipeline company TransCanada and the State of Alaska. The project includes a produced gas treatment facility, a 42-inch-diameter, 800-mile-long pipeline from Alaska's North Slope to Cook Inlet, and an LNG terminal at Nikiski. The terminal would have the capacity to make up to 20 MTPA of LNG. Although the Alaska LNG project would provide an export terminal on the West Coast of North America, it would not be able to access the gas supplies from western Canada and the Rocky Mountains. Thus, the Alaska LNG project cannot meet all of the objectives of the Oregon LNG Project.

Applications for more than a dozen LNG export projects in British Columbia have been filed with Canada's National Energy Board. Like the Oregon LNG Project, the proposed British Columbia LNG export terminals would be on the Pacific Coast of North America, and could potentially serve markets in Asia, as well as customers in Hawaii and Alaska. The main source of the natural gas for the British Columbia terminals would be from eastern British Columbia and Alberta. There are unresolved environmental, construction-related, and monetary issues regarding building new pipelines over the Canadian Rockies from the gas-producing regions in the interior to the terminals on the coast. In addition, there are regulatory and First Nation issues that are unique to Canada. Only one permit for an export terminal has been approved. Seven proposals are under environmental review and the rest have not begun an environmental review.

Of the proposed LNG projects in British Columbia, the 10 MTPA Kitimat LNG Project is furthest along and could be operational by 2020 if financial investment requirements are met. The Kitimat LNG Project has its major provincial and federal approvals in place as well as right-of-way agreements with the 16 First Nations that would be crossed by its pipeline (Chevron and Apache, 2015a). The initial site development has begun at its terminal site, a former pulp mill site near Kitimat, British Columbia, but major construction is pending completion of LNG plant engineering and final investment decisions. Kitimat LNG plans to build a 298-mile-long, 42-inch-diameter pipeline that would deliver natural gas from the Liard and Horn River basins in northeastern British Columbia (Chevron and Apache, 2015b). Right-of-way surveying and construction of some access roads has begun along Kitimat LNG's pipeline route but pipeline construction is pending development of gas resources.

Like the Oregon LNG Project, the Kitimat LNG Project would export natural gas from the West Coast of North America to Asian markets but would require a major expansion to accommodate the additional capacity proposed for the Oregon LNG Project, as well as a business agreement between the sponsors. This would require restarting the permitting process and result in delays to the current Kitimat LNG Project, assuming final investment decisions allow it to be completed. Furthermore, expanding this or one of the other proposed LNG facilities in British Columbia would be not be a reasonable system alternative because of operational and business considerations associated with a location outside the United States.

There is one other proposed LNG export terminal in Oregon besides the Oregon LNG Project. On May 21, 2013, Jordan Cove Energy Project, L.P. (Jordan Cove) filed an application with FERC in Docket No. CP13-483-000 for a proposed LNG export terminal at Coos Bay, Oregon (see figure 3.2.1-1). The terminal would have the capacity to produce up to 6 MTPA of LNG for shipment to customers

around the Pacific Rim. Pacific Connector Gas Pipeline, LP (Pacific Connector) filed its related application with FERC on June 6, 2013, in Docket No. CP13-492-00 for a new 232-mile-long, 36-inch-diameter pipeline capable of transporting up to 1 Bscfd of natural gas from the Malin, Oregon hub to the Jordan Cove terminal. Pacific Connector would obtain natural gas from western Canadian and Rocky Mountain sources, through interconnections with the Ruby and GTN pipelines; and would also serve markets in southern Oregon (see figure 3.2.1-1). In this document, we refer to these inter-related proposals as the Jordan Cove Energy and Pacific Connector Gas Pipeline (JCE & PCGP) Project. The purpose of the JCE & PCGP Project is to create a new West Coast LNG export point to mainly serve Asian customers, and potentially markets in Alaska and Hawaii.

Jordan Cove's proposed LNG terminal would be in Coos County, Oregon, on the bay side of the North Spit of Coos Bay. LNG marine carriers would access the terminal up the Coos Bay navigation channel about 7.5 miles to the proposed terminal. Proposed facilities would include a marine slip with a berth for one LNG vessel on the east side and a berth for tug boats on the north side capable of handling about 90 LNG marine carriers per year, two full-containment LNG storage tanks, each with a net volume of 160,000 m^3, and four natural gas liquefaction trains, each with the export capacity of 1.5 MTPA of LNG. The terminal would also include a natural gas liquids extraction facility and a new 420-MW electric power plant and utility corridor, a connection to the pipeline and gas processing plant, a transfer pipeline to the berth, loading facilities at the berth, firewater ponds, ground flares, support buildings, utility and access corridor between the terminal and the power plant, a security center, and a natural gas treatment plant.

The Pacific Connector Gas Pipeline (PCGP) would extend from the LNG terminal across Coos, Douglas, Jackson, and Klamath Counties, terminating at interconnections with PG&E and Tuscarora near Malin, Klamath County, Oregon. Aboveground facilities associated with the pipeline include a 41,000-horsepower compressor station near Butte Falls, 4 meter stations, 5 pig launchers and receivers, 17 MLVs, and 11 communication towers. The PCGP would traverse the Coastal Range and the Cascade Range, and cross lands administered by four BLM districts and three National Forests.

In order for the JCE & PCGP Project to meet its objectives as well as the objectives of the proposed projects it would have to be capable of manufacturing up to 9.0 MTPA of additional LNG for export and to store up to an additional 320,000 m^3 of LNG at the Jordan Cove terminal. Further, the PCGP would need transportation capacity for an additional 1.25 Bscfd at a MAOP of 1,440 psig, the volume of natural gas that the Oregon LNG Project pipeline would transport to support manufacturing LNG at the Oregon LNG Project terminal. The JCE & PCGP Project would have to add additional liquefaction and LNG storage facilities at the Jordan Cove terminal and additional pipeline facilities (either larger diameter pipe, additional compression, pipeline loops, or a combination of these types of facilities) to accommodate the pipeline transportation capacity that would be needed to support the operation of the additional LNG facilities. The additional volume of gas for export to FTA and non-FTA countries would have to be approved by DOE. As a result, we determined that the JCE & PCGP Project would not be an economically or practically feasible alternative to the Oregon LNG Project and the WEP. Thus, we do not recommend it as a system alternative.

3.3 LNG TERMINAL ALTERNATIVES

3.3.1 Offshore LNG Terminal Alternatives

The Commission received comments regarding alternatives related to building offshore LNG facilities where LNG could be transferred to and from LNG marine carriers at sea without the need for an onshore terminal facility. Offshore LNG terminals sited in federal waters fall under the jurisdiction of the

Marine Administration and the Coast Guard (pursuant to the Deepwater Port Act of 1974, as amended by the Maritime Transportation Security Act of 2002).

Fixed offshore LNG facilities include gravity-based structures (GBS) and offshore platforms. These facilities can be fitted with docking, transfer, storage, and liquefaction/vaporization equipment. A natural gas pipeline must be built along the ocean floor from the shore to the offshore terminal. These structures must be sited where the ocean floor is relatively level and has a geologic makeup with the ability to support the foundation and weight of the facility.

GBS are terminals with foundations built directly onto the ocean floor. The deep waters relatively close to the shore would limit the siting of a GBS to a location less than 2 miles off the Oregon coast, which would create aesthetic impacts on open ocean views. In addition, because a GBS is fabricated in a graving dock (or dry dock) at an onshore location and towed to the offshore terminal location, the GBS design is not completely devoid of adverse onshore impacts, such as impacts on wetlands and other sensitive land uses. The onshore graving dock must be of sufficient size and depth to fabricate the GBS, and in an area with access to a 45- to 50-foot deep channel to float the GBS. The fabrication site for a GBS would require between 50 and 100 acres, and availability of adequate infrastructure to facilitate construction. Offshore platforms can either exist as a result of new construction or from the conversion of an existing platform. Platforms are anchored using fixed-tower structures that can be located in deeper water than GBS, but fixed structures typically provide less LNG storage capacity. Existing platforms do not currently exist off the Pacific Northwest coast; therefore, the conversion of an existing platform in the vicinity of the Oregon LNG Project would not be possible.

Construction of a new platform or placement of a GBS would have associated environmental impacts on the marine environment, as would construction of a natural gas pipeline from the shore to the platform. Further, the winter ocean conditions (rough weather and high sea states) off the Oregon coast would make it difficult for construction, operation, and maintenance of these facilities (FERC, 2008). Once an LNG marine carrier is connected to an offshore terminal, safe loading and unloading operations are dependent on the ability to transfer LNG without interruption, which is contingent on sea states at the time of the transfer. Rough seas could create unfavorable ship motions, which could cause a ship to range against the mooring system and exceed limitations on piping systems and mooring lines.

A floating LNG unit consists of an oversized LNG marine carrier vessel that is outfitted with LNG vaporizers or liquefaction equipment, docking equipment, and LNG transfer equipment. This unit would be anchored offshore where conventional LNG marine carriers could dock next to and load or unload LNG. The facility would be connected to shore by an undersea pipeline. Floating units for liquefaction are very new.

A floating LNG unit would have fewer environmental impacts than a fixed facility, although the undersea pipeline impacts would be the same. A floating LNG unit would have less LNG storage capacity. Severe weather conditions would pose the potential for reduced berth operability and the relative motion of the floating unit and LNG ship during storm events could increase the difficulty and safety risks of LNG transfers.

An offshore LNG terminal alternative would avoid some of the environmental impacts of the Oregon LNG terminal, such as impacts associated with LNG marine carriers, conflicts with existing commercial and recreational users of the waterway, visual effects, and impacts on aquatic resources and water resources related to dredging. Considering the additional impacts on marine resources and safety and constructability issues associated with winter sea and weather conditions off the Oregon Coast, we do not consider an offshore terminal to be reasonable alternative to the Oregon LNG Project.

3.3.2 Onshore Terminal Site Alternatives

3.3.2.1 Initial Screening

The Commission received a number of comments suggesting alternative sites for the LNG terminal, including the Puget Sound area.

During its initial screening for LNG terminal locations, Oregon LNG conducted an analysis of regional markets around North America in relation to current and forecasted demand and available supply of natural gas, while also focusing on locations with deepwater access to Pacific Rim countries (e.g., China, Japan, South Korea, and Singapore). From a geographic perspective, the Pacific Northwest coast is an ideal location for exporting North American natural gas to Pacific Rim markets. To meet the purpose of the project, the terminal location also must have the ability provide natural gas to the Pacific Northwest, specifically the Portland metro area, as market conditions warrant it. Thus, Oregon LNG focused its search for LNG terminal locations along the Pacific Northwest coast, specifically locations providing access to the Portland metro area.

Oregon LNG identified potential onshore locations within the Pacific Northwest region using data and maps published by the American Association of Port Authorities, USACE, Coast Guard, and others. Locations were initially screened by Oregon LNG to identify sites that would fulfill the purpose and need of the project, while taking into consideration public safety and environmental factors, using the following criteria:

- **Depth of existing ship channel**: LNG is transported in large ships, about 1,000 to 1,200 feet long and 150 to 180 feet wide, requiring a minimum draft of 37 to 40 feet to safely access areas when fully loaded. Terminal sites with access to existing deep draft shipping channels having at least 43 feet of depth were preferred to minimize dredging.
- **Access to target markets**: The terminal would deliver LNG to Asian markets and to the Pacific Northwest, primarily the Portland metro area. Therefore, the site would need to provide access to both Asia and the Portland area.
- **Protection from severe winter conditions in the ocean waters off the Pacific Northwest coast**: During winter, severe weather conditions exist off the coast of the Pacific Northwest. Therefore, the terminal location would need to provide protection from these conditions for LNG marine carriers to dock and unload their cargo.
- **Minimization of impacts on natural habitats**: A site that had prior industrial use /or was man-made from dredged spoils or fill was preferred to avoid or reduce impacts on high value or sensitive habitats and native vegetation.
- **Distance from population centers**: The location should not be adjacent to medium or high density residential areas.
- **Availability of sufficient area**: Locations were removed from consideration if unavailable for acquisition by purchase or lease because they could not meet the project's purpose. In addition, the parcels had to be of sufficient size for all the facilities required for the terminal as well as for adequate exclusion zones around the terminal.
- **Proximity to existing utilities and infrastructure**: This includes basic services such as electricity, water, and sewerage as well as existing transportation facilities such as roads to move manpower and equipment to and from the terminal location during construction.

- **Consistency with existing use of the site and surrounding areas**: Sites that had been previously used for industrial purposes and where surrounding land uses were also industrial in nature rather than residential, commercial, or public were preferred.

The Puget Sound area was eliminated from consideration because of the legal challenges associated with attempting to add new supertanker traffic to the sound per the 1977 Magnuson Amendment to the MMPA, which effectively bans additional supertankers from Puget Sound. Sites in Coos Bay, Oregon, and in Grays Harbor, Washington, were also eliminated from consideration based on depth of the existing shipping channels and distance from Portland.

Eight locations along the lower Columbia River with reasonable access to the Portland metro area were initially considered as potential terminal locations. However, two of these sites were ultimately also eliminated from further evaluation. The first site at Barlow Point includes an area that would be generally suitable for an LNG terminal; however, the site, at RM 63, would require a lengthy trip upriver, which would increase air emissions from LNG marine carriers and slightly increase the safety and security risks associated with the LNG marine carrier transit. This location is also just west of the City of Longview and the City of Kelso, Washington. These are two of the largest population centers on the Columbia River outside of the Portland/Vancouver metro area. Therefore, siting a terminal in this location would increase the probability for conflict both on the river and on shore. In addition, the City of Longview is contemplating removing the industrial zoning from the property and redeveloping it as a mixed-use residential and commercial/retail center. The anticipated loss of the necessary zoning and the proximity of these incompatible uses make the site infeasible.

The other eliminated site, at Kalama, Washington, would be ideally located with respect to the Northwest pipeline; however, this site is at RM 68, requiring a long trip (more 56 miles longer than for the proposed site) upriver and under two existing bridges. In addition, existing residences in Prescott, Washington, would be within 2,000 feet of the docked LNG marine carriers. For these reasons, Oregon LNG dismissed this site from consideration.

3.3.2.2 Lower Columbia River Site Evaluation

Six potential LNG terminal locations along the lower Columbia River were carried forward for further analysis as shown on figure 3.3.2-1 and listed in table 3.3.2-1.

Table 3.3.2-1

Terminal Site Alternatives along the Lower Columbia River

No.	Potential Site Property	Comments
1	Tansy Point	RM 10, directly north of Warrenton and west of Astoria.
2	East Bank Skipanon Peninsula	RM 11.5, in Warrenton at the confluence of the Skipanon River.
3	Tongue Point	RM 18, 2 miles east of Astoria.
4	Bradwood Landing	RM 38, between Tenasillahe and Puget Islands, just south of Julia Butler Hanson National Wildlife Refuge.
5	Wauna	RM 41, directly west from Coffee Pot and Puget Islands
6	Port Westward	RM 53, west of Crims and Gull Islands



Figure 3.3.2-1: Terminal Site Alternatives Along the Lower Columbia River

These six sites were evaluated first for safety and constructability and then for environmental factors using the criteria and methodology described below. Based on a review of Oregon LNG's methodology and evaluation, we have determined that this is a reasonable approach for evaluating the site alternatives.

Safety and Constructability Criteria

Three main objectives and associated sets of criteria were developed to evaluate different aspects of safety and constructability for the alternative site, including: (1) LNG transport along the lower Columbia River federal navigation channel to each alternative site; (2) the safety and suitability of the berth and offloading area required to move the LNG between shoreland areas and LNG marine carriers; and (3) the safety, suitability, and compatibility of the shoreland areas identified for each site. The siting objectives and criteria were designed to be consistent with the Sandia National Laboratories' 2004 report, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (Sandia National Laboratories, 2004). The Sandia report is discussed further in section 4.1.13.7.

The siting objectives and criteria used in the evaluation of the alternative locations are described below.

1. Safety and Suitability of LNG Marine Carrier Navigation. The maritime transportation of LNG must comply with numerous federal regulatory requirements that influence the selection of an appropriate terminal location. For example, the Coast Guard imposes certain security zone requirements on LNG marine carriers when traveling to an LNG terminal. In addition to escort boats, the Coast Guard normally requires a moving security zone around the vessel.[1] The moving security zone around the LNG marine carriers has the potential to interfere with other shipping. The following three criteria were used to evaluate safety and suitability for LNG marine carrier navigation.

a. Number of times a Sandia Zone of Concern 1 or 2 (see section 4.1.13.7) would overlap a medium or high density population center throughout the transit of the LNG marine carrier in U.S. waters: The WSA prepared for the project identifies medium density areas as having a population between 1,000 and 9,000 persons per square mile, and high density as greater than 9,000 residents per square mile. This criterion is evaluated using the distance from the centerline of the federal navigation channel to the nearest point of medium and high density areas, typically defined by the shoreline of incorporated areas. Sites that result in an overlap of medium and high density population areas by Zone 1 or Zone 2 represent less favorable locations according to this criterion.

b. Number of bridges passed to reach proposed terminal location: The federal navigation channel on the lower Columbia River is crossed by a number of existing bridges. These include the Astoria-Megler Bridge, which crosses between Point Ellice, Washington and Astoria, Oregon, and the Lewis and Clark Bridge, which crosses to Longview, Washington from Rainier, Oregon. Each additional bridge crossing would present an additional perceived safety risk (Sandia National Laboratories, 2004) and potentially create a bottleneck for other large ships attempting to travel under the same bridge.

c. Distance traveled on the Columbia River to reach proposed location: Oregon LNG sought a site that would reduce the distance an LNG vessel is required to travel up the lower Columbia River

[1] The Coast Guard security zone is often referred to as an "exclusion zone," but other vessels are not, in fact, excluded. The zone is analogous to the zone surrounding airports; vessels are allowed to enter the zone but their travel is carefully coordinated and directed by the Coast Guard to minimize the potential for accidents.

federal navigation channel to minimize the possible impact on other river users. In addition, the lower Columbia River is designated critical habitat and Essential Fish Habitat for salmon. Thus, LNG marine carriers have a greater likelihood of impacting this habitat and subsequently the salmon when traveling longer distances upriver. The river mile adjacent to each site was recorded as the required travel distance. Sites requiring longer travel distances represent less favorable locations using this criterion.

2. Safety and Suitability of LNG Transfer Area. The Coast Guard security zone and the Sandia zones of concern would also apply while the LNG vessel is moored at the terminal site. Therefore, the dock would need to be far enough from the federal navigation channel so that the security zone would not interfere with other river vessels and users while the LNG marine carrier is loaded or off-loaded. In addition, the Sandia zones of concern around LNG marine carriers was applied as guidance to the potential berth locations at each site as this is typically the closest carriers would get to public areas.

a. Berth distance to public locations/existing residences within 5,250 feet: The Sandia National Laboratories report concludes that the impacts on public safety and property from an LNG spill are lower at distances beyond 5,250 feet. This distance is set as the threshold from which to measure to the nearest residence or public location from the probable berth location at each alternative site. A detailed berth design was not completed for each alternative and the distance between the shoreline and shipping channel varies from location to location. However, for the purposes of the evaluation, the distance between the nearest residence or public location and the midpoint between the shoreline and nearest edge (south) of the federal navigation channel at each location was used. Berth locations with distances less than 5,250 feet from the nearest residence or public location would represent less favorable locations using this criterion.

b. Berth distance to the federal navigation channel (1,780 feet): The Coast Guard typically recommends a security zone extending 1,500 feet from all sides of LNG marine carriers. No vessels can enter this zone without permission from the Coast Guard. An LNG terminal would need to include a berth location that allows LNG marine carriers to unload at least 1,500 feet from the federal navigation channel to provide other vessels with an unimpeded passage past the terminal location. In addition, the farther a berth is located from the federal navigation channel, the less chance there would be for vessel allisions (the striking of a stationary vessel by a moving vessel).

   Potential locations would allow for additional distance over the minimum 1,500 feet to accommodate the width of the LNG marine carriers and for the berth itself. The width of the largest LNG marine carriers expected to call at the Oregon LNG terminal would be about 180 feet, and the berth width would be about 100 feet. These measurements were added to the security zone giving a total minimum clearance distance of 1,780 feet from the nearest edge of the federal navigation channel. Terminal locations with distances less than 1,780 feet would represent less favorable locations using this criterion.

3. Safety and Suitability of Shoreland Areas. The safety and security requirements pertaining to LNG import terminals restrict potential siting locations. Potential terminal locations must comply with these requirements, as well as being suitable in terms of size, availability, topography, natural disaster risks, infrastructure, and utilities.

a. Onshore distance to population/residences: Community impacts of locating an LNG terminal on a particular site are directly related to the regulatory safety and security zones discussed above. For the purposes of this evaluation, a mandatory exclusion zone with a radius of 1,000 feet was

established as the minimum distance from the outside edge of each terminal location (excluding the berth facilities) to the closest residence or public location. Terminal alternatives with the greatest distances between terminal edge and nearby residences would be the most favorable locations using this criterion.

b. Site allows for reasonable terminal layout: Available acreage would be necessary to permit the installation of the onshore facilities and allow sufficient distance from the storage tanks to buffer any existing off-site structures, buildable properties, or easements. The site topography also would need to be suitable for development and the seismic conditions and tsunami exposure needs to be such that it would be practicable to make the facilities safe using existing construction technologies. The site would need to provide reasonable access to basic ground transportation and utility services.

c. Suitable zoning in place or available: Existing zoning should permit water-dependent industrial development, or there should be a strong likelihood that such zoning could be applied given the nature and history of the site, applicable land use criteria, and communications with local jurisdictions. Sites with existing zoning that allows the proposed use or with a strong likelihood that this zoning could be applied represent more favorable sites using this criterion.

Environmental Criteria

Additional siting objectives and criteria were developed to assess the alternative terminal sites for relative environmental impacts. Criteria were developed based on existing, readily available, public data sources. Terminal footprint and layouts for each alternative site were not developed; therefore the criteria were framed to evaluate the general site locations without specific terminal designs. The results include criteria that generally fall within three categories: 1) direct impacts on fish and wildlife; 2) impacts on onshore habitats; and 3) impacts on the surrounding environment (e.g., air quality).

1. Impacts on threatened, endangered, and other special status fish and wildlife especially during LNG marine carrier transit on the Columbia River. The lower Columbia River estuary supports 16 species of threatened or endangered fish plus, including salmon, steelhead, sturgeon, and eulachon. Federally listed bird and wildlife species also are closely associated with riparian habitat along the Columbia River. In addition, harbor seals, California sea lions, and Steller sea lions, protected under the MMPA, frequently use habitat in the lower Columbia River estuary. Terminal sites that would minimize impacts on these species are preferred. The following criteria were used to assess the alternative locations:

a. Minimize the density of salmonids adjacent to the site: Oregon LNG sought a terminal location that minimizes the adjacent density of salmonids, particularly juveniles. Although sub-yearlings do migrate through deepwater habitats, once in the estuary they tend to rear within a few yards of the shoreline in water less than four feet deep. The assumption used for this criterion was that the density of juvenile fish would be less in wider portions of the lower Columbia River estuary, thus reducing the likelihood for impacts. In contrast, the likelihood for impacts on juvenile salmon in nearshore areas rises in narrower portions of the lower Columbia River estuary where the fish may be more concentrated. Therefore, alternative terminal sites located in narrower sections of the river represent less favorable sites using this criterion.

b. Minimize the potential impacts from wake stranding of juvenile salmonids: The wakes produced by deep-draft vessels transiting the lower Columbia River have been observed to cause occasional stranding of juvenile salmon (see section 4.1.5.2). A recent study (Pearson et al., 2008) shows

that the susceptibility for wake stranding increases as deep draft vessels travel farther upriver, largely due to the narrowing of the river channel with distance from the sea. A number of studies use the proximity of the shoreline to the federal navigation channel as indication of the likelihood of wake stranding of salmonids. This is because wave height decays with distance, and therefore the susceptibility of wake stranding increases with shorter distances between the shoreline and the federal navigation channel. Thus, alternative terminal sites located farther upriver, where the overall river channel narrows, were determined to be less favorable using this criterion.

c. Minimize the number of seal and sea lion haulout areas passed within the lower Columbia River estuary: Harbor seals, California sea lions, and Steller sea lions use specific areas within the lower Columbia River estuary on a regular basis to climb out of the water. These areas, called haulouts, can include beaches, rocky areas, log booms, and floats. Specific seal and sea lion haul-outs within the lower Columbia River estuary are documented by Jeffries et al. (2000) in the report *Atlas of Seal and Sea Lion Haul-out Sites in Washington*. This information was used to identify the locations of these haulouts for this evaluation. The assumption for this criterion was that vessel traffic, especially deep draft traffic, may disturb seals and sea lions at adjacent haulout areas. Longer vessel voyages within the lower Columbia River estuary create potential for greater impacts on haulout areas. Therefore, less favorable terminal locations using this criterion are those sites which require a higher number of haulouts to be passed en route to the terminal.

2. Impacts on onshore habitat. The current onshore conditions found at the various alternative terminal sites range from totally undeveloped to developed, and the sites are used for a variety of purposes. Alternative terminal sites that would minimize impacts on wetlands and forest cover are preferred.

a. Minimize impacts on wetland habitat: Wetlands provide numerous beneficial functions including providing fish and wildlife habitat, protecting and improving water quality, and storing floodwaters. This criterion relies on wetland data for each alternative terminal site obtained from the NWI. Because a terminal layout and design was not developed for each alternative terminal site, a footprint of 100 acres was used as a conservative estimate of the total size necessary for an LNG terminal. A 100-acre rectangle was oriented to best fit the onshore area at each alternative location, and the percentage of NWI wetland occurring within the 100-acre rectangle was calculated. Alternatives with a larger percentage of wetlands potentially impacted at each site represent less favorable terminal locations using this criterion.

b. Minimize impacts on areas with forest cover: Forests provide multiple beneficial functions including wildlife habitat, natural carbon sequestering, oxygen production, and surface and subsurface water storage. The percentage of forest canopy within each 100-acre footprint (from 2a above) was determined using 2008 aerial photography. Alternatives with a larger percentage of forest cover potentially impacted at each site represent less favorable terminal locations using this criterion.

3. Impacts on the surrounding elements of the environment. The construction and operation activities would result in new air emissions. Alternative terminal sites that would minimize impact on elements in the surrounding environment are preferred.

a. Minimize LNG vessel emissions within the lower Columbia Estuary: The federal CAA sets standards for ambient air pollutant concentrations designed to protect public health and welfare. The EPA sets national ambient air quality standards for six specific pollutants (see section

4.1.12.1). Longer vessel voyages up the Columbia River would result in proportionally greater additional emissions within the estuary and, therefore, would be less favorable.

b. Minimize the number of Class I areas within 125 miles: The CAA attempts to "prevent significant deterioration" of the air quality in areas that are cleaner or in attainment of the primary and secondary air quality standards. Specifically, the PSD section of the CAA shows that among the clean air regions of the country, Class I areas deserve the highest level of air-quality protection. Class I areas are designated by Congress and include national parks larger than 6,000 acres, national wilderness areas, and national memorial parks greater than 5,000 acres. The Class I areas identified to be within 125 miles of at least one of the alternative locations are: Mount Adams Wilderness, Goat Rocks Wilderness, Mount Rainier National Park, Olympic National Park, Mount Hood Wilderness, Mount Jefferson Wilderness, and Alpine Lakes Wilderness. A larger number of Class I areas within 125 miles represents a less favorable terminal location using this criterion.

An evaluation of the terminal site alternatives and the proposed site is presented below and summarized in table 3.3.2-2 and table 3.3.2-3.

Tansy Point

Tansy Point is a low elevation headland on the south shore of the Columbia River at RM 10 in the City of Warrenton, Clatsop County, Oregon (see figure 3.3.2-2). The potential site covers about 90 acres and is owned by the City of Warrenton. The Warrenton Fiber Company leases the site from the city as a log yard and wood processing facility. The site is currently within the Water Dependent Industrial zoning district.

The Tansy Point alternative presents some advantages compared with other alternatives, including a short LNG marine carrier transit distance (10 river miles) up the Columbia River, no LNG marine carrier transit under existing bridges or past medium or high density population centers, and compatible existing site zoning.

Disadvantages include limited separation of the hypothetical berth from the federal navigation channel (440 feet) which would not allow for 1,780 feet of clearance required to accommodate the combined Coast Guard security zone, vessel width, and berth width, which could result in other vessel use of the federal navigation being impeded. In addition, the closest residence would be about 1,656 feet from the hypothetical berth location, within Sandia Zone of Concern 2. Further, a review of recent aerial photographs shows that more than 85 residential structures would be within 3,000 feet of the edge of the site; the nearest of which would be within 100 feet.

Environmental advantages of the Tansy Point alternative include the width of the Columbia River adjacent to the site. Of the terminal site alternatives, Tansy Point is located at the third widest point in the lower Columbia River estuary (about 20,495 feet in width). In addition, the site is the closest of all the terminal site alternatives to the mouth of the Columbia River at RM 10, thereby minimizing the risk of impacts on juvenile salmon from wake stranding, and minimizing the amount of air pollutant emissions that would result during LNG marine carrier transits. LNG marine carriers would pass by six seal and sea lion haul-outs on the way to Tansy Point, the lowest total number of the alternative sites.



Figure 3.3.2-2: Tansy Point

The 100-acre area incorporating the Tansy Point site includes about 22 acres of wetlands as defined by the NWI, which is in the middle compared to the other sites. The Tansy Point site has one of the smallest percentages of forest cover (11 percent). The Tansy Point site would be within 125 miles of five Class I areas, sharing the lowest number with the proposed site on the East Skipanon Peninsula.

East Skipanon Peninsula (Proposed Site)

The East Skipanon Peninsula is a protrusion of historic dredged material at RM 11.5 that extends into Youngs Bay along the east side of the confluence of the Skipanon and Columbia Rivers (see figure 3.3.2-3). The proposed terminal would be on the northern portion of the East Skipanon Peninsula on about a 96-acre parcel of land that is owned by the State of Oregon and leased to the Port of Astoria by the ODSL. Oregon LNG holds a long-term sublease for the entire land parcel. The terminal site is currently zoned as Water Dependent Industrial Shorelands I-2. The marine facilities are proposed in areas zoned Aquatic Development A-1.

Safety and constructability advantages of the proposed site include a short LNG marine carrier transit distance (11.5 river miles) up the Columbia River, no LNG marine carrier transit under existing bridges or past medium or high density population centers, and compatible existing site zoning.

The nearest public gathering point (Warrenton Marina) would be 6,235 feet to the south of the berth. The nearest structure (Weyerhaeuser mill building) would be 5,415 feet to the west of the berth, and the nearest residence would be 6,669 feet to the southwest of the berth. The proposed berth would be more than 1,896 feet from the federal navigation channel (meeting the 1,780 feet needed to accommodate the width of the LNG marine carrier, berth, and Coast Guard security zone). However, the Skipanon River channel, which is used by commercial fishing and recreational vessels, would be about 984 feet from the berth.

Environmental advantages of the proposed site include its location on the Columbia River. Because the site is at the widest point in the estuary (23,480 feet) when compared to the other alternative locations, fish are likely distributed over a wider area. This would minimize the likelihood for impacts on fish, especially to juveniles, which favor the top 20 feet of the water column.

In addition, the proposed site is at RM 11.5, and only the Tansy Point alternative is closer to the river mouth. Thus, wake stranding and air pollutant emission impacts from LNG marine carriers would be reduced compared to alternative terminal locations requiring longer transit distances. LNG marine carriers en route to the East Skipanon Peninsula would pass seven seal and sea lion haul outs, the second lowest total of the alternatives.

The 96-acre proposed site includes about 67 acres of NWI-mapped wetlands, the second highest percentage of wetland impacts compared to the other alternatives. The proposed site would disturb the least percentage of existing forest habitat (1 percent). The proposed site would be within 125 miles of five Class I areas, sharing the lowest number with the Tansy Point alternative.



Figure 3.3.2-3: East Skipanon Peninsula (Proposed Site)

Tongue Point

Tongue Point is a 300-foot-high peninsula that protrudes from the south shore into the Columbia River. The Tongue Point terminal site is at RM 18 within the City of Astoria's urban growth boundary in Clatsop County, Oregon. The main portion of the peninsula is connected to the south shore by a low, narrow isthmus. This alternative location contains over 100 acres, including an area along the main shoreline to the southwest of the forested peninsula (see figure 3.3.2-4). The Coast Guard has a buoy depot on the west side of the peninsula, while concrete piers from a former naval base are situated off the east side.

The Tongue Point site is on the east side of the Astoria-Megler Bridge which would require LNG marine carriers to pass under this structure on the way to the terminal site. In addition, the site is immediately adjacent to the Astoria city limits, which means that a medium density population center would be overlapped by Sandia Zone of Concern 2.

The hypothetical berth location would be about half way between the edge of the federal navigation channel and the shoreline (about 965 feet from the channel), significantly less than the 1,780-foot criterion. The closest point along the shoreline is about 1,930 feet from the nearest edge of the federal navigation channel. The closest private residence to the hypothetical berth would be 6,384 feet to the southwest of the site (outside Sandia Zone of Concern 2).

Aerial photography, residential zoning data, and Clatsop County ownership information show that the nearest privately owned residence to the onshore portion of the site is about 2,881 feet southwest of the site. The Lewis and Clark National Wildlife Refuge begins immediately east of the site.

The site is within three separate zoning districts in the City of Astoria: S5-Natural, In-Industrial, and S1-Marine Industrial. At a minimum, a zoning change would be required of the S5-Natural district to allow the terminal to be constructed at this location. Such rezoning is unlikely because of the presence of the Lewis and Clark National Wildlife Refuge.

Environmental advantages include the site's location on the Columbia River. The Tongue Point alternative is located at a relatively wide point in the Columbia River (22,334 feet) and so fish are likely distributed over a wider area. This would reduce the likelihood for impacts on fish, especially to juveniles, which favor the top 20 feet of the water column.

Air pollutant emissions and potential impacts on juvenile salmonids from wake stranding would be lower for the Tongue Point site than for the Bradwood Landing, Wauna, and Port Westward sites, but higher than the Tansy Point site and proposed site. LNG marine carriers traveling to Tongue Point would pass 10 seal and sea lion haul-outs, including the largest harbor seal haul-out in the lower Columbia River, the Desdemona sands, defined in the *Atlas of Seal and Sea Lion Haul-out Sites in Washington* as the main lower Columbia River haul-out for Harbor seals (Jeffries et al., 2000). The Tongue Point alternative has the smallest percentage of NWI wetlands (10 percent) within the 100-acre terminal site, but has the largest percentage of forest cover (63 percent), when compared with the other alternatives. The Tongue Point alternative would be within 125 miles of six Class I areas.



Figure 3.3.2-4: Tongue Point

Bradwood Landing

The Bradwood Landing alternative is in Clatsop County, Oregon, on the south shore of the Columbia River at RM 38 (see figure 3.3.2-5). The site was historically used for several different lumber mills. The Bradwood Landing alternative site is currently zoned by Clatsop County as Marine Industrial, Forest, Aquatic Development, Aquatic Natural, and Aquatic Conservation.

The Bradwood Landing alternative at RM 38 would require a longer trip up the Columbia River by LNG marine carriers than the previously discussed alternatives. LNG marine carriers would be required to pass under the Astoria-Megler Bridge and directly adjacent to the City of Astoria shoreline for about 3.5 miles, where a medium density population center would be overlapped by Sandia Zone of Concern 2.

The hypothetical berth location for an LNG terminal at this location would be about 300 feet from shore and about 1,784 feet from the federal navigation channel. The berth location would be about 2,742 feet from about 21 existing residential structures on the western end of Puget Island. These residences would be within Sandia Zone of Concern 2. The onshore facilities would be about 3,272 feet from the closest residences on Puget Island. The current zoning at the site could require changes to allow the construction of an LNG terminal, and the site contains some steep slopes that could present the potential for difficulties during construction.

The Bradwood Landing site is 1,775 feet from Tenasillahe Island and 2,430 feet from Puget Island. Beyond the islands, it is 13,553 feet to the nearest point along the north shore. This distance across the main channel of the river is the second narrowest of all the alternative terminal locations. Because the site would be at a relatively narrow point in the river when compared to the other alternative locations, there would be a greater potential of impacts on fish, especially to juveniles.

LNG marine carriers in transit to the Bradwood Landing site would travel 38 miles up the Columbia River resulting in greater air pollutant emissions and creating a greater potential for wake stranding of juvenile salmon than the previously discussed alternatives. In addition, LNG marine carriers transiting to Bradwood Landing would pass 24 seal and sea lion haul-outs.

Wetlands are present on 41 percent of the Bradwood Landing site. Only the Port Westward site and the proposed site have a greater percentage of wetlands. Forest covers about 25 percent of the site, which is in the middle of the range when compared to the other alternatives. The Bradwood Landing alternative would be within 125 miles of six Class I areas.

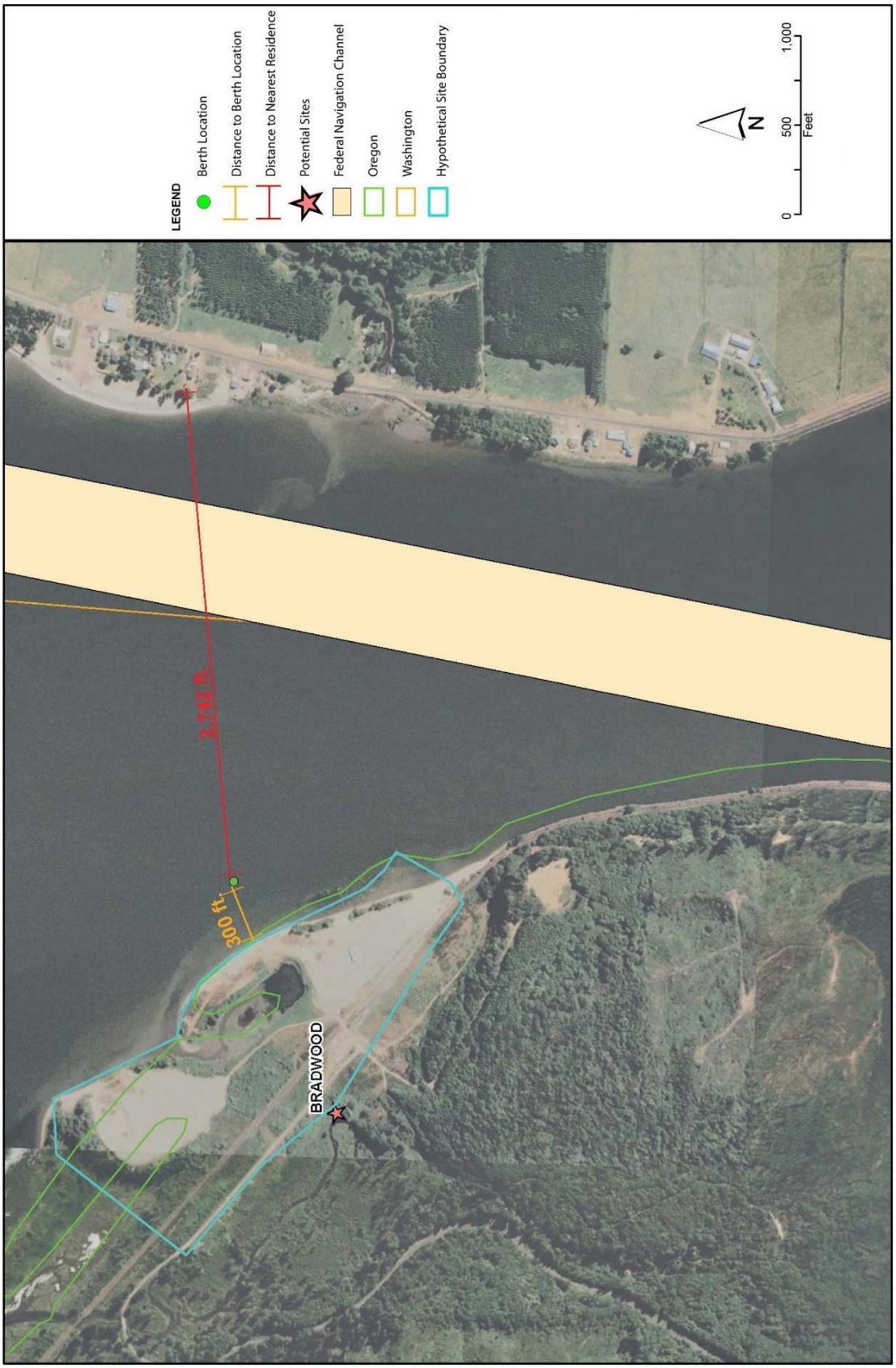


Figure 3.3.2-5: Bradwood Landing

Wauna

The Wauna alternative is on the south shore of the Columbia River at RM 41, in Clatsop County, Oregon, directly west of Coffee Pot and Puget Islands (see figure 3.3.2-6). It includes three existing parcels comprising about 100 acres. The majority of the site is covered by forest land and is within Clatsop County's F-80 Conservation Forestlands zoning district where a water-dependent industrial facility would not be allowed; therefore, a change in zoning would be required to develop an LNG terminal on the site. The site contains some steep slopes that could present the potential for difficulties during construction.

The Wauna alternative would require a longer trip up the Columbia River by LNG marine carriers than the previously discussed alternatives. LNG marine carriers would pass under the Astoria-Megler Bridge and directly adjacent to the City of Astoria, where a medium density population center would be overlapped by Sandia Zone of Concern 2.

The shoreline is about 900 feet from the nearest point of the federal navigation channel; therefore, the Wauna alternative would not allow for the 1,780 feet required to accommodate the combined Coast Guard security zone, vessel width, and berth width. The mid-point between the shoreline and federal navigation channel is 450 feet. A berth at this location would be within 2,312 feet of Puget Island to the northeast. More than 80 residences on Puget Island would be within Sandia Zone of Concern 2. The onshore portion of the Wauna alternative would be about 2,832 feet from the nearest residential structures on the southwest shore of Puget Island.

The Wauna onshore facilities would be about 2,600 feet from Puget Island and 14,814 feet from the nearest point of the north shore of the Columbia River. The Tansy Point, Tongue Point, and proposed sites are all located on wider portions of the Columbia River. LNG marine carriers in transit to the Wauna alternative would travel 41 miles up the Columbia River resulting in greater air pollutant emissions and creating a greater potential for wake stranding of juvenile salmon than the previously discussed alternatives. LNG marine carriers transiting to the Wauna alternative would pass 24 seal and sea lion haul-outs.

About 20 percent of the Wauna site is covered by NWI-mapped wetlands and about 62 percent is forest. The Wauna alternative would be within 125 miles of seven Class I areas.

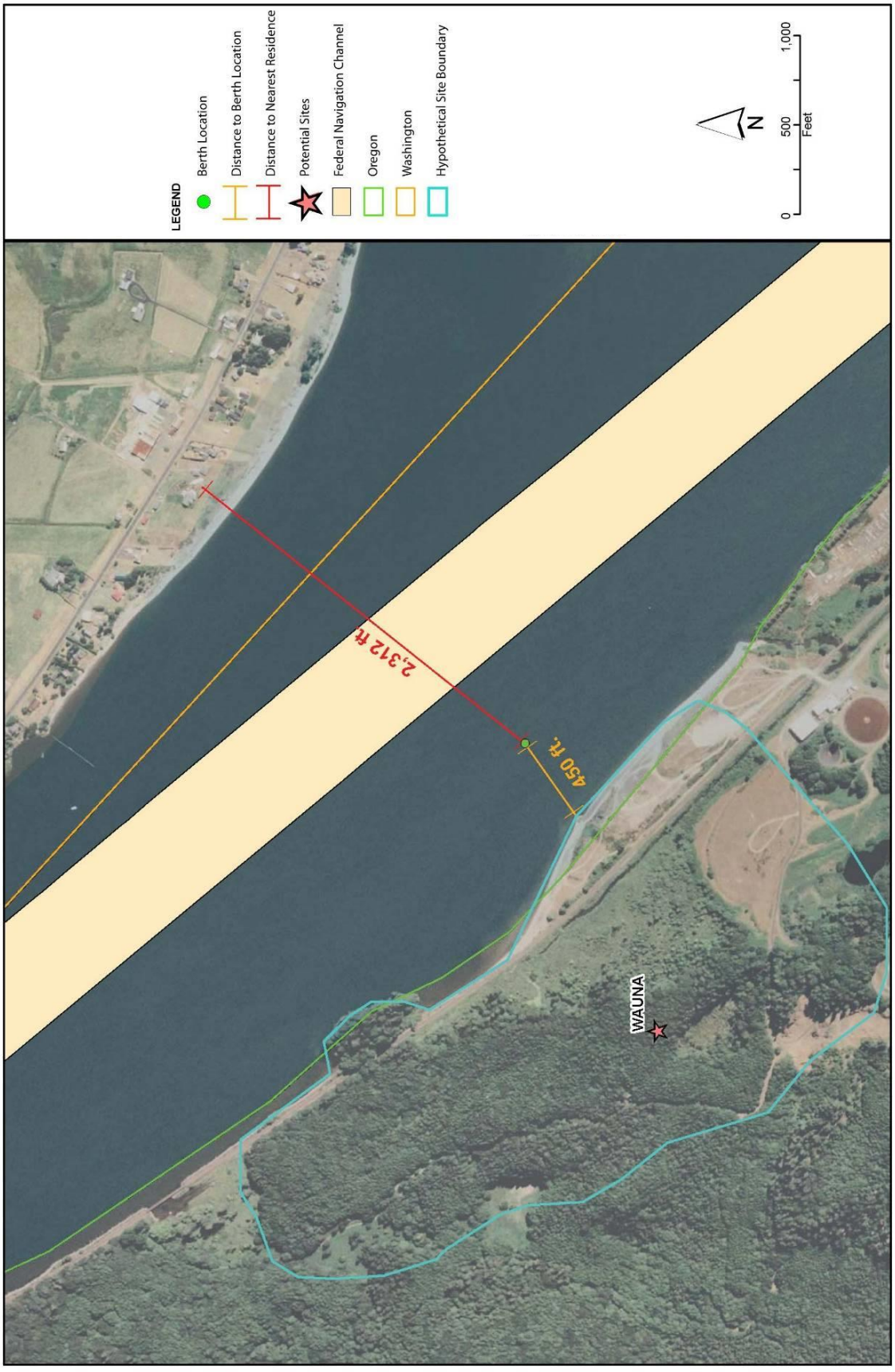


Figure 3.3.2-6: Wauna

Port Westward

The Port Westward alternative is on the south shore of the Columbia River at RM 53 in Columbia County, Oregon (see figure 3.3.2-7). The Port Westward alternative is within a larger economic zone managed by the Port of St. Helens. The Port Westward alternative was previously selected by Port Westward LNG as a possible LNG terminal location. However, Port Westward LNG was unable to obtain approval from the current landowner to use the site for an LNG terminal. The Port Westward site is within Columbia County's PA-38 Primary Agriculture zoning district where a water-dependent industrial facility would not be allowed. Therefore, a change in zoning would be required to develop an LNG terminal on the site.

The Port Westward alternative is the farthest upriver of all the alternatives. LNG marine carriers would be required to pass under the Astoria-Megler Bridge and directly adjacent to the City of Astoria, where a medium density population center would be overlapped by Sandia Zone of Concern 2.

The Columbia River width is about 2,061 feet at the Port Westward alternative. This is the narrowest of all the alternative locations. The shoreline is about 900 feet from the nearest point of the federal navigation channel and would not be able to accommodate the 1,780 feet needed for the Coast Guard security zone, the berth, and an LNG marine carrier.

The closest residence to the hypothetical berth location would be on the Washington side of the river about 2,100 feet to the northwest. More than 40 residences would be within Sandia Zone of Concern 2 if the berth was 450 feet from shore. Recent aerial photographs show that four existing residences would be within the boundary of the Port Westward site. These residences would have to be purchased and demolished as part of an LNG terminal design.

The Port Westward alternative is situated at the narrowest section of the river in comparison to the other alternatives, potentially causing the greatest impacts on fish species. LNG marine carriers in transit to the Wauna alternative would travel 53 miles up the Columbia River resulting in the greatest air pollutant emissions and potential for wake stranding of juvenile salmon of all the alternative sites. In addition, LNG marine carriers transiting to the Port Westward alternative would pass 27 seal and sea lion haul-outs, the greatest number of all the alternative sites. The Port Westward site has a moderate percentage of forest cover (24 percent), and a relative high percentage (74 percent) of NWI wetlands. The Port Westward alternative would be within 125 miles of seven Class I areas.

Lower Columbia River Site Evaluation Conclusions

Table 3.3.2-2 and table 3.3.2-3 summarize results of the detailed alternatives evaluation for the six alternative terminal sites on the lower Columbia River. Based on the criteria established for this analysis, the Tansy Point site and proposed site would be better locations for an LNG terminal compared to the other alternatives. Considering Oregon LNG's environmental impact criteria, Tansy Point has some advantages over the East Skipanon Peninsula because it would be about 1.5 miles closer to the mouth of the Columbia River, and it would also have fewer wetland impacts. However, relative to safety and constructability criteria, such as proximity of the berth to the federal navigation channel and proximity of the terminal to residences, the proposed site is more favorable. We conclude that none of the terminal site alternatives would have a significant environmental advantage over the proposed terminal site on the East Skipanon Peninsula.



Figure 3.3.2-7: Port Westward

Table 3.3.2-2

Lower Columbia River Site Alternatives—Safety and Constructability

Objectives and Criteria	Units	East Skipanon Peninsula (Proposed)	Tansy Point	Tongue Point	Bradwood Landing	Wauna	Port Westward
Site Objective 1: Safety and Suitability of LNG Ship Navigation							
The number of times a Zone of Concern 1 or 2 overlaps a medium or high density population	number	0	0	1	1	1	1
Number of bridges passed	number	0	0	1	1	1	1
Distance traveled on the Columbia River	river miles	11.5	10	18	38	41	53
Site Objective 2: Safety and Suitability of LNG Ship Offloading Area							
Berth distance to public areas/existing residence (at least 5,250 feet)	feet	6,669	1,656	6,384	2,742	2,312	2,100
Berth distance to federal navigation channel (at least 1,780 feet)	feet	1,896	440	965	1,784	450	900
Site Objective 3: Safety and Suitability of Shoreland Areas							
Onshore distance to population/residences	feet	2,062	< 100	2,881	3,272	2,832	< 100
Site allows for reasonable terminal layout	--	Wetlands present	Existing surrounding development including park and residences	Adjacent to Wildlife Refuge, narrow point of land/ground access	Difficult land/ground access, some steep slopes	Difficult land/ground access, some steep slopes	Heavy wetland cover
Suitable zoning in place or available	--	Water Dependent Industrial, Aquatic Development (Warrenton)	Water Dependent Industrial, Aquatic Natural, Aquatic Development (Warrenton)	Natural, Marine Industrial, Institutional, Aquatic Conservation, Aquatic Development (Astoria)	Marine Industrial, Aquatic Development, Aquatic Natural, Aquatic Conservation (Clatsop Co.)	Forest, Heavy Industrial, Aquatic Conservation (Clatsop Co.)	Primary Agriculture, Rural Industrial Planned Development (Columbia Co.)

Table 3.3.2-3

Lower Columbia River Site Alternatives—Environmental Impacts

Objectives and Criteria	Units	East Skipanon Peninsula (Proposed	Tansy Point	Tongue Point	Bradwood Landing	Wauna	Port Westward
Site Objective 1: Impacts on threatened, endangered, and other special status fish and wildlife especially in LNG vessel transport up the Columbia River							
Minimize density of salmonids adjacent to the site (Width of Columbia River	feet	23,480	20,495	22,334	13,553	14,814	2,061
Minimize the potential impacts from wake stranding of juvenile salmonids (distance up Columbia River)	river miles	11.5	10	18	38	41	53
Minimize the number of seal and sea lion haulout areas along LNG waterway	number	7	6	10	24	24	27
Site Objective 2: Impacts on onshore habitat							
Minimize impacts on wetland habitat (assumes 100 acre site)	percent	67	22	10	41	20	74
Minimize impacts on areas with forest cover (assumes 100 acre site)	percent	1	11	63	25	62	24
Site Objective 3: Impacts on the surrounding elements of the environment							
Minimize LNG vessel emissions within the lower Columbia Estuary (distance up Columbia River)	river miles	11.5	10	18	38	41	53
Minimize the number of Class I areas within 125 miles	number	5	5	5	6	7	7

3.3.2.3 Terminal Design Alternatives

Terminal Layout

Oregon LNG evaluated alternative LNG terminal site configurations during the pre-filing process to reduce impacts on wetlands. The proposed import terminal layout (as outlined in Oregon LNG's 2008 application filed with FERC) was modified during 2009 to reduce impacts on wetlands in the vicinity of the terminal; and was subsequently modified again in 2010 to further reduce impacts associated with construction and operation of the facility, and to align the terminal configuration more closely with specific regulations and development standards.

To accommodate the equipment and infrastructure necessary for the import/export project, the terminal layout was redesigned for Oregon LNG's amended application in 2013. While, the new layout would impact more wetlands, Oregon LNG states that the layout has been compressed as much as possible to avoid and minimize wetland impacts.

Terminal Access Road

We evaluated three alternative road configurations for accessing the terminal in addition to the proposed access road route. These access road alternatives all would extend north onto the East Skipanon Peninsula from East Harbor Street, which is oriented east to west and located south of the terminal site. The three alternatives and the proposed access road are shown in figure 3.3.2-8 and described below:

- **Alternative 1** – Realign East Harbor Street/Southeast Marlin Avenue intersection with an extension north onto the East Skipanon Peninsula. From there the access road would turn west to the west side of the East Skipanon Peninsula and then turn north again to follow the Skipanon River dike to the terminal.
- **Alternative 2** – Realign East Harbor Street/Southeast Marlin Avenue intersection with extension onto Northeast Harbor Place. From Northeast Harbor Place the access road would run west to Northeast King Avenue and from there, via Northeast King Avenue, north to the terminal.
- **Alternative 3** – Extend East Harbor Street/Southeast Neptune Drive intersection to a new Northeast Harbor Place extension. From Northeast Harbor Place the access road would run west to Northeast King Avenue and, from there, north to the terminal.
- **Proposed Access Road** – The existing East Harbor Street/Northeast King Avenue intersection would provide access to the terminal via the existing Northeast King Avenue, north of East Harbor Street.

The terminal access road layout alternatives were evaluated relative to environmental impacts and consistency with the City of Warrenton's other road infrastructure plans and the Draft Conceptual Master Plan for the East Skipanon Peninsula. The proposed terminal access road alignment was selected because it would balance anticipated environmental impacts with the need to integrate into the City of Warrenton's other road infrastructure plans. This access road alignment would extend from the existing intersection at East Harbor Street and Northeast King Avenue north across the East Skipanon Peninsula to the terminal along a 60-foot-wide right-of-way previously platted for Northeast King Avenue. This access road alignment would minimize environmental impacts because it would be a more direct route from the existing roadway system to the terminal location, would cross fewer areas of wetlands, and would cross fewer City of Warrenton zoning districts.

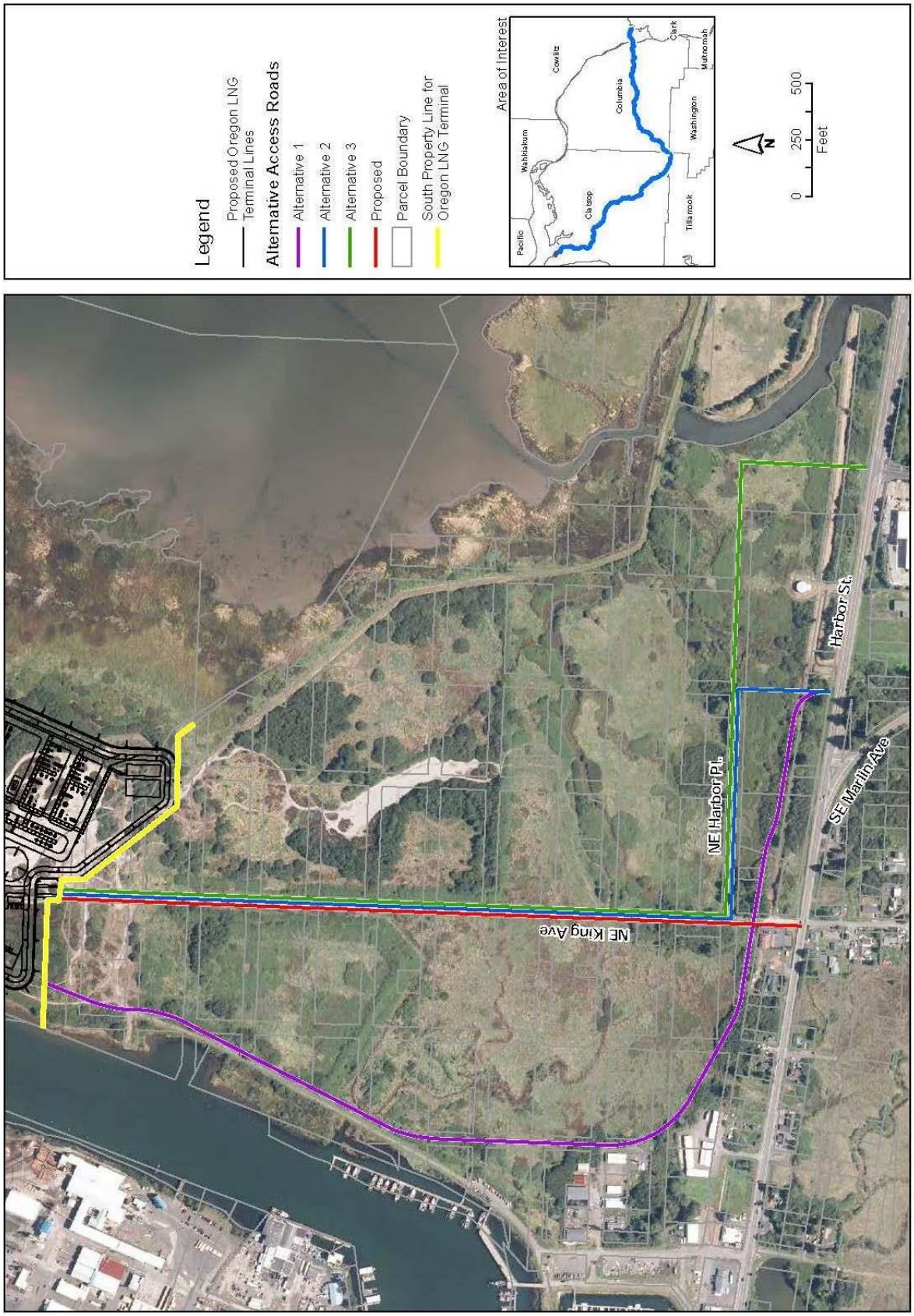


Figure 3.3.2-8: Terminal Access Road Alternatives

Vaporization Technologies

Two different vaporization technologies were considered for the terminal: ambient air vaporizers and shell-and-tube vaporizers. Ambient air vaporizers extract heat from the surrounding air and are usually coupled with a supplementary heating system comprising shell and tube heat exchangers that use an intermediate heat transfer fluid, with the heat source being provided by waste heat from a gas engine/turbine exhaust or from some form of fired heaters. Ambient air vaporizers can cause fog under certain atmospheric conditions.

Shell-and-tube vaporizer systems involve a heat exchanger in which tubes containing LNG pass through a shell containing an external fluid counter-current of heat exchange media such as a water/glycol mixture. On the opposite end of the heat exchanger loop, the water/glycol mixture is typically heated by using direct-fired combustors burning natural gas. However, the source of heat may vary depending on the particular design.

Oregon LNG initially proposed ambient air vaporizers for the terminal but changed to shell-and-tube vaporizers, which would not cause fog. We conclude that shell-and-tube vaporizers are preferred over ambient air vaporizers because they would not create issues with fog.

3.3.3 Dredging Alternatives

We received comments regarding the need to consider alternatives for dredging methods and dredged material placement sites. As discussed in section 2.1.1.1, Oregon LNG would dredge about 1.2 million cubic yards of sediment from the ship berth and maneuvering area to enable LNG marine carriers to dock and turn in the Columbia River. This volume was determined based on the minimum amount needed to safely accommodate LNG marine carriers.

As described in its draft Dredge Material Management Plan (CH2M HILL, 2013b), Oregon LNG would conduct dredging and dredging-related activities in accordance with applicable federal, state, and local permit stipulations. Dredging alternatives were evaluated to minimize impacts on water quality and biological resources.

3.3.3.1 Dredged Material Placement Sites

The Columbia River Estuary Dredged Material Management Plan (Columbia River Estuary Study Taskforce [CREST], 2002) provides guidelines for identifying in-water, nearshore, or upland placement sites with respect to requirements relating to post-placement site monitoring, possible effects on biota, possible hydraulic effects, potential impacts on various fisheries, and other key considerations. Determining appropriate placement options requires an evaluation of factors such as sediment and water quality, circulation and transport, possible impacts on fisheries, and biological communities (emphasizing threatened, endangered, or other special-status species).

Four broad categories of dredged material placement options were initially considered based on practices used elsewhere along the lower Columbia River:

- **beach nourishment sites**, where the material is placed in an intertidal or shallow subtidal littoral zone;
- **flow-lane and/or scour hole placemen**t, where the dredged material is placed within or near the federal navigation channel in areas of adequate depth;

- **open-water placement** (may be shallow and/or deep), where the material is placed in a predesignated, permitted location established for that purpose; and
- **upland facilities**, where the material is placed in a designated, permitted facility that is above the intertidal zone.

Oregon LNG met with resource agencies to discuss alternatives for placement of dredged materials (see appendix B2). Based on agency feedback that it would be preferable to keep dredged material at previously allocated sites already "in the system," upland disposal sites were eliminated from further consideration in this analysis.

The remaining three potential dredged material placement sites were screened using the following criteria:

- **Permitting**: Most favorable would be a fully-permitted or nearly fully-permitted site. Least favorable would be a site that has not yet been permitted.
- **Biological Issues**: Most favorable would be a site with minimal "take" of federally listed species with few nonlisted species of concern; least favorable would be a site with significant potential effects to listed species or nonlisted species of concern.
- **Habitat Considerations, including Sediment Quality**: Most favorable would be a site that could promote clear beneficial uses associated with clean sediments, including habitat enhancement (e.g., the site would promote a healthy habitat for salmonid outmigrants). Least favorable would be a site that would potentially promote minimal beneficial uses with little or no habitat enhancement, and/or could have sediment contamination issues.
- **Available Capacity**: Most favorable would be a site with sufficient capacity to accommodate all material to be dredged (about 1.2 million cubic yards); least favorable would be a site that could only accommodate 10 to 25 percent of the material requiring placement.
- **Zoning/Use Restrictions**: Most favorable would be a placement site that has been zoned with few restrictions; least favorable would be a site that has many restrictions (except those imposed by the CZMA).

Beach Nourishment

Generally, beach nourishment placement occurs on eroding beaches and serves a dual purpose of dredged material disposal and restoring the beaches to their original profile. This option is viable only if no riparian vegetation is present that could be disturbed by the placement activities, and no emergent vegetation is present in the beach area. The USACE has designated several beach nourishment sites that are currently in use along the lower Columbia River:

- **Skamokawa Vista Park**. This 11-acre site is at RM 33.4 on the Washington side of the river. It is 3,300 feet long and has a total material capacity of 250,000 cubic yards. The site is owned by Wahkiakum Port District No. 2.
- **Orhberg's Beach**. This site at RM 38.7 is 2,900 feet long and has a total material capacity of 205,000 cubic yards. The site is owned by Wahkiakum County.

- **Wahkiakum County Consolidated Diking District**. This site is at RM 39.5 and has a total material capacity of 200,000 cubic yards. It is owned by Wahkiakum County Consolidated Diking District.

These beach nourishment sites would range in distance from 22 to 28 river miles away from the terminal site. Beach nourishment sites involve beneficial reuse and help to retain the material in the lower Columbia River littoral zone. However, it is not clear that these sites would be available for use by Oregon LNG and, in general, the use of beach nourishment sites would have the disadvantage of complicated permitting and/or zoning requirements.

Flow-Lane and/or Scour Hole Placement

Oregon LNG evaluated Three Tree Point (RM 30.2) and Price Island (RM 34.8) as candidate sites for dredged material placement because of their capacity to take dredged material and potential environmental benefits. Both these sites are deep scour holes and the in-river disposal of dredged material could benefit the river by reintroducing sediments. At Three Tree Point (about19 miles upstream from the dredging site), river currents have removed mobile sediments from the bank line by natural processes and material placed at this location would eventually be reintroduced into the river's sand transport system. The site appears to be self-maintained at depths greater than the authorized depth of the federal navigation channel.

At the Price Island site (about 23 miles upstream from the dredging site) deep scour holes have developed downstream and landward from the pile dike. The formation of scour holes (up to 115 feet deep) most likely resulted in acceleration of the shoreline erosion along Price Island. Material placed into the scour hole at Price Island would reduce erosion, stabilize the shoreline, and provide shallow and intermediate habitat for salmonids and other migrating fish species.

In 2008, Price Island and Three Tree Point were the preferred dredged material placement sites for the Oregon LNG Project. However, in May 2010, the eulachon (also known as Columbia River smelt), which spawn near these sites, was listed as threatened under the ESA. NMFS then reduced in-water work windows from 4 months to 2 months. Green sturgeon habitat is also present at both of these sites. Consequently, Oregon LNG reevaluated the dredged material placement options and eliminated these two sites from further consideration. We agree that these sites should not be further considered.

Open-water Placement Alternatives

Oregon LNG considered a deepwater (ocean) placement site and two shallow-water (nearshore) placement sites which adjoin the north jetty and the south jetty at the mouth of the Columbia River. Approval for dredged material placement at these sites requires evaluation of the dredged material by the EPA and the USACE under Section 103 of the Marine Protection, Research, and Sanctuaries Act. The EPA Shallow Water Site, South Jetty Nearshore Site, and the Deepwater Site are depicted in figure 3.3.3-1. EPA strongly supports nearshore disposal (such as the Shallow Water Site or South Jetty Nearshore Site) of dredged material whenever possible to keep the material within the active littoral zone, which provides ecological benefits and coastal protection.

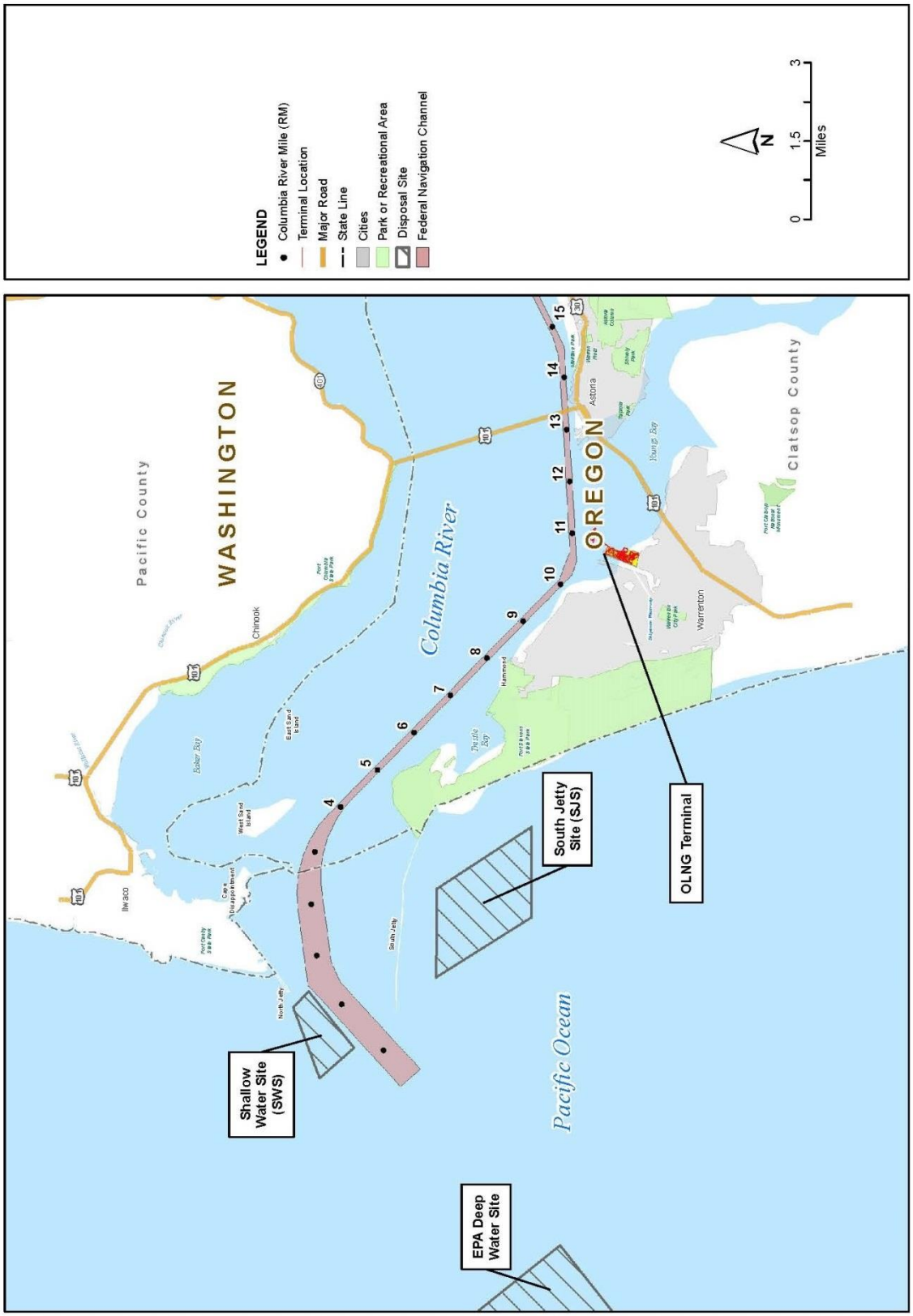


Figure 3.3.3-1: Dredged Material Placement Alternatives

EPA Shallow Water Site

The shallow-water placement site adjoining the north jetty is an active site that is operated by EPA and used extensively. Use of the Shallow Water Site has helped to stabilize the inlet by reducing the north jetty's exposure to wave attack and by mitigating associate scour that typically occurs at the toe of such structures (USACE/EPA, 2012). As of April 2012, the static capacity of this site was estimated to be 3 million cubic yards. The specific capacity available to Oregon LNG for a given year would need to be determined because dredged material from the federal navigation channel has priority at both the EPA Shallow Water Site and the South Jetty Nearshore Site. Extensive dispersion and transport modeling studies conducted by the USACE and others indicate that this site is highly dispersive due to energetic tidal flux, weather conditions, and powerful currents occurring at the mouth of the Columbia River. However, due to the exposed ocean conditions of this site at the river mouth, the dredged material placement window is limited to between June and November. In addition, only one dredge is allowed access to this site at any given time due to safety restrictions.

The USACE has indicated that it uses all of the available capacity at the Shallow Water Site each year, and therefore, we conclude it unlikely that the site would be available for use by Oregon LNG.

South Jetty Nearshore Site

The South Jetty Nearshore Site is south of the South Jetty in waters 60 feet deep. It was initially used by the USACE in 2012. The South Jetty Nearshore Site provides sand to the shoals and bar system in the nearshore area adjacent to the South Jetty and Clatsop Spit. According to the USACE, this site has a maximum annual capacity of 300,000 cubic yards and a placement window of 6 weeks. Capacity restrictions are based on the need to limit the disturbance of benthic infauna. Use of this site would be limited by Oregon's crab fishing season; site management provisions require placement of sand after August 15 when crab season ends. Only one vessel, the government dredge *Essayons*, is currently approved to dispose at the South Jetty Nearshore Site.

Deepwater Site

EPA's Deepwater Site is about 9 nautical miles southwest of the mouth of the Columbia River. EPA selected this area as a deepwater placement site to avoid potential impacts on more biologically productive areas. It has been designed to be useable for at least 50 years.

Placing material dredged from the Columbia River system at this site would be less desirable because the sediments would be removed from a river system that is already sediment-deprived due to extensive upstream dams. In addition, this site would be the farthest disposal site of the open-water placements, at about 14 miles from the terminal. The greater distance would increase air emissions from the transport vessels.

Section 103 of the MPRSA assigns the USACE responsibility for issuing permits for the ocean dumping of dredged materials, and for authorizing the transport of dredged material for ocean disposal at designated sites. That permit decision would be made using the EPA's environmental criteria and would be subject to EPA's concurrence. EPA would require Oregon LNG to conduct its own site capacity assessment, analyzing the effect of its use of the Deepwater Site on site capacity, based on USACE data and its own projected use. This assessment and the EPA and USACE comment and approval would need to be completed prior to EPA's evaluation of a request for a MPRSA Section 103 permit for disposal of dredged material at the Deepwater Site. Furthermore, the USACE Regulatory Project Manager would submit a public notice to EPA and a Section 103 criteria evaluation for the action. In this review, EPA would consider impacts on economic potentialities, which would include any impacts on the USACE ability to maintain safe navigation for the public.

3.3.3.2 Dredging Methods

Selection of the dredging equipment and methods used to perform the dredging activities in the lower Columbia River depends on a number of factors, including:

- physical characteristics of the material to be dredged;
- quantities of material to be dredged and rate of dredging;
- dredging depth;
- distance to the disposal area; and
- the physical environment of the dredging and disposal areas.

The methods typically used in dredging projects in the lower Columbia River by both USACE and private industry include hopper, mechanical, and hydraulic pipeline dredging.

Hydraulic hopper dredges have been used to dredge the federal navigation channel in the lower Columbia River for many years. Hopper dredges are self-propelled seagoing ships with hulls and lines similar to those of a typical oceangoing vessel. Dredged material is raised by dredge pumps through suction pipes that are pulled along the channel in contact with the channel bottom. The material is discharged into hoppers built into the vessel. During dredging operations, hopper dredges travel at a ground speed of 2 to 3 mph and can dredge in water depths from about 10 feet to more than 80 feet. Once fully loaded, hopper dredges move to the disposal site to unload either by opening doors in the bottom of the hoppers and allowing the dredged material to be released to an open-water disposal site, or by pumping the dredged material to an upland disposal site.

Mechanical dredges include dipper, clamshell, articulated fixed-arm, and drag-line dredges. Mechanical dredges are capable of removing hard-packed material or debris and are well suited for removing fine-grained material, cemented sands, gravels, or well-fractured rock outcrops. Mechanical dredges are well suited to operations that require relatively accurate dredging, and dredging in areas where space is limited. Most mechanical dredges are not self-propelled and must operate from a barge and therefore require a tugboat to move over long distances. Excavated material is commonly placed in scows or hopper barges that are towed to the disposal area or material management site. A slurry-processing unit can also be used to fluidize dredged material and hydraulically transport the material to the material management site. Historically, clamshell dredging with in-water disposal has been common on the lower Columbia River.

The hydraulic cutterhead dredge is equipped with a rotating cutter apparatus surrounding the intake end of the suction pipe, and can efficiently dig and pump alluvial materials and compacted deposits such as clay and hardpan. The cutterhead has the capability to pump dredged material distances of up to about 1 mile without a booster pump (and greater distances with booster pumps) to in-water material management sites. A cutterhead on the end of an arm is buried about 3 to 6 feet deep in the river bottom material and swings in a 250-foot to 300-foot arc in front of the dredge. The excavated material may be pumped to an open-water site or to confined disposal facilities located either upland or in-water.

Because none of the dredged material placement sites would be close enough to make use of the hydraulic cutterhead dredge feasible, this method was dropped from consideration. The hopper dredge was determined to be most suitable for the project taking into consideration the characteristics of the area to be dredged and the likely dredged material placement locations.

3.3.3.3 Dredging Alternatives Conclusions

The existing permitted beach nourishment site alternatives are considerably farther from the LNG terminal than the open-water sites and their availability for use by Oregon LNG is uncertain. Therefore at this time we do not consider them to be reasonable dredged material placement alternatives for the Oregon LNG Project.

The three open-water placement alternatives considered by Oregon LNG are already permitted and thus have undergone environmental review. The main advantage of the Deepwater Site over the other open-water sites is its capacity; however, resource agencies strongly discourage the use of this site when other alternatives are available. The advantages of the Shallow Water Site and the South Jetty Nearshore Site are that they would be relatively close to the terminal and would keep the sediment within the Columbia River system. A disadvantage is that dredged material from the federal navigation channel has priority at the Shallow Water Site and the South Jetty Nearshore Site, which would likely limit Oregon LNG's use of those sites. In fact, the USACE has indicated that it uses all the available Shallow Water Site capacity each year, and only the government hopper dredge, *Essayons*, is permitted to use the South Jetty Site. Therefore, Oregon LNG proposes to use the Deepwater Site as the primary site for dredged material placement. Subject to EPA and USACE concurrence on the suitability of the dredged material for transport and disposal, we conclude that the Deepwater Site would be the preferred alternative among the existing permitted dredged material disposal sites.

Subject to permit conditions, we further agree that a hopper dredge would be the preferred dredging method because it is a proven method for the lower Columbia River, and it would be appropriate for the dredged material placement area proposed.

3.4 PIPELINE ALTERNATIVES

The Commission received comments regarding the need to evaluate pipeline route alternatives that minimize environmental impacts. Major route alternatives include those that deviate from the proposed route for a significant distance, often a majority or more of the proposed route's length, and which provide a substantially different pathway from the source area to the delivery area. Minor route alternatives deviate from the proposed route less substantially than major route alternatives, are often designed to avoid large environmental resources or engineering constraints, and typically remain within the same general area as the proposed route. Minor route variations are typically site-specific and may allow for avoidance of certain localized features such as a home, wetland, or orchard.

We initially considered a major pipeline route alternative that would extend from Sumas, Washington to the Oregon LNG terminal. However we determined that such an alternative, which would require a new greenfield right-of-way through Washington, would have substantially greater environmental impacts than pipeline route alternatives that utilize and overlap or abut the existing Northwest Pipeline right-of-way. Therefore, we dismissed it from further evaluation.

3.4.1 Oregon LNG Project

During the preliminary design stage for the project, Oregon LNG participated in our pre-filing process (see section 1.6). This process emphasizes identification of potential stakeholder issues early in the development of a project, as well as identification and evaluation of alternatives that may avoid or minimize these issues. During this process, Oregon LNG made multiple modifications to its proposed pipeline route to address stakeholder concerns. These changes were subsequently made part of the proposed route when Oregon LNG filed its application and supplements.

We assessed whether it might be possible to significantly reduce environmental impacts associated with the construction and operation of the Oregon LNG pipeline by following alternative routes. We also considered if there were alternative locations for the proposed compressor station that would have lesser environmental impacts.

The "proposed route," is the pipeline route filed by Oregon LNG in its June 2013 application with FERC, as modified by supplemental filings thereafter up until the publication of this draft EIS. The proposed route is illustrated on maps contained in appendix E1. The two major alternatives to the proposed route are evaluated below as well as several minor route alternatives. In addition, a number of minor variations were evaluated to avoid or minimize impacts on specific, localized resources such as residences, high value agriculture lands, and wetlands.

3.4.1.1 Pipeline Route Alternatives Eliminated from Detailed Analyses

A pipeline route that would cross the Columbia River directly north of the terminal and be routed east to tie into the Northwest pipeline system east of Kelso, Washington, was determined to be infeasible due to several factors. Directly north of the terminal, the Columbia River is too wide to allow for a successful HDD crossing for the pipeline. In addition, a pipeline routed through Washington would pass through the population centers of Longview and Kelso.

HDD is more technically feasible farther upstream, at about RM 30, where the Columbia River narrows. However, the first several miles upstream of a technically feasible HDD crossing of the Columbia River are not preferred crossing locations due to potential impacts on the Lewis and Clark and Julia Butler Hansen National Wildlife Refuges. These areas provide habitat for many sensitive wildlife species, including the Columbian white-tailed deer, and would not be environmentally preferable to the proposed route.

3.4.1.2 Major Route Alternatives

Alternatives to the proposed pipeline route must meet Oregon LNG's objective to export Canadian-sourced natural gas to foreign markets as LNG and supply natural gas to the Pacific Northwest region and Portland metro area. The nearest existing pipeline to the terminal and target domestic markets with sufficient capacity is the Northwest pipeline system. Two major route alternatives were analyzed and compared to the proposed Oregon LNG pipeline. One of these, Alternative Route 1, would tie into the Northwest pipeline at the same point as the proposed Oregon LNG pipeline near Woodland, Washington. The other, Alternative Route 2, would connect to the Northwest pipeline in the vicinity of Kalama, Washington, at an alternative interconnection point referred to as the Green Mountain interconnect (see figure 3.4.1-1). Table 3.4.1-1 and the text below compare the alternatives to the proposed route.

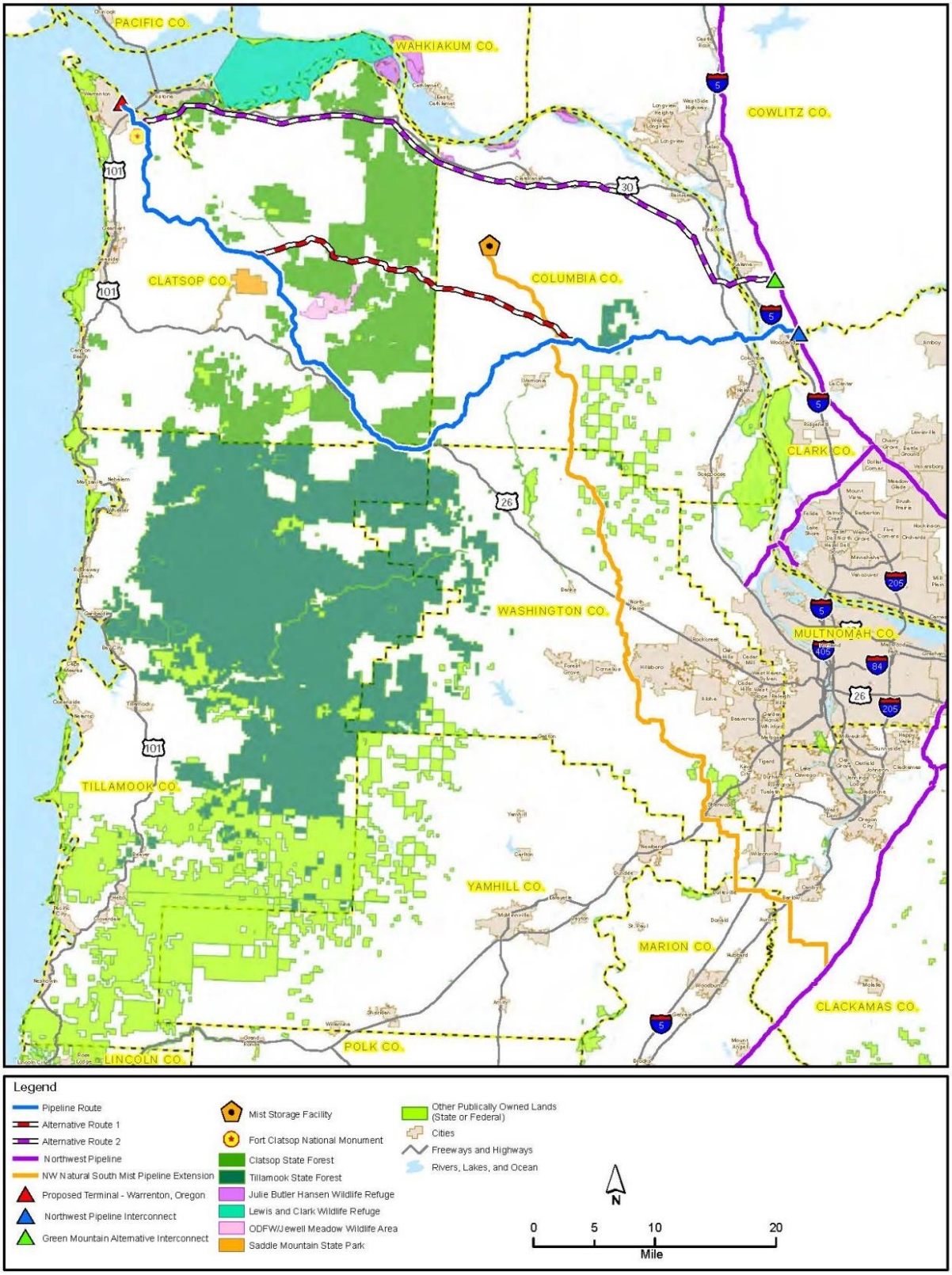


Figure 3.4.1-1: Major Pipeline Route Alternatives

Table 3.4.1-1

Comparison of Major Oregon LNG Pipeline Route Alternatives

Environmental Factor	Proposed Oregon LNG Route	Alternative Route 1	Alternative Route 2
Total Length (miles)	86.8	73.3	61.6
Permanent Right-of-Way (acres) [a]	1,052.1	888.5	746.7
Residences with 50 Feet of Construction Right-of-Way (number)	2	2	27
Land Parcels Crossed (number)	201	182	374
Percentage Adjacent to Existing Corridors	13	7	89
Total Waterbodies Crossings (number) [b]	107	152	193
Major Waterbody Crossings (number)	6	6	13
NWI Wetlands Crossed (miles)			
Palustrine Forested	0.5	0.5	0.6
Palustrine Shrub	0.7	0.6	0.6
Palustrine Emergent	3.8	4.2	3.0
Estuarine	0.9	0.9	1.6
Riverine	0.9	1.1	1.2
Total Wetlands	6.8	7.3	7.0
Fish Bearing Waterbodies Crossed (number)	39	44	41
Federally Designated Critical Habitat Crossed [c] (miles)	5.3	7.0	2.7
Length of Forested Lands Crossed (miles)	70.2	58.0	40.4
Length of High-Value Farmland Crossed (miles)	5.1	5.1	2.4
Length of Agricultural Lands Crossed (miles)	1.1	9.7	4.2
Public Lands Crossed (miles)	13.0	6.4	8.1
Roads Crossed (number)	133	163	137
Scenic Highways Crossed (number)	3	2	2
Steep Slopes Crossed >30 Percent (miles)	6.8	8.5	7.5

[a] Assumes a 100-foot right-of-way
[b] According to the U.S. Bureau of Land Management, National Hydrography Dataset
[c] Includes marbled murrelet and northern spotted owl habitat

Alternative Route 1

Alternative Route 1 would consist of about 73.3 miles of pipeline routed through Clatsop and Columbia Counties in Oregon, and Cowlitz County in Washington. It would share the same alignment as the proposed route from MP 0.0 to MP 21.4, and from proposed route MP 65.3 to the interconnect with the Northwest pipeline at MP 86.8. Alternative Route 1 was considered because it would provide a shorter, more direct path than the proposed route, and also would avoid populated areas. Where the proposed route turns and continues in a southeast direction at MP 21.4, Alternative Route 1 would continue generally east across the Clatsop State Forest into Columbia County where it would rejoin the alignment of the proposed route at MP 65.3.

As shown in table 3.4.1-2, this alternative would result in slightly greater (25 percent) impacts on critical habitat for marbled murrelet and northern spotted owl than the proposed route. Alternative Route 1 would cross 1.6 miles (about 23 percent) more steep topography. Because a lower percentage of the alternative route would be parallel to existing corridors than the proposed route, more clearing of trees and vegetation would be required. Alternative Route 1 would be 13.5 miles shorter but would cross 45

more waterbodies (including 5 more fish-bearing waterbodies) and 30 more roads than the proposed route. Alternative Route 1 would be shorter and cross fewer parcels, but we conclude that these factors would not offer significant environmental advantages over the proposed route.

Alternative Route 2

Alternative Route 2 would consist of about 61.6 miles of pipeline routed through Clatsop and Columbia Counties in Oregon, and Cowlitz County in Washington. Alternative Route 2 would be collocated with an existing high-voltage electric transmission for most of its length. This alternative would follow the same alignment as the proposed route from MP 0.0 to MP 2.7, and would terminate at the Green Mountain interconnect with the Northwest pipeline, which would be about 4.9 miles north of the proposed Northwest pipeline interconnect at Woodland.

Although about 89 percent of Alternative Route 2 would be collocated with existing linear corridors, it would result in the greatest impacts on populated areas and would impact more landowner parcels than Alternative Route 1 or the proposed route. The areas along the Columbia River and Highway 30 are generally more densely populated than the areas that would be crossed by the proposed route. Alternative Route 2 would cross 9.9 miles of residential parcels, compared to 1.1 miles crossed by the proposed route. The construction right-of-way for Alternative Route 2 would be within 50 feet of 27 residences, compared to two residences for the proposed route.

Alternative Route 2 would cross five more waterbodies designated as critical habitat for Chinook salmon and 65 percent more designated critical habitat for northern spotted owl and marbled murrelet than the proposed route. Alternative Route 2 would also cross known habitat of the federally endangered Columbian white-tailed deer. Although Alternative Route 2 does not directly impact the Lewis and Clark Wildlife Refuge, it does pass as close as 2,000 feet in certain sections, potentially contributing to cumulative impacts on the Refuge. Based on the U.S. Bureau of Land Management, National Hydrography Dataset, Alternative Route 2 would cross 193 waterbodies, including 13 major waterbodies (greater than 100 feet wide), compared to 107 and 6 crossed, respectively, by the proposed route (the 6 major river crossings include 3 crossings of the same river, the Lewis and Clark).

Alternative Route 2 would cross 0.7 mile (about 10 percent) more land with slope greater than 30 percent than the proposed route. According to Oregon LNG, the HDD crossing of I-5 for Alternative Route 2 would be difficult because the utility corridor is narrow where it meets the steep cliff face on the east side of I-5. Alternative 2 would not have the potential for a future interconnect with the South Mist Extension, which could limit access to the Portland market.

Alternative Route 2 would be shorter than the proposed route and has both advantages (collocation with other linear corridors) and disadvantages (greater impacts on critical habitats) over the proposed route. However, we conclude that Alternative Route 2 would not offer significant environmental advantage over the proposed route.

3.4.1.3 Minor Route Alternatives

We examined multiple minor route alternatives for the Oregon LNG pipeline between MP 80.5 and the interconnection with the Northwest Pipeline. These include the Green Mountain and Deer Island minor route alternatives and minor route alternatives for crossing I-5.

Deer Island and Green Mountain Minor Route Alternatives

Figure 3.4.1-2 is a map depicting the Green Mountain and Deer Island minor route alternatives. The Deer Island alternative would depart from the proposed route at MP 80.5 and parallel the existing Northwest pipeline HDD crossing of the Columbia River at the north end of Deer Island. This minor route alternative would tie into the Northwest pipeline system at the Green Mountain alternative interconnect in Cowlitz County, Washington. According to Oregon LNG, anecdotal information suggests that the HDD at this location had been a challenging effort in spite of its small diameter and this alternative would require pipeline construction through significant stretches of wetlands on Deer Island. Therefore, it was determined that the drawbacks to this alternative would significantly outweigh the benefits.

The Green Mountain minor route alternative would depart from the proposed route at MP 84.5 in Cowlitz County, Washington, at the crossing of I-5, and extend north along an existing petroleum pipeline corridor. The route would then turn east, paralleling the existing Northwest Mainline-Kalama lateral to the same interconnect point as the Deer Island alternative. This minor route alternative would be about 5 miles long.

The Green Mountain minor route alternative was eliminated from further consideration for the following reasons:

- the pipeline crossing of I-5 would be difficult because the utility corridor is narrow where it meets the steep cliff face on the east side of I-5;
- the existing petroleum pipeline corridor is narrow and runs through a rural residential area, where numerous landowners would be impacted;
- the existing Northwest Kalama-Mainline corridor runs through a rural residential area where numerous landowners would be impacted; and
- while this alternative would connect with the Northwest pipeline a few miles farther north, it would only marginally reduce the distance the natural gas would have to travel from Sumas and it would not reduce the amount of new pipeline construction required.

Based on the above reasons, we conclude that the Deer Island and Green Mountain minor route alternatives would not be environmentally preferable to the proposed route.

Crossing of Interstate 5 Minor Route Alternatives

Near MP 85.0, the proposed pipeline route must cross I-5 before reaching the proposed interconnect in Woodland. As depicted in figure 3.4.1-3, five alternatives for crossing I-5 were evaluated, in addition to the proposed route, to minimize impacts on traffic on I-5.

A route was first evaluated about 2 miles north of the proposed route that extended down the center median of the interstate between the north and southbound lanes for about 0.5 mile and then continued east following an existing overhead power transmission corridor between about MP 85.3 and 85.9. This alternative (labeled as the I-5 Median route in figure 3.4.1-3) was identified because it would cross fewer landowners and would have the greatest distance from Woodland High School. This was the route Oregon LNG proposed in its 2013 amended application; however, WSDOT expressed concerns that routing the pipeline through the highway median was not consistent with WSDOT's Utilities Accommodation Policy. In addition, the WDFW expressed concerns about the impacts of crossing Burris Creek multiple times.

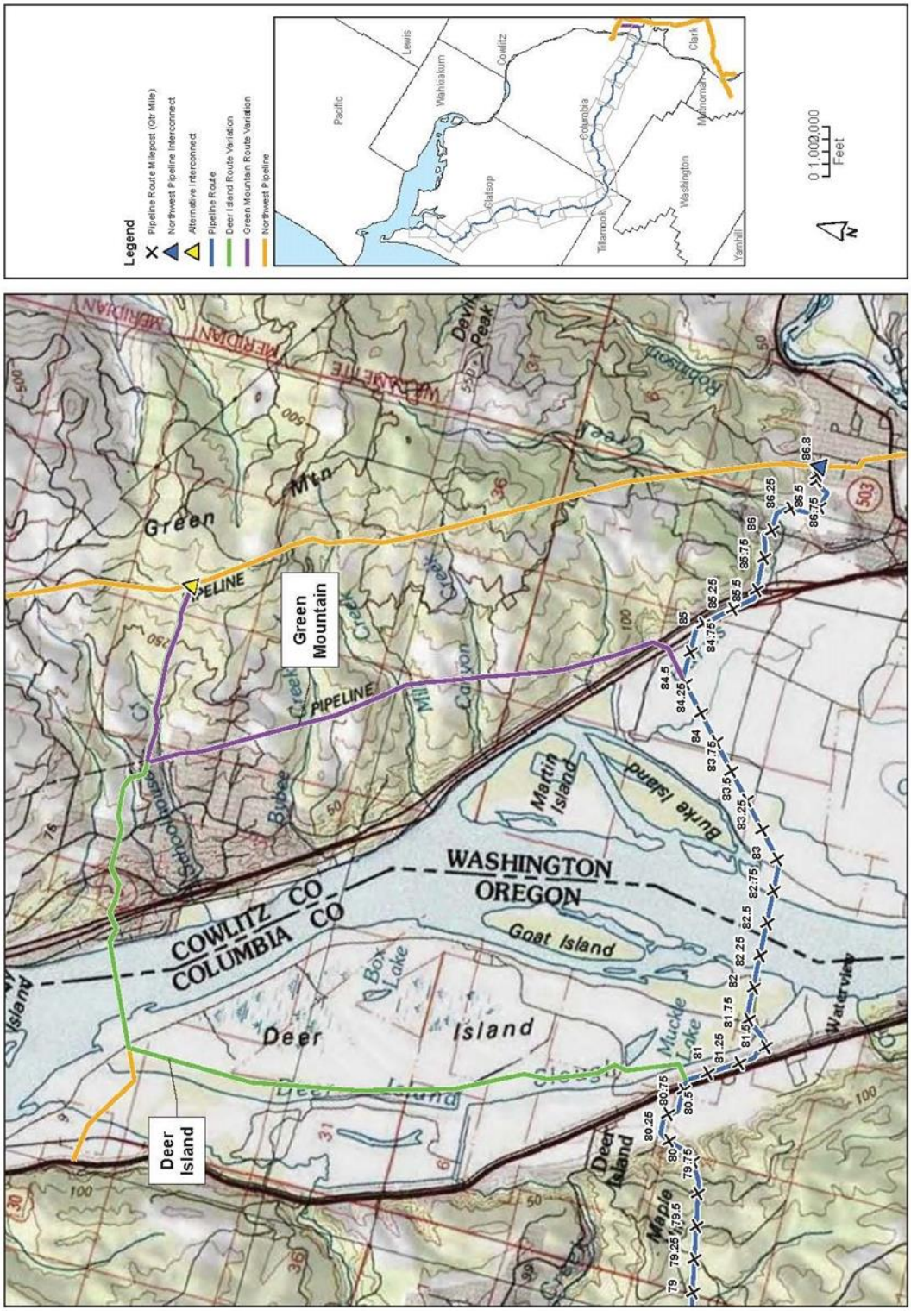


Figure 3.4.1-2: Deer Island and Green Mountain Minor Route Alternatives

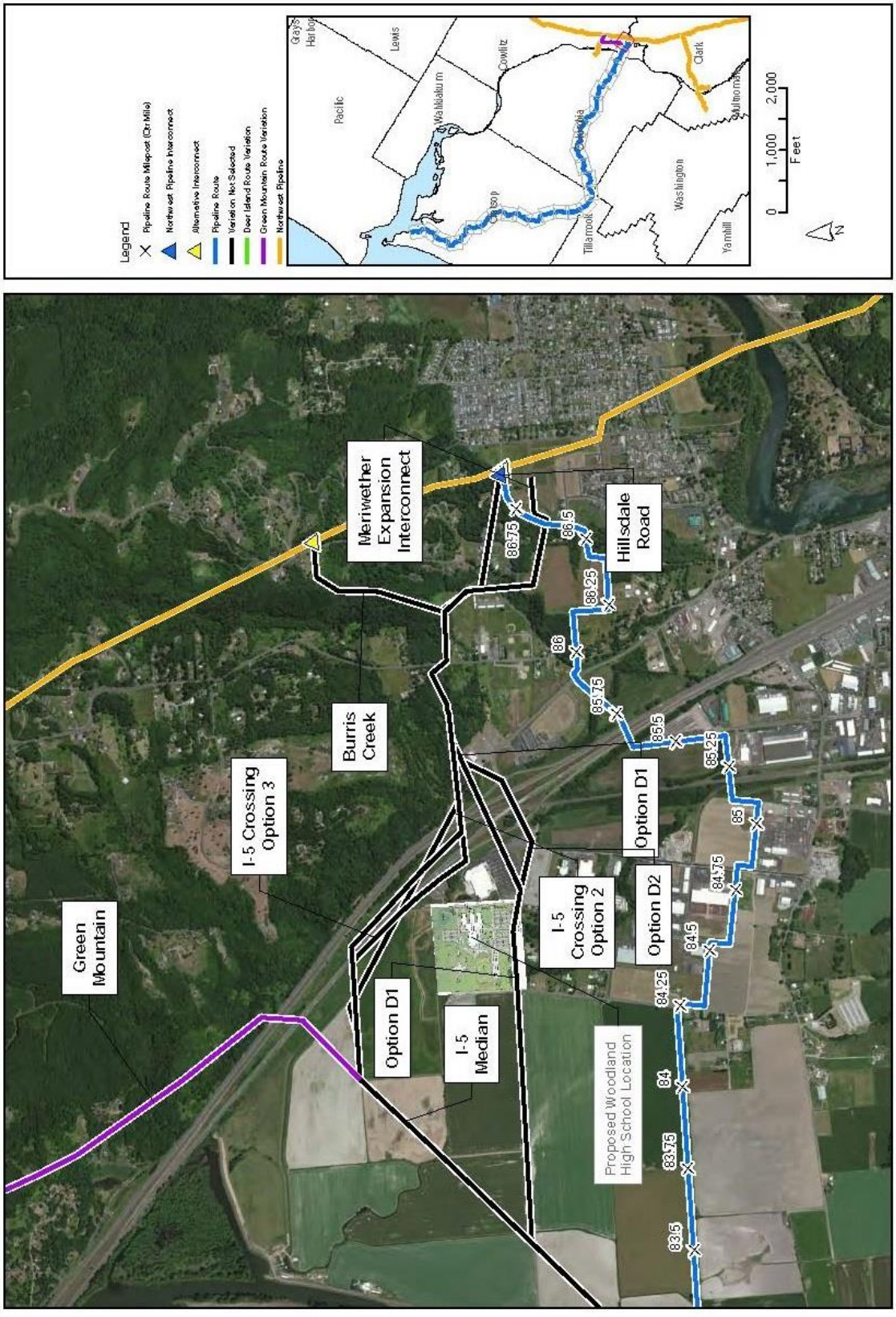


Figure 3.4.1-3: I-5 Crossing Minor Route Alternatives

Also considered was an alternative that followed a similar route but paralleled the highway on the west side of the southbound lane (Option 3), but this alternative impacts an existing USACE mitigation property, an electrical substation, and the parking lot for a large commercial building. An HDD alternative along this route (Option 2) was also considered but eliminated because HDD equipment laydown areas would impact the USACE mitigation site.

A fourth alternative (labeled as Option D1) proposed a perpendicular crossing of I-5 to address WSDOT's concerns, but this route would cross property of the new Woodland High School. East of the high school property, an HDD would be used to cross the parking lot of a large commercial building and I-5. A fifth alternative (labeled as Option D2) would follow the same alignment across the school property and then travel further southeast to avoid impacts on the commercial parking lot. While these two alternatives would be the most direct, they would also impact the most landowners and be closest to the new high school. Therefore, Oregon LNG dismissed these alternatives from consideration.

In April 2014, Oregon LNG filed with FERC a modification to the proposed route in this area, referred to as the Cowlitz County Reroute, in response to feedback from the USACE and WSDOT. This modified route has the following key features:

- the original proposed HDD of the Columbia River would be slightly shifted in alignment, and reduced in length from about 6,100 feet to about 5,030 feet so it would not cross the existing dike and associated Dike Access Road, which would be crossed by a separate bore or other trenchless method; and
- the reroute provides for a perpendicular crossing of the I-5 corridor rather than down the center median of the interstate.

The Cowlitz County Reroute would travel primarily to the north of the City of Woodland, Washington, following property boundaries and then, at MP 85.7, cross I-5 south of the interchange. The interstate would be crossed by bore. We conclude that Oregon LNG's proposed Cowlitz County Reroute is preferable to the corresponding segment of the original proposed route because it addresses USACE and WSDOT concerns and would not result in overall greater environmental impacts.

3.4.1.4 Minor Route Variations

We received comments regarding the need to evaluate route variations to avoid or minimize localized impacts on specific resources, including residences, high value agricultural lands, archaeological sites, wetlands, and waterbodies. Route variations were also identified as specific landowner concerns were raised, such as shifting the route to follow property lines and field edges where possible instead of through the center of properties.

Prior to filing its application with FERC in 2008, Oregon LNG met with landowners, reviewed comments, and received feedback from agencies regarding the pipeline route. As a result, minor route and construction-method variations were incorporated by Oregon LNG in an effort to avoid or minimize potential impacts on specific localized resources, including residences, high value agricultural lands, archaeological sites, wetlands, or waterbodies. These route variations are summarized in table 3.4.1-2 and maps are provided in appendix E3.

Table 3.4.1-3 provides details on minor route variations that were incorporated into the proposed pipeline route by Oregon LNG from November 2011 to July 2012 as it developed a new pipeline segment for its bidirectional project. The table describes why the minor route variation was selected over the original route. Maps of these minor route variations are provided in appendix E3.

Table 3.4.1-2

Minor Route Variations Incorporated by Oregon LNG Prior to 2008 Application

Variation Name	From MP	To MP	Original Route Length (feet)	Variation Route Length (feet)	Description
Adam's Slough	0.4	1.3	5,255	5,255	HDD was selected to cross a substantial wetland and come out near the Astoria Airport. This variation avoids dense population and commercial buildings in Warrenton.
Seppa Dairy	2.1	6.2	19,217	21,739	A variation was selected to avoid the Lewis and Clark National Historic Park.
Red Bluff Road	31.4	33.3	8,916	10,117	A minor variation was selected to provide a better approach to the HDD crossing of the Nehalem River. HDD would be used to go under the river, minimizing impacts.
Christmas Tree Road	33.3	35.7	10,525	12,754	A variation was established to avoid the dense residential housing along Christmas Tree Road. This would place less impact on individual landowners.
Sunset Springs Rest Area	40.8	43.6	15,719	17,047	HDD was selected to cross Oregon Highway 26 and continue on the south side of the highway to avoid a State of Oregon rest area and Sunset Springs, which is a natural spring providing drinking water to passersby. This variation continues on the south side of Highway 26 and crosses back on the north side at MP 43.0. It would not be practical to stay on the south side of the highway because of severe side slopes and potential wetland impacts.
Youngs River	21.5	22.5	5,350	5,380	The alignment was moved to the south to avoid impacts on Youngs River.
Wilson Parcel	32.9	33.7	3,893	4,204	The alignment was adjusted to the north to minimize impacts on future residential building sites.
Highway 101	2.5	3.7	6,198	6,504	A realignment of an HDD was selected to avoid impacts on an existing motocross track. The realignment also shifted the HDD exit point and associated point of intersection farther from the edge of an existing slough.
Lewis and Clark River	4.8	5.5	3,998	3,938	The HDD construction method was selected to minimize impacts on both private landowners and the Lewis and Clark River.
Speelyai Creek	10.6	11.6	5,232	5,549	Realigned to move the pipeline north, avoiding any crossings of Speelyai Creek. The former alignment included two crossings of Speelyai Creek. Moving the pipeline in this location also increases the distance from a bald eagle nest site from about 800 feet to about 1,200 feet.
Nehalem River	33.4	34.1	5,093	5,233	A realignment and increased length were added to an HDD to minimize riparian impacts on east side of the Lewis and Clark River. This realignment provides additional separation from a private landowner on the east side of the Lewis and Clark River and places the additional temporary work space in existing agricultural lands. The proposed realignment is also the result of consultation with private landowners on the west side of the Lewis and Clark River.
Jewell Junction	36.2	36.6	2,632	2,613	Realigned north to minimize impacts on a waterbody and associated wetland as well as avoiding the Quarry and Mining zoning district in Clatsop County.

Table 3.4.1-3

Minor Route Variations Incorporated from November 2011 to July 2012

Variation Name	From MP	To MP	Original Route Length (feet)	Variation Route Length (feet)	Description
Topography Reroute A	49.2	50.1	4,399	4,743	Realigned to the north to avoid steep topography to the south and multiple crossings of logging roads.
Clear Creek	50.1	51.4	6,712	7,066	Realigned to avoid a steep (near vertical) slope west of Clear Creek and avoid other steep topography to the south.
Rocky Point Road	52.0	52.4	2,303	2,112	Realigned to avoid steep topography along Rocky Point Road and to streamline the pipeline.
Weed Creek Road	55.3	56.0	3,410	3,498	Realigned to avoid forested wetlands to the west and avoid steep topography along Weed Creek Road.
Rock Creek	56.6	60.8	19,043	22,058	Realigned to avoid landslide features to the south and impacts on private landowners along Keasey Road.
Coates Mountain	60.8	62.1	6,824	6,702	Realigned to avoid uneven topography to the north.
Pittsburg Road	64.1	64.8	3,655	3,723	Realigned to avoid steep topography and create space for an HDD crossing of Highway 47. The reroute also reduces the number of crossings of Pittsburg Road to one.
Baker Point	64.9	66.5	8,467	8,197	Realigned to avoid steep topography along Baker Point.
Schaffer Road	70.8	71	970	1,034	Realigned to avoid private landowners and wetlands while minimizing impacts on riparian zones through a trenched crossing of Schaffer Road.
Topography Reroute B	73.9	74.7	4,458	4,366	Realigned to avoid steep topography.
Pinkney Road	75.0	75.6	3,620	3,194	Realigned to avoid steep topography and to reduce impacts by paralleling Pinkney Road.
Topography Reroute C	76.9	77.9	5,440	5,442	Realigned to the northeast along a more level portion of an area of steep topography.
Topography Reroute D	78.3	78.8	2,770	2,954	Realigned to avoid steep topography.
Knife River Quarry	78.8	82.0	13,967	16,597	The route was realigned around a quarry and to minimize impacts on waterbodies by crossing through the Dyno-Nobel Dike Road.
Deer Island	80.8	N/A	42,709	31,782	Realigned to minimize impacts on wetlands near Deer Island.
I-5 Crossing Option 1	83.0	86.6	16,137	19,347	Realigned to avoid a longer crossing of the City of Woodland in an area of commercial and industrial development.
Green Mountain	84.5	N/A	30,354	12,194	Realigned to minimize the overall length and to avoid the steep topography near Green Mountain.
I-5 Crossing Option 2	84.7	85.5	3,264	3,503	Realigned to avoid a USACE wetland mitigation site and maximize the distance to an existing Walmart store and proposed Woodland High School.
I-5 Crossing Option 3	84.9	85.5	3,281	3,239	Realigned to avoid a USACE wetland mitigation site and maximize the distance to a Walmart store and proposed Woodland High School.
Burris Creek	86.1	N/A	2,702	3,785	Realigned to avoid the steep topography near the Burris Creek variation.
Hillsdale Road	86.1	N/A	2,756	2,904	Realigned to avoid several residences, move away from a few forested areas, and avoid a direct crossing of steep topography.

Table 3.4.1-4 lists minor route variations incorporated into the proposed pipeline route during the pre-filing review period for the Export Project from August 2012 to April 2013. The table describes why the minor route variation was selected over the original route. Maps of these minor route variations are provided in appendix E3.

Table 3.4.1-4
Minor Route Variations Incorporated into the Proposed Route from August 2012 to April 2013

Variation Name	From MP	To MP	Original Route Length (feet)	Variation Route Length (feet)	Realignment Description
Terminal Reroute	N/A	1.3	8,015	7,203	Realigned to avoid impacts on sensitive area.
Clatsop County 1	4.1	4.8	3,545	3,539	Realigned to avoid impacts on sensitive area.
Clatsop County 2	35.2	37.2	10,493	9,226	Realigned to avoid impacts on sensitive area.
North Fork Wolf Creek	47.5	47.7	902	869	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Clear Creek 2	50.4	50.5	606	683	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Cedar Creek	55.5	56	2,640	2,784	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Clatskanie River	70.3	71.2	3,733	4,596	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Deer Island 2	81.4	81.5	790	820	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Option D1	83.8	85.7	8,355	10,040	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Option D2	85.1	85.6	2,770	2,865	Realigned to avoid impacts on sensitive area, based on field visit with FERC.
Meriwether Expansion Interconnect	86.6	N/A	889	1,104	Realigned to avoid impacts on sensitive area, based on field visit with FERC.

3.4.1.5 Compressor Station Alternatives

Oregon LNG evaluated several alternative locations for the compressor station in addition to the proposed location between Deer Island Slough and Hwy 30 at MP 80.9. Figure 3.4.1-4 shows the proposed and alternative compressor station locations. The compressor station would occupy about 7.0 acres.

The primary engineering criterion considered in the alternatives analysis was access to reliable commercial electrical power, because the compressors would be equipped with electric drive motors. Compared to gas or diesel engines, electric drive motors produce lower noise levels without CO_2 or nitrogen oxide emissions. Additionally the electric drive motors provide a high degree of reliability and lower maintenance than gas or diesel engines. Other considerations included: good site access, existing site grade, availability of additional area for expansion, and proximity to the proposed pipeline.

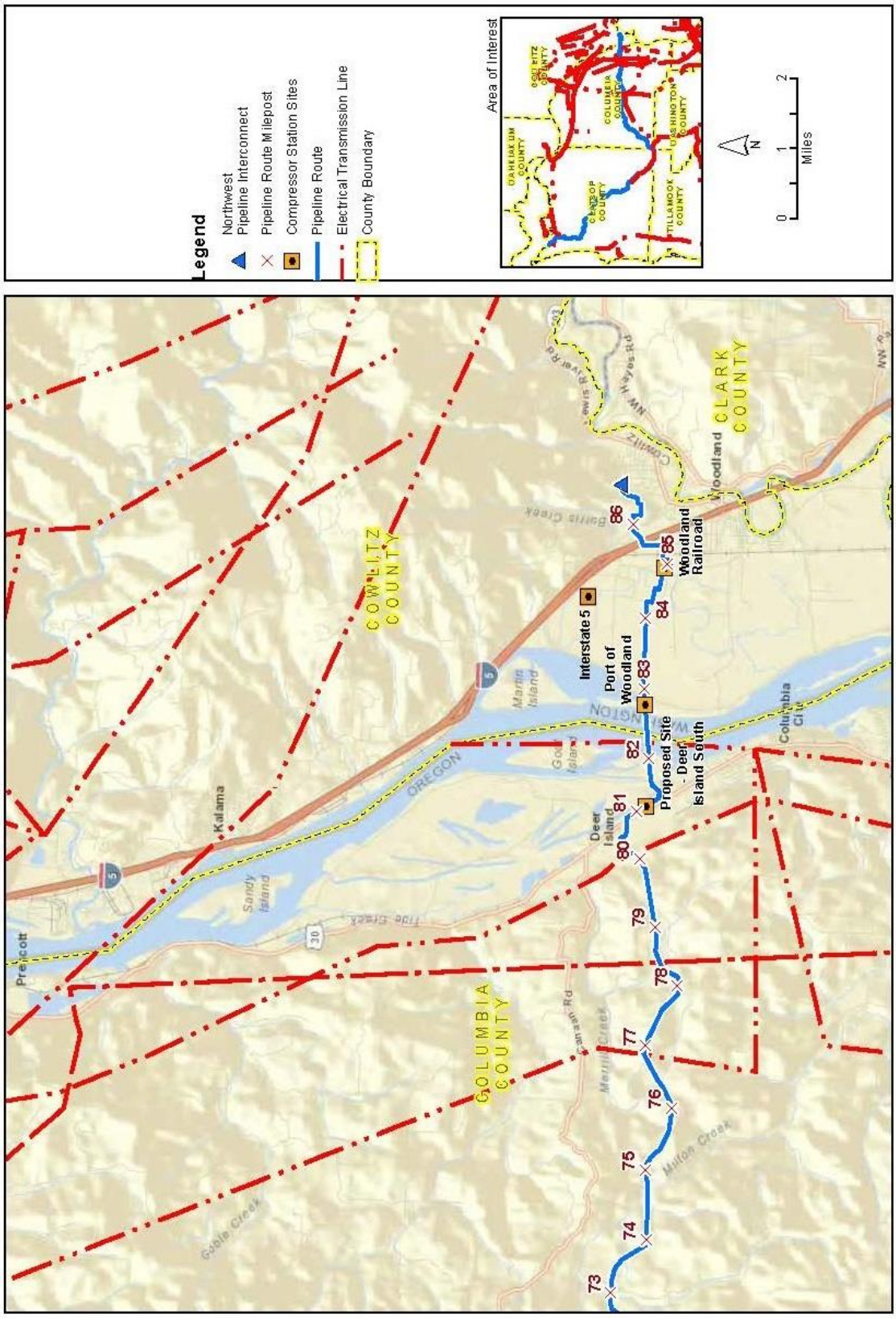


Figure 3.4.1-4: Compressor Station Site Alternatives

Environmental criteria considered for compressor locations included the presence of, or proximity to, prime farmland and soils, floodplains, noise sensitive areas (NSA), residences, wetlands, critical habitat, threatened or endangered species, and cultural resources. Oregon LNG visited and surveyed the proposed site and two alternatives for potential environmental issues prior to its selection of the proposed site. Table 3.4.1-5 provides a comparison of factors that were used to distinguish between the alternative and proposed compressor station sites.

Table 3.4.1-5

Comparison of the Alternative Compressor Station Sites

Environmental Factor	Proposed Site	I-5 Alternative	Port of Woodland Alternative	Woodland Railroad Alternative
Existing Land Use	Agricultural/Trees	Agricultural/Field	Agricultural/Field	Agricultural/Field
Distance to Nearest Residence/NSA (feet)	1,671.0	1,826.0	825.0	183.0
NWI Wetlands Permanent Impacts (acres)	0.0	0.4	1.3	0.0
Proximity to Sensitive Wildlife Areas (feet)	0.0	6,343.0	0.0	0.0
Distance to Nearest Waterbody (feet)	107.0	128.0	381.0	1,080.0
Proximity to Recreational Areas (feet)	6,370.0	9,254.0	78.0	2,162.0
Prime Farmland Permanent Impacts (acres)	3.1	7.0	0.0	7.0
Distance to Electric Power Source (miles)	0.5	0.6	2.0	1.0

The proposed compressor station site would be about 1.2 miles south the community of Deer Island. Oregon LNG states that this site is preferable compared to the alternative locations evaluated because it:

- is adequate from an engineering standpoint, including pipeline hydraulics, well-located electrical transmission lines within 0.5 mile, and generally a level building site;
- provides good access to Hwy 30, forgoing the need for easement access to the site; and
- is in an area that is sparsely populated.

Oregon LNG initially considered a location for the compressor station about 1 mile north of Woodland, Washington, and 0.1 mile west of I-5 in Cowlitz County. This alternative would be at about MP 85.0 of the proposed pipeline route as it was proposed in Oregon LNG's 2013 Application. In April 2014, Oregon LNG modified its pipeline route in Cowlitz County, which resulted in the I-5 Alternative compressor station site no longer being on the proposed pipeline route. Therefore, it was eliminated as a viable alternative and replaced with the Woodland Railroad Alternative.

The Woodland Railroad Alternative site would be about 0.4 mile west of I-5 at about MP 85.0 on a field surrounded by agricultural lands and commercial buildings. The compressor station at this alternative site would connect to the Cowlitz Public Utility Department substation about 1 mile north. This alternative site would be the closest to existing buildings and would be less than 200 feet from the nearest residence and less than 1 mile from the new Woodland High School.

The Port of Woodland Alternative would be at MP 82.5, about 2 miles west of Woodland, Washington, in Cowlitz County. This alternative would be on the east bank of the Columbia River off Dike Road and would have good road access. The Port of Woodland Alternative would have the disadvantages of being adjacent to a recreational boat launch and the Columbia River. Additionally, it would require the installation of additional 115-kV power lines from the Cowlitz Public Utility Department substation in Woodland to this site.

The proposed compressor station site, Woodland Railroad Alternative, and Port of Woodland Alternative would all be within purple martin habitat. Oregon LNG would implement measures to avoid or minimize impact to this species, including:

- conduct preconstruction surveys within 2 weeks of vegetation clearing;
- if nesting habitat is present, avoid clearing until nesting is completed or failed; and
- install nest boxes if necessary.

Based on our review of the compressor station site alternatives, we concur that none of the alternatives offer significant environmental advantages over the proposed site.

3.4.2 Washington Expansion Project

3.4.2.1 Major Route Alternatives

Because about 132 miles, or 94 percent of the length of the WEP would be installed within Northwest's existing easement, we determined that any major route alternative would have significantly greater environmental impacts than the proposed project, producing a much larger construction footprint. Further, installation of a pipeline loop that significantly deviates from the existing right-of-way would require increasing the length of the pipeline and potentially increasing the amount of compression to meet the required flow capacity. Increasing compression would result in greater air quality and noise impacts to nearby noise sensitive areas. Therefore, we eliminated major route alternatives from further consideration.

3.4.2.2 Minor Route Variations

For the WEP, we assessed route variations at river crossings and two wetland crossings. The analysis of each route variation included a number of environmental factors, such as proximity of residences, wetlands impacts, and an assessment of the geologic hazards (liquefaction and landslide). Geologic hazard data, including data sources, are discussed in more detail in section 4.2.1. Maps of the route variations are provided in appendix I3.

Kalama River Crossing

Northwest's existing 30-inch-diameter pipeline and the abandoned-in-place 26-inch-diameter pipeline cross the Kalama River using a four-span structure consisting of two steel beams and a plate girder support built in 1972. The total length of the aerial span is about 420 feet (180 feet of which is directly over the river). To the north, the existing right-of-way crosses slopes and valleys up the southeastern face of Mount Pleasant. To the south, the existing right-of-way crosses slopes up the northwestern face of Green Mountain. The combination of these slopes makes it infeasible to cross the Kalama River at this location by HDD. We reviewed three options for crossing the Kalama River as summarized in table 3.4.2-1. These include the proposed route and one alternative route as shown in figure 1 of appendix I3.

Table 3.4.2-1

Kalama River Crossing Alternatives

Environmental Factor	Units	Option A (Proposed)	Option B	Option C
Total Length [a]	feet	10,412	11,589	10,412
Within Existing Right-of-way [b]	feet	10,412	72	10,412
New Right-of-way [c]	feet	0	11,526	0
Construction Right-of-way [d]	acres	22.7	25.2	22.7
Permanent Right-of-way	acres	17.9	19.9	17.9
NWI Wetlands	acres	0.3	0.3	0.3
Perennial Waterbodies Impacted	number	2	3	2
Major Waterbodies Crossed	number	0	0	1
Residences within 50 feet of Construction Right-of-way	number	4	3	4
Documented Landslides	feet	4,033	0	4,033
Medium to High WDNR Potential Shallow Landslide	feet	2,907	1,454	2,907
Moderate to High or High Liquefaction Hazard	feet	870	985	870

[a] For purposes of comparing environmental factors, the total length of the proposed route is considered from the first point a minor route variation deviates from the WEP to the last point at which a minor route variation rejoins the WEP route.

[b] Northwest's existing, permanent right-of-way.

[c] Assumed to be outside of Northwest's existing, permanent right-of-way corridor.

[d] Assumed to be typical 95-foot-wide construction right-of-way; does not include ATWS, which have not been determined for minor route variations.

Kalama River Option A (Proposed)

Northwest proposes to remove the abandoned 26-inch-diameter pipeline that currently spans the Kalama River and retrofit the aerial span for the new 36-inch-diameter pipeline. The existing aerial span would undergo additional structural review to finalize the design. The pipeline would be constructed within the existing right-of-way, resulting in limited landowner and environmental impacts.

This option would span the Kalama River aboveground, minimizing impacts on fisheries and water resources. The construction right-of-way would be within 50 feet of four residences, one of which would be within 25 feet; however, these residences are along Northwest's existing permanent right-of-way.

Immediately north of the Kalama River crossing, the Option A (proposed) route would cross a known geologic hazard area, passing through two areas mapped as Cowlitz County-identified landslide features. These two features, the Kalama North Landslide and Mount Pleasant Landslide, are included in Northwest's geologic hazards monitoring and mitigation program. Northwest has historical data on the nature of the land movement, and has put in place mitigation measures to minimize potential soil movement and impacts on the existing pipelines. See section 4.2.1 for further information about landslide hazards and mitigation.

Northwest states that the mitigation measures are functioning and that Northwest can safely install and operate a new 36-inch-diameter pipeline through both landslide areas in Cowlitz County. No other potential landslide or steep slope hazard areas have been identified along the proposed route. The WDNR's relative landslide hazard mapping indicates that the hazard ranges from low to medium along the route.

Relative liquefaction hazard along the proposed route is very low, except in the immediate vicinity of MP 1253.4 on the south side of the Kalama River, where the liquefaction hazard is moderate to high. The aerial span would minimize the hazard associated with liquefaction.

Kalama River Option B

Option B would relocate the Kalama River crossing about 2,060 feet southwest of the existing span. The route variation would be about 2.2 miles long, beginning at MP 1253.0 of the WEP. The route would extend northwest for 0.4 mile before turning west-southwest for 0.2 mile and crossing Bates Road. The route would then head north-northwest to the Kalama River, cross the Kalama River with a trenchless installation method, such as an HDD, and then continue toward Kalama River Road. At this point, the route would redirect to a north-northeast orientation and climb the hillside north of the Kalama River valley. The route would traverse the ridgeline in a general north-northwest heading for about 1.6 miles until it would again join the WEP near MP 1254.9.

The route for Option B would not be collocated with an existing pipeline right-of-way. Option B would cross three perennial waterbodies and 0.3 acre of NWI-mapped wetlands. The construction right-of-way for Option B would be within 50 feet of three residences, one of which would be within 25 feet.

No potential landslide areas have been documented along the Option B route. However, there is a possibility that this route would traverse unmapped geologic hazards for which Northwest has no historical data. The WDNR's relative landslide hazard mapping indicates a low to medium hazard along the route of Option B. The relative liquefaction hazard along the Option B route is very low, except for a distance of about 0.2 mile in the immediate vicinity of the Kalama River, where the liquefaction hazard is shown to be moderate to high.

Option B would result in environmental impacts on over 11,000 feet of new right-of-way. For that reason, we do not consider Option B to be preferable to the proposed route, Option A.

Kalama River Option C

Under this route variation, Northwest would cross the Kalama River in the same general location (slightly offset from the existing 30-inch-diameter pipeline) of the existing aerial span, using a wet, open-cut crossing method. This crossing method would result in impacts on fisheries and water resources because of trenching within the river as compared to Options A or B. The route deviation would impact two perennial waterbodies and would cross 0.3 acre of wetlands mapped by NWI.

The crossing location has steep slopes on the south side of the river and limited space on the north side. After crossing the river, the route would be identical to that described for the proposed route, with similar environmental and landowner impacts.

Crossing the Kalama River using a wet open-cut crossing would result in impacts on fish and water resources. The aerial span crossing of the Kalama River (Option A) would not impact fish or surface water, including wetlands. For these reasons, we do not consider Option C to be preferable to the proposed route, Option A.

Toutle River Crossing

The area where Northwest's existing pipelines cross the Toutle River in northern Cowlitz County is an historic floodplain. This area was used as spoil storage by the USACE for dredging operations following the eruption of Mount St. Helens in 1980. The spoil pile consists of a thickness of about

70 feet to 80 feet of lahar deposits placed within the floodplain and over Northwest's existing 30-inch-diameter pipeline and abandoned 26-inch-diameter pipeline.

In November 2006, an extreme high water event in the Toutle River caused the river to migrate over 200 feet from its previous bed. The flooding exposed both the existing 30-inch-diameter pipeline and the abandoned 26-inch-diameter pipeline that paralleled the river at this reach. Northwest undertook emergency measures to return natural gas service, which included installing a temporary, lateral bypass pipeline and removing the pipelines from the river. Northwest then permanently rerouted the portion of the 30-inch-diameter pipeline within the historic floodplain. To provide long-term protection for the pipeline, Northwest excavated to depths of up to 80 feet through the lahar deposits when installing the re-routed 30-inch-diameter pipeline. The pipeline was buried so deeply in order to reduce potential scour concerns in the event of future lateral migration of the Toutle River. Northwest provided us with a stream channel assessment and scour analysis for the waterbodies crossed by the WEP, including the Toutle River.

In 2007, before the permanent reroute of the pipeline was completed, Northwest evaluated the feasibility of crossing the Toutle River using HDD methods. Based on a site visit and review of existing information, Northwest initially identified six alternative crossing routes as shown in figure 2 of appendix I3 along with the existing pipeline right-of-way. The 2007 evaluation indicated that Reroute Alternative B/C had a high probability of failure. Reroute Alternative E was determined to have favorable conditions for HDD and is presented as Option E for the WEP.

Northwest later conducted a further evaluation of the feasibility of a trenchless crossing of the Toutle River in the vicinity of the Northwest's existing right-of-way. This evaluation assessed the practicability of crossing the river using both HDD and Direct Pipe installation methods. The subsurface conditions along the proposed crossing consist of deep deposits of sand and gravel soils. In addition, wood and woody debris, cobbles, boulders, and the potential for pockets of gas are present. These conditions add to the complexity of the crossing and pose a high risk of failure for a trenchless crossing at this location.

Because of the risk of an unsuccessful trenchless installation and limitations associated with Direct Pipe and HDD methods, Northwest evaluated the open-cut installation method for crossing options in the vicinity of the existing Northwest right-of-way. Northwest evaluated the feasibility of a dry, open-cut crossing for the Toutle River, but it was deemed impractical based on summer volumes and subsurface water flows. Options A, B, C, and D for the Toutle River crossing would use the wet, open-cut installation method. Options A through E are summarized in table 3.4.2-2 and shown in figure 3 of appendix I3.

Table 3.4.2-2

Toutle River Crossing Alternatives

Environmental Factor	Unit	Option A (Proposed)	Option B	Option C	Option D	Option E
Total Length [a]	feet	18,652	15,985	16,419	18,384	22,420
Within Existing Right-of-way [b]	feet	10,561	9,601	10,403	9,407	115
New Right-of-way [c]	feet	8,091	6,384	6,016	8,977	22,305
Construction Right-of-way [d]	acres	8.5	34.8	35.7	39.7	44.5
Permanent Right-of-way	acres	30.5	27.6	28.2	31.6	35.2
NWI Wetlands	acres	1.1	1.1	1.3	1.7	0.0
Perennial Waterbodies Impacted	number	2	3	4	5	4
Major Waterbodies Crossed	number	1	1	1	1	0
NRHP-listed Properties	number	0	0	0	0	1
Residences within 50 Feet of Construction Right-of-way	number	0	0	0	0	1
Documented Landslides	feet	0	0	0	0	5,278
Medium to High WDNR Potential Shallow Landslide	feet	1,457	1,328	1,198	1,268	1,472
Moderate to High or High Liquefaction Hazard	feet	7,231	5,075	5,466	6,559	883

[a] For purposes of comparing environmental factors, the total length of the proposed route is considered from the first point a minor route variation deviates from the WEP to the last point at which a minor route variation rejoins the WEP route.

[b] Northwest's existing, permanent right-of-way.

[c] Assumed to be outside of Northwest's existing, permanent right-of-way corridor.

[d] Assumed to be typical 95-foot-wide construction right-of-way; does not include ATWS, which have not been determined for minor route variations.

Toutle River Option A (Proposed)

The proposed route (Option A) would depart from Northwest's existing right-of-way at MP 1274.2 to cross the Toutle River at MP 1274.4, about 900 feet downstream from the 30-inch-diameter pipeline. The proposed route would cross two perennial waterbodies and 1.1 acres of NWI-mapped wetlands mapped.

The proposed route crosses two Cowlitz County-identified potential landslides or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is low to medium along the route, but in some areas the hazard is high. Relative liquefaction hazard along this alignment is moderate to high.

Northwest has implemented mitigation and monitoring practices to manage risk to its pipelines. Northwest states that it would continue to conduct pipeline and surface monitoring and maintenance to identify conditions which suggest that future movement could occur. Northwest also states that geotechnical explorations would be conducted in these areas as necessary to evaluate the potential for slope movement and to evaluate mitigation alternatives. See section 4.2.1 for further information about landslide hazards and mitigation.

Toutle River Option B

The route for Option B would leave Northwest's existing right-of-way at MP 1274.21 and travel north through dredge spoils, avoiding wetlands that occur to the west and crossing the Toutle River with a wet open-cut crossing. Option B was Northwest's proposed route for crossing the Toutle River in its June

2013 Application. However, after further evaluation, it is no longer the proposed route due to constructability concerns, including the depth of cover required to avoid potential scour issues and landslide potential on the north side of the river.

Option B would cross three perennial waterbodies and 1.1 acres of NWI-mapped wetlands. The route crosses two Cowlitz County-identified potential landslide or steep slope hazard areas. The pipeline route would cross the edge of one of these mapped hazard areas for about 0.4 mile; but, Northwest states that the route has been field verified to be outside of this hazard area. The WDNR's relative landslide hazard mapping indicates low to medium hazard along most of the route, with some areas where the hazard is high.

Relative liquefaction hazard along the route of Option B is moderate to high for a distance of about 0.9 mile south of the Toutle River. The remainder of the route would cross areas with a low to moderate or very low relative liquefaction susceptibility.

Toutle River Option C

Option C would cross the Toutle River using a wet, open-cut crossing method in the vicinity of the existing 30-inch-diameter pipeline. Option C would deviate from the WEP route at MP 1274.1, travel northwest to cross the Toutle River, and continue northwest for about 0.6 mile through a shooting range before turning northeast to rejoin the WEP at MP 1275.8. Option C was Northwest's proposed route for crossing the Toutle River in its Pre-filing Review Draft Resource Reports filed in January 2013; however, it was removed as the proposed route in the June 2013 Application due to constructability concerns, including the need to maintain cover depths up to 80 feet through the lahar deposits to avoid potential scour issues, and to avoid impacts on landowners. Option C would cross four perennial waterbodies and 1.3 acres of NWI-mapped wetlands.

Northwest did not identify any documented landslide features along this alternative alignment. The route would cross two Cowlitz County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is low to medium along the route, but indicates some areas where the hazard is high.

Relative liquefaction hazard along this alignment is moderate to high for a distance of about 0.20 mile south and 0.90 mile north of the Toutle River. The remainder of the alignment is classified as having low to moderate or very low liquefaction susceptibility.

Toutle River Option D

Option D, similar to Option C, would use a wet, open-cut crossing method, but would leave the proposed route at MP 1273.9 and cross the river about 1,140 feet west of the existing pipeline. The route would also cross the shooting range crossed by Option C before rejoining the proposed route at MP 1275.9. This route has landowner impacts and the same constructability concerns identified for Option C to maintain cover depths through the lahar deposits to avoid potential scour issues; but, these depths would be required for a greater distance. This route would cross five perennial waterbodies and 1.7 acres of NWI-mapped wetlands. Option D would cross within 100 feet of one residence, but would not cross within 50 feet of any residences.

The route would cross one Cowlitz County-identified potential landslide or steep slope hazard area. The WDNR's relative landslide hazard mapping indicates that the hazard is generally low along the route; however, there are isolated areas where the hazard is medium to high. The relative liquefaction hazard along this alignment would be about the same as described for Option C.

Toutle River Option E

Option E would cross the Toutle River using HDD about 4.2 miles east of the existing Northwest pipeline crossing. This option would deviate from the existing right-of-way at MP 1273.2, continuing northeast through about 2.0 miles of new right-of-way. Northwest evaluated the subsurface geology at this crossing location in 2007 and determined that conditions are favorable for HDD. The HDD crossing would be about 2,000 feet long with the entry point north of the river on a relatively flat terrace surrounded by moderately sloping timberland. The exit pit would be in adjacent pastureland that provides adequate space for pipe stringing. After the crossing, the route would continue northwest for an additional 1.8 miles before rejoining Northwest's existing right-of-way at MP 1276.8.

Option E would cross five perennial waterbodies, including the Toutle River, which would not be impacted due to the HDD methodology. Option E would not cross any NWI-mapped wetlands because the HDD methodology would avoid surface impacts on wetlands. However, this minor route variation would impact 33 new landowners and would be within 100 feet of three residences outside of Northwest's existing easement (one of which is within 50 feet). Option E would also cross the Tower Road Cemetery, a property listed in or eligible for the NRHP, located between Tower Road and the proposed route.

A large documented landslide feature is present north of the Toutle River along this alternative route. The landslide feature is shown on both WDNR and Cowlitz County landslide hazard mapping. The route for Option E would cross about 0.7 mile of the landslide feature shown on Cowlitz County mapping and about 0.4 mile of the landslide feature shown on WDNR mapping. Documented landslide features are not shown along this route variation option south of the Toutle River.

The route does not cross any Cowlitz County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is low to medium along the route, but some areas classified as high hazard would be crossed by the Option E route.

Relative liquefaction hazard is classified as moderate to high for about 0.3 mile of the Option E route, immediately adjacent to the Toutle River. The remainder of the route is estimated to have low to moderate or very low relative liquefaction susceptibility.

Although Option E would avoid direct temporary impacts on aquatic resources to the Toutle River through the use of HDD, this would be offset by the greater impacts that would result from the additional extra workspace and 2.7 miles of new pipeline right-of-way when compared to the corresponding segment of the proposed route.

Taking into consideration constructability issues and overall environmental impacts, we did not find any of the alternative route variations analyzed to be preferable to the proposed route for crossing the Toutle River.

Deschutes River and Vail Mountain Crossing

Because of known geologic hazards, we assessed two minor route variations in the Deschutes River and Vail Mountain area and a potential alternative crossing location for the Deschutes River. These alternatives are within the Chehalis Loop in Thurston County, are compared in table 3.4.2-3 and shown in figures 4a and 4b of appendix I3.

Table 3.4.2-3

Deschutes River/Vail Mountain Crossing Alternatives

Environmental Factor	Unit	Option A (Proposed)	Option B
Total Length [a]	feet	19,778	25,359
Within Existing Right-of-way [b]	feet	18,779	152
New Right-of-way [c]	feet	999	25,207
Construction Right-of-way [d]	acres	54.7	55.2
Permanent Right-of-way	acres	34.2	43.5
NWI Wetlands	acres	0.4	0.0
Perennial Waterbodies Impacted	number	3	4
Major Waterbodies Crossed	number	0	0
Residences within 50 feet of Construction Right-of-way	number	1	0
Documented Landslides	feet	916	1,271
Medium to High WDNR Potential Shallow Landslide	feet	3,358	1,044
Moderate to High or High Liquefaction Hazard	feet	0	0

[a] For purposes of comparing environmental factors, the total length of the proposed route is considered from the first point a minor route variation deviates from the WEP to the last point at which a minor route variation rejoins the WEP route.

[b] Northwest's existing, permanent right-of-way.

[c] Assumed to be outside of Northwest's existing, permanent right-of-way corridor.

[d] Assumed to be typical 95-foot-wide construction right-of-way; does not include ATWS, which have not been determined for minor route variations.

Deschutes River and Vail Mountain Option A (Proposed)

Northwest would cross the Deschutes River by a dry, open-cut crossing. The location of the crossing would be parallel to its existing 30-inch-diameter pipeline crossing at the Deschutes River at MP 1315.1. Northwest would use the boring method to install the pipeline under the Weyerhaeuser Railroad crossing to the north of the river. There are steep slopes on the south side of the river crossing location and limited space on the north side.

The proposed route (Option A) would cross three perennial waterbodies and 0.35 acre of NWI-mapped wetlands. The route would cross within 25 feet of one residence. The proposed route would cross the NRHP-listed historic Chehalis Western/Vail to South Bay rail line.

The only documented landslide features mapped along the proposed route are immediately south of the Deschutes River. About 0.2 mile of this alignment would cross a documented slide feature shown on WDNR mapping. In addition, Northwest has identified and investigated a small landslide near MP 1314.6, which would be crossed by the proposed route. Northwest implemented mitigation measures in 1997 to stabilize this small slide and also installed three strain gauges in the vicinity of this slide. Two of the strain gauges are monitored remotely with real-time download of data. Northwest states that data from existing strain gauges along the proposed route indicate that the mitigation measures are functioning and that Northwest can safely install and operate a new 36-inch-diameter pipeline through the area.

The route would not cross any Thurston County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard would be low to medium along the proposed route. Relative liquefaction hazard for the proposed route is classified as very low to low.

Deschutes River and Vail Mountain Option B

The Option B alternative would cross the Deschutes River about 5,940 feet west of the existing crossing, using a dry, open-cut crossing method. The Option B route would leave Northwest's existing right-of-way at MP 1311.9 and travel northwest, paralleling the existing Olympic pipeline right-of-way for about 3.2 miles before crossing the Deschutes River. The river at this location is about 60 feet wide at water's edge. The route would then continue east-southeast for about 1.2 miles before rejoining Northwest's existing right-of-way at MP 1315.6.

Option B would cross four perennial waterbodies and no NWI-mapped wetlands. No residences would be within 50 feet of the construction right-of-way. Similar to the proposed route, this minor route variation would also cross the NRHP-listed historic Chehalis Western/Vail to South Bay rail line.

Option B would avoid a known geologic hazard at Vail Mountain south of the Deschutes River crossing; however, it would encounter unavoidable side slopes. This route would cross about 0.2 mile of documented landslide immediately south of the Deschutes River. The route would not cross any Thurston County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is low to medium along the route; however, there are isolated areas where the hazard is high. Relative liquefaction hazard along the entire length of the route of Option B is mapped as very low to low, the same as the proposed route.

Although Option B would avoid a known geologic hazard at Vail Mountain, it would still cross documented landslide areas and areas of high landslide hazard. We agree that installing the WEP parallel to its existing 30-inch-diameter pipeline where the geologic hazards have been evaluated and mitigation is already in place is the preferred alternative. Further, the proposed route would have fewer environmental impacts than Option B because it would be shorter and require less new right-of-way.

Queen's Bog Crossing and Unnamed Bog at MP 1381.3 Crossing

The WEP would cross two bogs within the Sumner North B Loop in King County. These include Queen's Bog and an unnamed bog at MP 1381.3. All wetlands that meet the criteria for bogs (soils, vegetation, or acidity) are granted the highest wetland rating level (Category I) due to the ecosystem services provided by bog environments and the fact that bogs cannot be recreated or their services replaced through compensatory mitigation. We reviewed minor route variations that would avoid crossing these bogs. These options are shown in figure 5 of appendix I3 and summarized in table 3.4.2-4.

Table 3.4.2-4

Bog Crossing Alternatives

Environmental Factor	Unit	Queen's Bog Option A (Proposed)	Queen's Bog Option B	Unnamed Bog Option A (Proposed)	Unnamed Bog Option B
Total Length [a]	feet	889	2,031	1,516	6,032
Within Existing Right-of-way [b]	feet	889	54	1,516	73
New Right-of-way [c]	feet	0	1,977	0	5,959
Construction Right-of-way [d]	acres	1.7	4.3	2.8	13.1
Permanent Right-of-way	acres	1.4	3.4	2.4	10.3
NWI Wetlands	acres	0.7	<0.1	1.2	3.6
Perennial Waterbodies Impacted	number	0	1	1	2
Residences within 50 feet of Construction Right-of-way	number	0	4	0	5

[a] For purposes of comparing environmental factors, the total length of the proposed route is considered from the first point a minor route variation deviates from the WEP to the last point at which a minor route variation rejoins the WEP route.

[b] Northwest's existing, permanent right-of-way.

[c] Assumed to be outside of Northwest's existing, permanent right-of-way corridor.

[d] Assumed to be typical 95-foot-wide construction right-of-way; does not include ATWS, which have not been determined for minor route variations.

Queen's Bog

Under the proposed route (Option A), Northwest proposes to cross Queen's Bog at MP 1379.1 using a push-pull crossing methodology. The push-pull method is typically used where very soft or unstable ground will not support the construction equipment normally used for pipeline installation. The proposed route would parallel Northwest's existing 30-inch-diameter pipeline within the existing right-of-way, which is about 600 feet from the west edge of the bog. The proposed route would not cross any perennial waterbodies but would cross 0.7 acre of NWI-mapped wetlands. Two residences would be within 100 feet of the construction right-of-way but no residences would be within 50 feet construction right-of-way.

Option B would avoid Queen's Bog by deviating to the west. The route for Option B would leave the proposed route at MP 1379.0, travel west around the bog perimeter and return to Northwest's existing easement at MP 1379.2. This alternative would present constructability concerns because of the constrained work area between the bog and the adjacent residential developments. Additionally, the alternative would require the removal of a large number of mature trees and other vegetation along the alternative route. About 1,980 new feet of right-of-way would be required, with 4.3 acres of construction right-of-way.

Option B would cross one perennial waterbody and less than 0.1 acre of NWI-mapped wetlands. The construction right-of-way for this option would be within 100 feet of 12 residences, of which four would be within 50 feet. Although Option B would avoid Queen's Bog, it would result in an additional waterbody crossing, more tree clearing, and additional impacts on residences. Therefore, we conclude that Option B is not environmentally preferable to the proposed route.

Unnamed Bog at MP 1381.3

The proposed route (Option A) for the unnamed bog crossing at MP 1381.3 would also use the push-pull method. Northwest would install the pipeline within its existing right-of-way about 2,500 feet

from the east edge of the bog. The proposed route would cross one perennial waterbody, and 1.2 acres of NWI-mapped wetlands. One residence would be within 100 feet of the construction right-of-way and none would be within 50 feet. Option B would avoid the unnamed bog by looping around the western boundary of the bog. The route would deviate from the existing right-of-way at MP 1381.2, travel west to avoid the majority of the bog before returning east to rejoin the WEP route at MP 1381.5. This alternative would be more difficult to construct because of the limited work area for excavation around the edges of the bog. An existing retention pond would be about 100 feet from the south end of the pipeline in Option B, and an existing recreation area, including a football field, would be about 40 feet from the south end of the pipeline in Option B.

On the north end of Option B, additional recreational areas, including a baseball diamond and football and soccer fields, are within 30 feet of the pipeline route. To minimize inclusion of these existing recreation areas within the construction right-of-way, the reroute would require the removal of mature trees and vegetation around the perimeter of the bog. About 5,960 feet of new right-of-way would be required, with 13.1 acres of construction right-of-way. Option B would cross two perennial waterbodies and 3.6 acres of NWI-mapped wetlands. The construction right-of-way for this option would be within 100 feet of eight residences, five of which are within 50 feet. We conclude that the additional tree clearing, waterbody crossing, and new right-of-way that would be required for Option B would result in greater environmental impacts than the proposed route.

Skagit River/Heartbreak Hill

Within the Mt. Vernon North A Loop, the area south of the Skagit River, known as Heartbreak Hill, consists of steep slopes and rocky terrain. Northwest's existing 30-inch-diameter pipeline crosses this hill and then crosses the Skagit River by a suspension-supported aerial span. We reviewed two alternative routes for crossing Heartbreak Hill and the Skagit River. These alternatives are shown in figure 6 of appendix I3 and summarized in table 3.4.2-5.

Table 3.4.2-5

Skagit River/Heartbreak Hill Crossing Alternatives

Environmental Factor	Unit	Option A (Proposed)	Option B
Total Length [a]	feet	11,632	24,856
Within Existing Right-of-way [b]	feet	11,632	23
New Right-of-way [c]	feet	0	24,833
Construction Right-of-way [d]	acres	25.4	54.1
Permanent Right-of-way	acres	20.1	42.7
NWI Wetlands	acres	0.9	4.4
Perennial Waterbodies Impacted	number	1	4
Unlisted, potentially eligible historical properties	number	0	2
Residences within 50 feet of Construction Right-of-way	number	2	5
Documented Landslides	feet	685	0
Medium to High WDNR Potential Shallow Landslide	feet	0	0
Moderate to High or High Liquefaction Hazard	feet	452	14,321

[a] For purposes of comparing environmental factors, the total length of the proposed route is considered from the first point a minor route variation deviates from the WEP to the last point at which a minor route variation rejoins the WEP route.

[b] Northwest's existing, permanent right-of-way.

[c] Assumed to be outside of Northwest's existing, permanent right-of-way corridor.

[d] Assumed to be typical 95-foot-wide construction right-of-way; does not include ATWS, which have not been determined for minor route variations.

Skagit River/Heartbreak Hill Option A (Proposed)

The proposed route (Option A) would parallel the existing 30-inch-diameter pipeline over Heartbreak Hill for its entire length (between MP 1442.0 and MP 1445.0). The new 36-inch-diameter pipeline would tie into the existing 30-inch-diameter pipeline at the base of Heartbreak Hill (MP 1444.9) and cross the Skagit River using the existing aerial span. The proposed route would not impact the Skagit River because it would use the existing span. The proposed route would cross one other perennial waterbody and 0.9 acre of NWI-mapped wetlands. The construction right-of-way would be within 50 feet of two residences. No new right-of-way would be needed.

The proposed route would cross through a small, documented landslide on the south side of the Skagit River. This area is crossed by Northwest's existing 30-inch-diameter pipeline, and Northwest states that the slide has been investigated and consists of shallow sloughing. This area is included in Northwest's geologic hazards monitoring and mitigation program. The route would not cross any Skagit County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is medium to high along the route. The relative liquefaction hazard mapped along this route is estimated to be very low to the south of the Skagit River and moderate to high north of the river.

Skagit River/Heartbreak Hill Option B

This option would skirt the west side of Heartbreak Hill and cross the Skagit River using HDD. Option B would depart from the WEP route at MP 1442.9, traveling northwest for about 1.6 miles around the southern base of Heartbreak Hill, turning north to parallel State Highway 9 for about 0.7 mile before turning west to cross the Skagit River by HDD that would be about 1,950-foot long. The HDD crossing would be about 5,000 feet west of the existing aerial span over the Skagit River. The HDD exit would be north of the river on a relatively flat terrace, compared to the steep slopes at the existing crossing. The Option B route would rejoin the proposed route at MP 1445.0.

Option B would impact four perennial waterbodies and 4.42 acres of NWI-mapped wetlands. The construction right-of-way would be within 50 feet of five residences. Option B would cross Old Tram Road, which is potentially historic and currently unevaluated but recorded, and would cross Old Railroad Grade paralleling State Highway 9, a site which is currently unrecorded and unevaluated.

The route crosses very steep terrain that would encounter some unavoidable side slopes. Observations made during field reconnaissance suggest that landslides may be present; however, the alignment would not pass through any documented landslide features shown on either WDNR or Skagit County landslide hazard mapping.

The route does not cross any Skagit County-identified potential landslide or steep slope hazard areas. The WDNR's relative landslide hazard mapping generally indicates the hazard is low along the route; however, there are isolated areas where the hazard is classified as high. There is also a small segment of the route where no relative landslide hazard mapping is available.

The relative liquefaction hazard along the southernmost 1.6 miles of Option B is mapped as very low. The relative hazard is indicated as high for a distance of about 0.8 mile north and about 1.7 miles south of the Skagit River. The relative liquefaction hazard along the northernmost 0.2 mile of the Option B route is classified as moderate to high.

Option B would be 2.5 miles longer than the proposed route and would require 4.7 miles of new right-of-way compared to Option A which would not require any new permanent right-of-way. Option B would have reduced landslide risk but would have significantly greater environmental impacts. In section 4.2.1.4 we include recommendations that address geotechnical investigations for landslide areas, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan. With these recommendations, and contingent on geotechnical investigation results confirming that the landslide risk can be safely mitigated, we conclude that the proposed route is preferred over Option B.

4.0 ENVIRONMENTAL ANALYSIS

This section describes the affected environment as it currently exists and discusses the environmental consequences of the Oregon LNG Project (addressed in section 4.1) and the WEP (addressed in section 4.2). The environmental consequences of constructing and operating the proposed projects would vary in duration and significance. Four levels of impact duration were considered: temporary, short-term, long-term, and permanent. A temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to 3 years following construction. Impact was considered long term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modifies a resource to the extent that it would not return to preconstruction conditions during the life of the project. We considered an impact significant if it would result in a substantial adverse change in the physical environment and the relationship of people with the environment. **Cumulative impacts for both projects are addressed in section 4.3.**

Oregon LNG and Northwest, as part of their proposals, developed certain mitigation measures to reduce the impact of the projects. In some cases, we determined that additional mitigation measures could further reduce the project's impacts. Our additional mitigation measures appear as bulleted, boldfaced paragraphs in the text of this section and are also included in section 5.2. We will recommend that these measures be included as specific conditions in any Authorization the Commission may issue to Oregon LNG and Northwest for their projects.

The conclusions in this EIS are based on our analysis of environmental impacts and the following assumptions:

- Oregon LNG and Northwest would comply with all applicable laws and regulations;
- the proposed facilities would be constructed as described in section 2.0 of this document; and
- Oregon LNG and Northwest would implement the mitigation measures included in their applications and supplemental submittals to the FERC and cooperating agencies, and in other applicable permits and approvals.

4.1 OREGON LNG PROJECT

4.1.1 Geological Resources

4.1.1.1 Terminal

Geologic Setting

The geology of Oregon and Washington is complex and varies widely from west to east. Much of this variation can be attributed to the offshore Cascadia Subduction Zone (CSZ), where the Juan de Fuca Plate is actively subducting beneath the western margin of the North American Plate. The ongoing subduction has created a seismically active area with numerous faults, volcanoes, mountains, and valleys (Orr et al., 1999).

The LNG terminal would be in the Coast Range physiographic province (Orr et al., 1999). The Coast Range physiographic province is a narrow strip of land bordered by the continental shelf to the west, the Willamette Valley to the east, the Columbia River to the north, and the Middle Fork of the Coquille River to the south. A narrow belt of mountains extends north to south across the length of the province with elevations ranging from sea level along the coast to over 4,000 feet. The western slopes of the mountains receive more than 100 inches of rain per year, while the eastern slopes receive less than 40 inches of rain.

The proposed location for the terminal is on the Skipanon Peninsula in Warrenton, Oregon, in northwestern Oregon along the southern shore of the Columbia River, at about RM 11.5, upstream from the Pacific Ocean. Areas now above high tide at the site were created by the deposition of dredged material over the past 70 to 80 years. Based on soil borings conducted by Oregon LNG, the dredged material fill is 10 to 15 feet thick at the terminal site.

The fill at the terminal site is underlain by alluvial sediments deposited by the Columbia River over the last 10,000 years to the maximum depth (about 351 feet) explored during geotechnical investigations conducted for the project in 2007 and 2008 (CH2M HILL, 2013a). In general, the soil profile consists of very soft or loose silt, clay, or sand within the upper 15 to 20 feet; underlain by about a 105-foot-thick layer of medium dense to very dense sand (elevation -10 feet to -115 feet); underlain by a 10-foot-thick firm to stiff silt lens (elevation -115 feet to -125 feet); followed by interbedded sand and silt to a depth of 351 feet (about elevation -341 feet).

The offshore berth area of the terminal site is underlain by alluvial soil to the maximum depth explored (about elevation -226 feet). In general, the soil profile consisted of a very soft or loose silt, clay, or sand within the upper 15 to 25 feet; underlain by about a 70- to 80-foot-thick layer of dense to very dense sand with two firm-to-stiff silt lenses at about elevation -80 feet and -100 feet, and underlain by interbedded sand and silt to the maximum depth explored.

Based on other soil borings done in the area, the top of bedrock beneath the terminal site is estimated to be at a depth of 370 to 400 feet (CH2M HILL, 2013a). The uppermost bedrock unit is the lower Miocene to upper Eocene Smuggler's Cover Formation, which is underlain by the Keasey and Hamlet Formations. These formations are described in table 4.1.1-1.

Table 4.1.1-1

Terminal Site Stratigraphy

Geologic Unit	Age	Description	Approximate Thickness (feet)
Fill	Recent	Dredged material ranging from silty sand to sand.	10-15
Quaternary Alluvium	Holocene	Includes sand bars, islands, and bioturbated to laminated estuarine clay, silt, and fine sand.	360
Smugglers Cove Formation	Lower Miocene to Upper Eocene	Primarily claystone and siltstone. Also contains a few graded, volcanic sandstone beds and tuffs, clastic dikes, and sandstone.	1,000
Keasey Formation	Upper Eocene	Thinly bedded to laminated glauconitic to tuffaceous siltstone with arkosic lenses. Also contains tuffaceous strata, as well as beds containing calcareous concretions and clastic dikes.	400
Hamlet Formation	Upper Eocene	Primarily carbonaceous and mica-bearing mudstone. Also contains a few thin interbeds of graded, fine-grained sandstone and medium- to coarse-grained basaltic sandstone.	600

Sources: Oregon Department of Geology and Mineral Industries (DOGAMI), 1985 and CH2M HILL, 2013a

Proposed Site Improvements

To create the berth area and turning basin at the terminal, Oregon LNG would dredge to a depth of -48 and -43 feet MLLW, respectively, with 2 additional feet allowed for overdredging in both cases. The footprint of the turning basin would be about 135 acres; construction of the turning basin would require dredging of about 109 acres (see figure 2.1.3-2) and about 1.2 million cubic yards of dredged material would be removed. The sides of the dredged area would be cut to a 5:1 (horizontal to vertical) slope or flatter, depending on the final slope stability analysis results. Oregon LNG would dredge the berth and maneuvering area using either a hopper (hydraulic suction) or mechanical clamshell dredge.

The dredging activity would alter the bathymetry of the river at the turning basin. The turning basin would be subject to sedimentation and would require maintenance dredging every 3 years to maintain navigable depths.

The terminal site elevation is currently about 10 feet NAVD 88. The base elevation of the LNG storage tanks would be 0 feet. Excess material from grading and ground improvement in the storage tank area would be used to raise the base grade in the process and operations area to an elevation of about 18 feet NAVD 88. A riprap-armored earthen berm would be built to elevation 22 to 27 feet around the terminal's critical facilities as protection from tsunamis. Some granular material such as gravel and sand would need to be imported to the site for construction purposes. Boulders and cobbles could also be imported for use as riprap along the berm. All imported materials would be from approved sources and free from contaminants. No dredged material would be used on the site. Bedrock would not be encountered in any of the excavation work that would occur at the terminal location. Therefore, no blasting would be necessary for construction.

Dredging and grading of the terminal site would be the only impacts on surface geology and no mitigation would be necessary for geologic resources.

Mineral Resources

In 2013, the principal nonfuel mineral production of Oregon (in order of value) was crushed stone, construction sand and gravel, portland cement, diatomite, and perlite. The value of production was $328 million (USGS, 2014).

Oregon LNG reviewed Department of Geology and Mineral Industries (DOGAMI), USGS, and DNR records and determined there are no known mineral resources within 0.5 mile of the terminal site or the waterway for LNG marine traffic. The Quaternary alluvium at the terminal site consists of unconsolidated floodplain deposits of clay, silt, sand, and basalt gravel, and has no current or potential mineral value.

DOGAMI oil and gas records (DOGAMI, 2013a) indicate a number of oil and gas wells were permitted in Clatsop County, mostly during the 1980s. The closest of these was about 2.6 miles from the terminal site and was drilled by the Lower Columbia Oil Company to a depth of 4,808 feet. The status is listed as "unknown" and no permit date is given. Based on this information, we conclude that construction of the terminal and long-term operation of the facilities would have no effect on known mineral resources.

Seismic-related Hazards

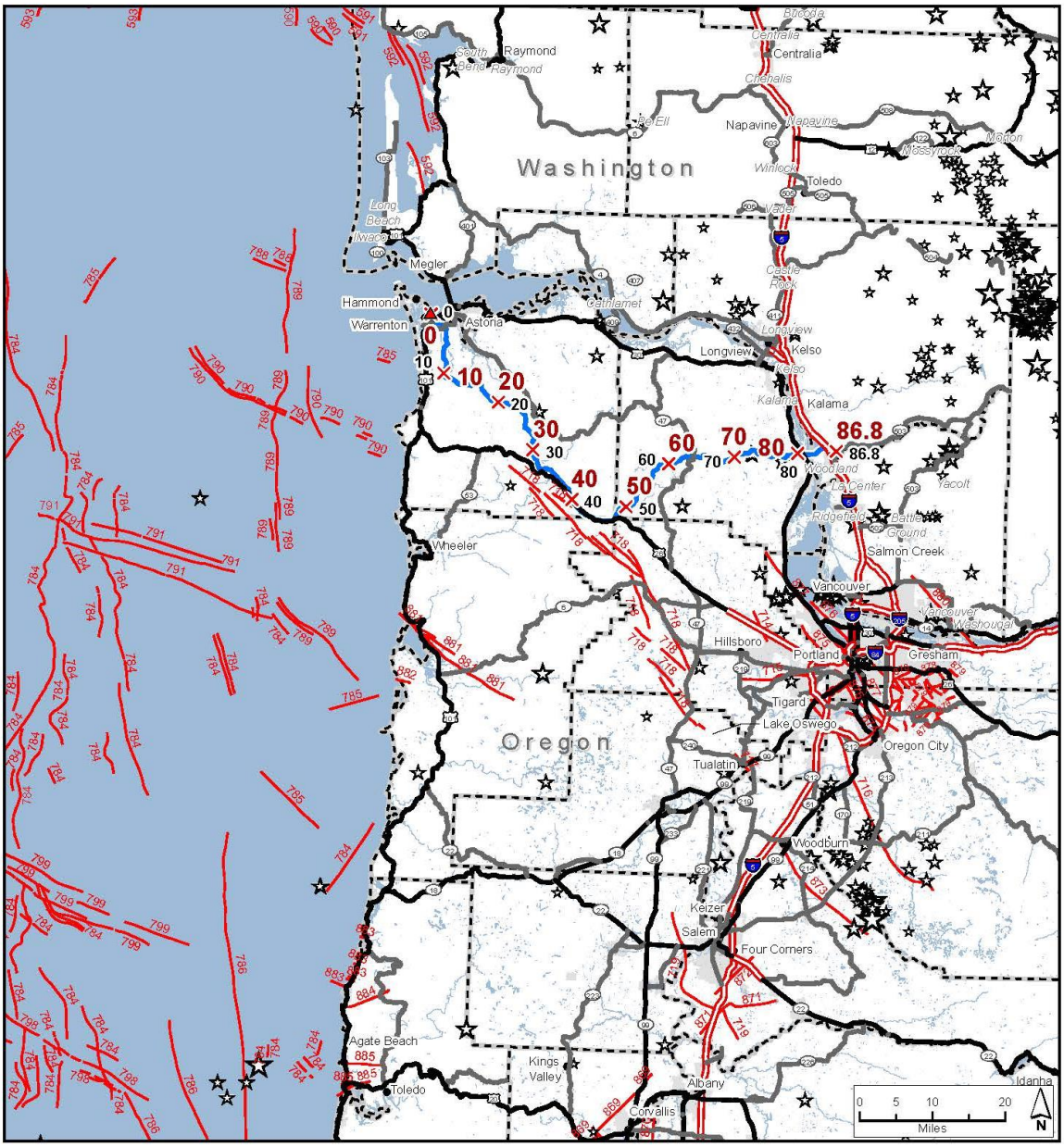
During the scoping period, a number of comments were received expressing concerns about potential damage to the terminal from an earthquake. Seismic-related hazards that may affect the terminal include earthquakes, surface faulting, soil liquefaction and settlement, tsunamis, and seismic-induced subsidence. These hazards, their potential to occur in the vicinity of the terminal and waterway, and proposed mitigation measures (where applicable), are described in this section. Risks of seismic-related hazards resulting in damage to the project would be avoided or minimized by Oregon LNG's implementation of specific design criteria, ground improvements, other construction techniques, and operating procedures.

Earthquakes

Figure 4.1.1-1 depicts historical earthquakes in the area of the Oregon LNG Project. The major tectonic feature of the Pacific Northwest is the CSZ, which is primarily responsible for the many earthquakes in the region. The CSZ extends from Cape Mendocino, California to Vancouver Island, British Columbia. The subduction zone begins off the coast of Oregon about 85 miles west of the terminal site and dips downward to the east beneath western Oregon (see figure 4.1.1-2). The terminal site is approximately 12 miles above the dipping CSZ at its nearest point.

There are three different types of earthquakes in the Pacific Northwest based on their source location. Interface earthquakes originate at the interface of the two tectonic plates (i.e., at the subduction zone). Intraslab earthquakes originate deep within the subducting Juan de Fuca plate as it is deformed by tectonic pressure. Shallow crustal earthquakes are smaller earthquakes resulting from built-up tectonic stresses within the North American Plate.

Turbidites have been studied to determine the historical interface earthquake activity along the CSZ (Goldfinger et al., 2003). Turbidites are marine sedimentary deposits that can be triggered by such events as storms and earthquakes. Based on the turbidite record, 19 to 20 great earthquakes have occurred along the CSZ over the past 10,000 years, defining a recurrence interval of 500 to 530 years. The earthquakes have not been evenly spaced, but rather, have had a repeating pattern of clustered earthquakes that includes four cycles of two to five earthquakes separated by unusually long intervals of 700 to 1,200 years. Two of the four cycles terminated with what were likely very large earthquakes.



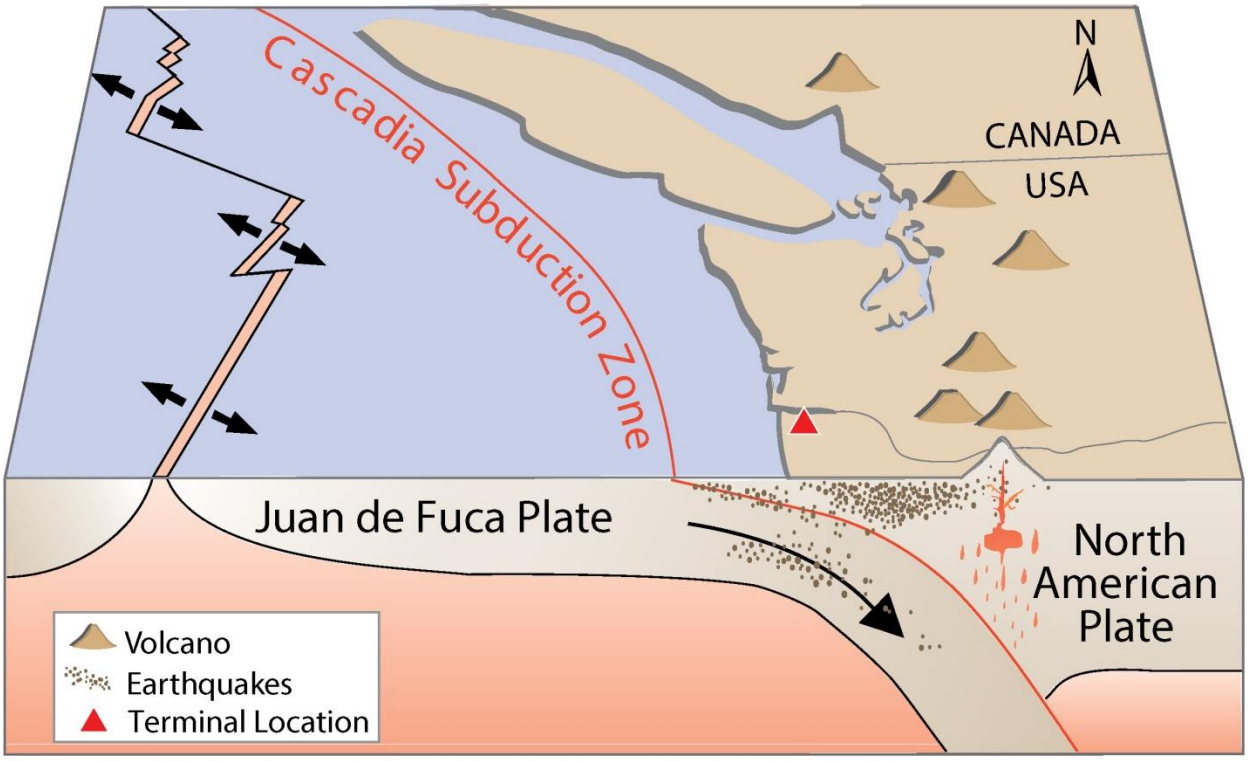
Legend

Historical Earthquake (Magnitude)
- 0.0-2.0
- 2.0-3.0
- 3.0-4.0
- 4.0-5.0
- >5.0

- Terminal Location
- Pipeline Route Milepost
- Pipeline Route
- Class A Quaternary Fault with USGS ID
- Cities
- Limited Access Highway
- Highway
- Major Road

Sources:
U.S. Geological Survey (USGS). 2012. *Quaternary Fault and Fold Database for the United States*. http://geohazards.usgs.gov/cfusion/qfault/index.cfm. Website dated July 23, 2012. Last accessed April 1, 2013.
U.S. Geological Survey (USGS). 2013. *Global Earthquake Search*. http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_global.php. Website dated February 25, 2013. Last accessed April 1, 2013.

Figure 4.1.1-1: Quaternary Faults and Historical Earthquakes, Oregon LNG Project Area



Source: USGS, 2010. Mount Hood—History and Hazards of Oregon's Most Recently Active Volcano, U.S. Geological Survey Fact Sheet 060-00, Online Version 1.0.

Figure 4.1.1-2: Cascadia Subduction Zone

The turbidite record indicates the most recent great earthquake occurred around 1700 A.D. This timing is consistent with tsunami evidence found by researchers in Japan for a CSZ earthquake with moment magnitude (M_w) estimated between 8.7 and 9.2 (Satake et al., 1996, 2003). According to Goldfinger et al. (2012), the turbidite data indicate a probability of 7 to 12 percent that an earthquake associated with the northern portion of the CSZ will occur during the next 50 years.

Intraslab earthquakes are estimated to range from M_w 6 to 7.5, based on historical occurrences (Geomatrix Consultants, 1995). Three large earthquakes in recent history have been attributed to the intraslab source: the 1949, 1965, and 2001 earthquakes in the Puget Sound region, with M_w 7.1, 6.5, and 6.8, respectively. No large (i.e., M_w greater than 5.0) intraslab earthquakes have occurred beneath northwestern Oregon (although the Puget Sound earthquakes were felt in Portland), and there is controversy over whether the intraslab source is active in Oregon. However, Oregon LNG considered the intraslab source to be an active seismic source in its site-specific seismic hazard evaluation for the terminal (CH2M HILL, 2013c).

The historical (about the last 160 years) crustal seismic activity reported within a 60-mile radius of the terminal site has been relatively minor (CH2M HILL, 2013c). Of the three seismic source types, the CSZ interface is likely to generate the strongest and longest ground motions at the terminal site and is thus the controlling seismic source for the terminal site (CH2M HILL, 2013c).

Seismic risk can be quantified by the motions experienced by the ground surface or structures during a given earthquake as expressed in terms of g (the acceleration due to gravity), or peak ground acceleration (PGA). The USGS has developed a series of maps for the entire United States that describe the likelihood for shaking of varying degrees to occur in a given area. The USGS indicates that the terminal is in an area where a PGA of 0.59 g has a 2 percent chance of being exceeded in 50 years, and a PGA of 0.2 g has a 10 percent chance of being exceeded in 50 years (USGS, 2008). The USGS is in the process of updating its seismic hazard maps and these values may change based on the results of new studies, such as described above.

Surface Faults

The USGS maintains a database containing information on faults and associated folds in the United States that are believed to be sources of earthquakes with magnitudes greater than 6.0 during the Quaternary (the past 1,600,000 years). According to the USGS Quaternary fault database (USGS, 2012), the closest active fault to the terminal is an unnamed offshore fault (Fault ID 785) about 9 miles southwest of the terminal (see figure 4.1.1-1).

No fault scarps or lineaments at the site were observed on stereographic pairs of 1:10,000-scale, color aerial photographs and no indications of faults were identified in Oregon LNG's geotechnical investigation for the terminal site. Therefore, the seismic assessment for the terminal concluded that the risk of ground rupture at the terminal is low. However, for the purpose of its seismic hazard analysis, Oregon LNG incorporated potentially unidentified faults using background seismicity into its modeling used in the analysis.

Soil Liquefaction and Settlement

Strong ground shaking during an earthquake can cause soil liquefaction, which is the loss of shear strength in saturated soil deposits. The susceptibility of a soil deposit to liquefaction is a function of the degree of saturation, soil grain size, relative density, percent fines, age of deposit, plasticity of fines, earthquake ground motion characteristics, and several other factors. Soils most prone to liquefaction are poorly graded (i.e., have a uniform grain size) and noncohesive. Soil liquefaction can result in a loss of bearing capacity, soil consolidation, settlement, buoyancy of objects buried in the soil, and lateral spreading. Lateral spreading is the lateral movement of ground on and within a zone of liquefied soil. Lateral spreading can occur on gentle slopes or along an open face when liquefaction occurs in a relatively widespread and continuous layer.

Earthquake hazard maps of the Astoria-Warrenton area (DOGAMI, 1999) indicate that the terminal area has a high risk for soil liquefaction. Based on Oregon LNG's geotechnical analysis, there are several layers of unimproved soil beneath the terminal site that would be at risk of liquefaction during a seismic event of the magnitude and must be considered in terminal design. The soils susceptible to liquefaction are primarily from the surface of the site to a depth of between 15 and 25 feet and between about 50 to 75 feet below the ground surface. Oregon LNG's geotechnical assessment (CH2M HILL, 2013a) concluded that settlement of up to 2.4 feet may occur from liquefaction effects at the terminal during a large earthquake if no ground improvement is done.

Oregon LNG would use ground improvement (i.e., CDSM and stone columns) in the areas of critical facilities to make the ground more resistant to soil liquefaction, to mitigate the effects of lateral spreading, and to reduce potential settlement. Pile-supported foundations would be used to prevent buoyancy and to prevent loss of bearing capacity.

CDSM is a soft soil stabilization method that mixes soft soil with cement slurry to produce soil-cement with higher strength and lower compressibility than the native soil. CDSM would be used

beneath the LNG storage tank area and the deluge pump house. The CDSM would extend 40 feet laterally beyond the outside diameter of the tank foundation slab and 80 feet below the ground surface. CDSM columns are typically 2.5 to 5.0 feet in diameter and would be laid out in an interlocking grid type pattern. The average design strength of the CDSM-improved zone would be up to 200 pounds per square inch and estimated average shear wave velocity in the top 100 feet of the improved zone, V_{s30}, would be 590 feet per second.

Oregon LNG would use stone columns beneath the ground flare facility, other buildings and equipment foundation slabs, and portions of the earthen berm where the crest elevation is above +22 feet. The stone columns would extend 15 feet laterally beyond the outside footprint of the slabs and 25 feet below the ground surface to mitigate liquefaction in the upper loose sand layer. The average shear wave velocity, V_{s30}, in these areas was determined to be 637 feet per second. Oregon LNG would construct the columns in a triangular pattern with equal spacing between columns.

Driven steel pipe piles would support the LNG tanks, pipe rack/spill containment trough, spill containment basin, flare, and building and equipment slab foundations. The deep foundations would provide uplift capacity, transfer tank dead load uniformly to the underlying soil, and limit static and seismic settlement. The LNG tank piles would be driven to a depth of 280 feet while the piles supporting other LNG facility structures would be driven to depths ranging between 200 and 220 feet. The LNG tank structures would be supported on a mat foundation which would be seismically isolated to reduce seismic forces in the tanks.

The marine facilities would also be supported on driven steel piles. The average shear velocity, V_{s30}, of the seafloor in the location of the marine facilities was determined to be 700 feet per second.

Seismic-induced Subsidence

As described in CH2M HILL (2013d), regional land subsidence from a subduction zone earthquake at the terminal site is predicted to be about 7.6 feet. The subsidence would occur during the earthquake at the same time the tsunami forms offshore above the CSZ.

Tsunami

During the scoping period, a number of comments were received expressing concerns about potential damage to the terminal from a tsunami. The terminal site is within the mapped tsunami inundation boundary (DOGAMI, 2013b).

Oregon LNG conducted a site-specific tsunami hazard analysis for the proposed terminal location that incorporated information gained from the 2011 Great Tohoku Earthquake in Japan (Coast and Harbor Engineering, 2013). The analysis was based on a 2,500-year return-period CSZ earthquake. The site-specific tsunami hazard analysis predicts that the design tsunami elevation would range between +8 and +16 feet (NAVD 88) at the terminal site considering the tsunami occurred at mean high water tidal elevation and would vary based on local topography focusing effects that amplify the tsunami wave heights at some locations. As described above, it is estimated during the CSZ earthquake, the terminal site would lower 7.6 feet due to tectonic subsidence. Therefore the effective water surface elevation would range between +15.6 feet and +23.6 feet considering tsunami wave, tidal, and subsidence effects. Modeling predicts a tsunami wave would reach the site in about 43 minutes after the design earthquake and a second wave would arrive about 153 minutes after the earthquake. During a tsunami, up to 1 to 2 feet of scour could occur at the berm, 0 to 1 feet of scour could occur on the northern side of the site, and up to 2 feet of scour could occur at the dock.

To protect the process area and LNG tanks during a tsunami, Oregon LNG would construct an earthen berm designed to withstand surge, hydrodynamic, and debris forces due to a tsunami (see figure 4.1.1-3). The top of the berm would range in elevation from +27 feet near the ground flare to +22 feet in areas where focusing of the tsunami wave would be less. The elevation of the berm crest was determined by requiring it be at least 1 foot above the predicted tsunami maximum water surface elevation at each location around the berm, considering the crest would settle an additional 2.4 feet because of liquefaction effects if no ground improvement is done. Oregon LNG would armor the berm with riprap to resist erosion during tsunami and flooding events. The berm would be designed to withstand at least two periods of tsunami inundation as described in Geotechnical Investigation Report (CH2M HILL, 2013a). Some structures, such as the dock, would be outside of the berm and may be damaged in a tsunami, but the terminal critical facilities would be within the berm where they would be protected from damage.

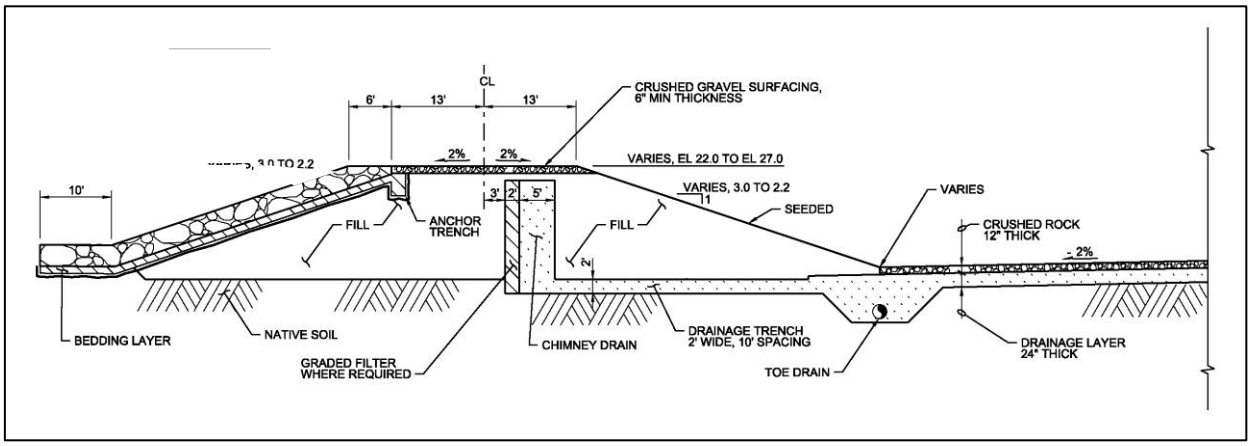


Figure 4.1.1-3: Berm Around LNG Storage Tanks and Process Facilities

The waterway for LNG marine traffic would also be affected by a tsunami triggered by an earthquake originating in the CSZ. The Oregon LNG site-specific tsunami hazard study indicated that the tsunami wave elevation at the dock would be +11.0 feet and slightly less elevation would be expected in the main navigation channel of the Columbia River. While transiting the Columbia River the Coast Guard requires an LNG marine carrier be assisted by tugboats. Given the 43-minute warning of an impending tsunami wave caused by an CSZ earthquake, during transit the tugboats would position the LNG marine carrier to best take on the advancing tsunami wave and would assist the LNG marine carrier in holding its position. It is expected that a tsunami wave making contact with an LNG marine carrier of the size being considered for the project could cause the vessel to roll or pitch (depending on the direction in relation to the heading of the vessel) but would not likely cause any damage to the vessel. While there is uncertainty associated with the current tsunami impact predictions, we conclude that there would be little effect of such a wave on a tugboat assisted an LNG marine carrier while in the main navigational channel of the Columbia River.

Given the location and orientation of the turning basin associated with the LNG terminal entrance relative to the main channel, an LNG marine carrier at berth may experience similar tsunami wave energy as those in the channel. As indicated above, the tsunami wave elevation at the dock would be +11 feet and the pile supported dock is expected to drop 7.6 feet because of tectonic subsidence. The top of the dock is + 31 feet so the top of the dock is over 12 feet above tsunami wave elevation. The LNG loading arms would be fitted with an emergency release system that would be activated to rapidly and safely disconnect the loading arms from the vessel in the event of a CSZ earthquake triggered tsunami warning. This system would eliminate the risk of the loading arms failing because of movement of the vessel,

thereby preventing damage to the ship and the loading arms, and the accidental release of cargo. Oregon LNG would keep the LNG marine carrier moored at the dock in the event of a CSZ earthquake triggered tsunami. Therefore the dock and mooring system would need to be designed to accommodate the changes in water elevation and flow velocities associated with a CSZ earthquake generated tsunami. The depth-averaged velocity from a tsunami at the dock would be between 7 feet per second (ft/s) and 9 ft/s (Coast and Harbor Engineering, 2013). The preliminary design for the dock considered a maximum 8.4 ft/s flood or ebb current. Because the tsunami-driven current is at or near the velocity used for the preliminary design of the dock and mooring system, the LNG marine carrier could potentially be pulled off the dock if designed for tsunami loadings. Therefore, **we recommend that:**

- **Prior to terminal construction, Oregon LNG should file with the Secretary the final design of the dock and LNG marine carrier mooring system, stamped and sealed by the professional engineer-of-record. The final design should incorporate a maximum tsunami velocity of 9 ft/s and the LNG marine carrier mooring system should be designed for loadings with relatively sudden changes in water elevations associated with tsunami waves and tectonic subsidence.**

Seismic Design

Seismic Design Requirements

The seismic design requirements for LNG facilities are contained in the DOT regulations at 49 CFR Part 193, which adopts the seismic design provisions of the NFPA 59A (2006). NFPA 59A (2006) defines two levels of earthquake motions, the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) for the design of Seismic Category I Structures, Systems and Components. The OBE and SSE ground motions must be determined by site-specific evaluations and are defined in terms of 5 percent damped response spectra with the following probability levels:

The OBE ground motions at the site are defined as future potential ground motion with a 10 percent probability of exceedance within a 50-year period (475-year return period). The SSE ground motions at the site are defined as the future potential ground motion with a 2 percent probability of exceedance within a 50-year period (2,475-year return period) with deterministic limits.

These motions were used as the basis criteria for the earthquake-resistant design of the LNG facility, applied to the following limited specific list (i.e., Seismic Category I) of critical safety-related structures, systems, and components per NFPA 59A (2006):

1. LNG storage containers and their impounding systems;
2. system components required to isolate the LNG container and maintain it in a safe shutdown condition; and
3. structures and systems, including fire protection systems, the failure of which could affect the integrity of (1) or (2) above.

NFPA 59A (2006) specifies that the above-referenced structures, systems, and components must be designed to remain operable during and after an OBE, and must provide for no loss of containment capability of the primary container during and after an SSE. The facility design must also provide for the ability to isolate and maintain the LNG container during and after an SSE. After an SSE event, the container must be emptied and inspected prior to resumption of container filling operations. At a minimum, the impounding system must be designed to withstand an SSE while empty, and an OBE while holding the maximum operating volume of the LNG container. Seismic recording instrumentation is also required.

Other structures, systems and components are classified as Seismic Category II or III. These structures are to be designed to satisfy the seismic design requirements of 2010 Oregon State Specialty Code and ASCE 7-05. Category II facilities are expected to survive the design earthquake (DE), which is two-thirds the MCE, with potential structural damage that would not be so severe as to preclude continued occupancy and function of the facility. Category III facilities are considered "nonessential." Normal, nonessential facilities would be designed for the DE in accordance with ASCE 7-05, and are expected to sustain repairable damage when subjected to DE ground motions, although it may not be economical to do so. The MCE is defined with the same return period ground motion as the SSE.

Site-specific Seismic Hazard Evaluation

Oregon LNG performed a site-specific seismic hazard evaluation to develop Seismic Category I site-specific design response spectra for the SSE, OBE, MCE, and DE. The OBE is represented by the site-specific 475-year return period earthquake (10 percent probability of being exceeded in 50 years). The SSE and MCE are represented by the 2,475-year return period earthquake (2 percent probability of being exceeded in 50 years). The DE is defined as two-thirds of the MCE. Separate horizontal and vertical component design spectra for SSE and OBE earthquake events at 5 percent damping were developed. Three site-specific sets of design response spectra were developed for the site: LNG storage tanks with ground improvement to mitigate for liquefaction in the upper 80 feet, LNG process area and other facilities with no ground improvement, and marine facilities. The site-specific values of the peak ground acceleration and spectral response accelerations at 0.2 seconds and 1.0 seconds for each of these conditions is provided below in table 4.1.1-2. Details regarding these design spectra and the seismic hazard evaluation that determined them are provided in Site-Specific Seismic Hazard Evaluation for the Oregon LNG Bidirectional Terminal (CH2M HILL, 2013c).[1]

Table 4.1.1-2

Site-specific Probabilistic Seismic Hazard Analysis Values for the Oregon LNG Terminal

Earthquake Level/Location	Peak Ground Acceleration (percent of gravity)	Spectral Acceleration at 0.2 Second (percent of gravity)	Spectral Acceleration at 1 Second (percent of gravity)
OBE – LNG Tanks (with soil mixing)	26.0	64.0	39.0
SSE – LNG Tanks (with soil mixing)	44.0	110.0	84.0
DE- Marine Facilities	29.0	73.0	58.0
MCE – Marine Facilities	44.0	110.0	87.0
DE- Other Facilities	28.0	73.0	73.0
MCE – Other Facilities	42.0	110.0	110.0

The design of the facility is currently at the Front End Engineering Design (FEED) level of completion. Oregon LNG has proposed a feasible design and it has committed to conducting a significant amount of detailed design work for the terminal if the project is authorized by the Commission. Information regarding the development of the final design, as detailed below, would need to be reviewed by FERC staff to ensure that the final design addresses the requirements identified in the FEED. Therefore, **we recommend that:**

- **<u>Prior to commencing final design of the terminal</u>, Oregon LNG should file with the Secretary, stamped and sealed by the professional engineer-of-record, the following:**

  a. final geotechnical investigations necessary to support all final foundation designs in satisfying the criteria stated in Oregon LNG's application and

[1] This report was filed as appendix I1 to Oregon LNG's Resource Report 13 and is available on FERC's eLibrary at http://www.ferc.gov/docs-filing/elibrary.asp in Docket No. CP09-6-001 et al. under Accession No. 20130607-5084.

subsequent data request responses. These investigations should include how the identified potential zones of liquefaction at the terminal site, and in particular the protective berms, would be mitigated and the details of the liquefaction mitigation method(s), procedures, plan extent, and verification methods proposed to verify mitigation of liquefaction potential;

b. detailed calculations of seismic slope stability and lateral movements anticipated after the liquefaction mitigation is implemented to verify the stability of critical structures and the tsunami berm for the LNG terminal design earthquake motions;

c. final seismic specifications to be used in conjunction with the procuring Seismic Design Category I and II equipment;

d. final Quality Control and Quality Assurance procedures that would be used for design;

e. a final list of Seismic Category assignments for all structures, systems, and components;

f. final Seismic Design Criteria for all Seismic Design Category I and II structures, systems, and components that satisfy the criteria stated in Oregon LNG's application and subsequent data request responses; and

g. LNG tank and foundation design that demonstrate agreement with the FEED level documents.

- **Prior to commencing with procurement, fabrication, or construction of the terminal, Oregon LNG should file with the Secretary, stamped and sealed by the professional engineer-of-record, the following information:**

  a. final foundation design recommendations, including foundation design and/or liquefaction mitigation measures for all other structures;

  b. all detailed design and construction documents (drawings, calculations, specifications, etc.) for Seismic Category I and II structures, systems, and components, including the LNG tanks and seismic isolation peer review report; and

  c. Final Quality Control and Quality Assurance procedures that would be used for procurement, fabrication, and construction.

The seismic isolation system for the LNG tanks should comply with the design, analysis, and testing requirements of Chapter 17 of ASCE 7-05 and the additional requirements below. Peer Review of the design should be performed as required by Chapter 17. Calculations, testing, and design documents that demonstrate the requirements of Chapter 17 were satisfied have not yet been filed by Oregon LNG. Therefore, **we recommend that:**

- **Prior to commencing final design of the LNG storage tanks, Oregon LNG should file with the Secretary, stamped and sealed by the professional engineer-of-record, the following information:**

  a. nonlinear response history analysis should be performed of the LNG tank and isolation system. The analysis should simultaneously include all three components of ground motion. Each of the site-specific time history vertical components of motion used in the analysis should be scaled such that the

response spectra of each motion envelops the site-specific vertical design response spectra developed for the project. Each of the horizontal component pairs of ground motions used in the analysis should be rotated so that one of the components of the pair is the maximum component of response at the isolated period of the tank isolation system;

b. nonlinear analyses for both maximum and minimum design liquid levels of the LNG tanks;

c. separate nonlinear analysis to account for variations of design stiffness, minimum and maximum values of friction, and other properties as required by Sections 17.5 and 17.2.4.1 of ASCE 7-05; and

d. documentation that the lateral displacement capacity of the seismic isolation bearings is not less than 24 inches.

Because we recognize the project area is in an area of high seismicity, our regulations in 18 CFR 380.12(h)(5) recommend that a special inspector be contracted by Oregon LNG to observe the work performed to ensure the quality and performance of the seismic resisting systems. Oregon LNG did not indicate in its submittals that a special inspector would be employed by them to observe construction of the facilities. Therefore, **we recommend that:**

- **Prior to terminal construction, Oregon LNG should file with the Secretary documentation that it would employ a special inspector during construction to perform duties described in Section 6 of NBSIR84-2833, Data Requirements for the Seismic Review of LNG Facilities.**

Other Geologic and Natural Hazards

Volcanism

The Pacific Northwest region has a number of active volcanoes along the Cascade Mountain Range. The closest volcanoes to the project area and their distances from the terminal are: Mount St. Helens, 85 miles; Mount Rainier, 115 miles; Mount Adams, 120 miles; and Mount Hood, 120 miles.

Large volcanic eruptions often cause damaging pyroclastic flows (avalanches of hot, dry, volcanic rock and gas), landslides, lahars (rapidly moving mixtures of rock and water), and lava flows. These hazards generally flow downhill and the damage they cause typically decreases the farther they travel from the volcanic source. USGS maps (USGS, 1996) indicate that volcanic eruptions of Mount St. Helens, Mount Hood, and Mount Adams are capable of producing lahars that could reach the Columbia River. An eruption of Mount St. Helens could produce a lahar that would reach the Kelso, Washington, area on the Columbia River, about 45 miles east of the terminal. This would be the closest point to the terminal area. Any pyroclastic flows, landslides, and lava flows generated by volcanic eruptions would remain even farther away.

A volcanic eruption could also result in distribution of volcanic ash across the region, which could cause minor health hazards for personnel, damage to certain types of equipment, and disruptions to social and economic activities. Mount St. Helens erupted on May 18, 1980, and the ash fallout covered a wide region. The heaviest deposits occurred downwind (east) within about 60 miles of the mountain and also about 195 miles away from the mountain near Ritzville, Washington. USGS maps show that the terminal site is unlikely to experience significant ash deposits given its upwind location. We consider volcanic activity to be a negligible risk for the proposed terminal.

Landslide

A landslide is the downslope movement of soil, rock, and organic materials under the effects of gravity and also the landform that results from such movement (Highland and Bobrowsky, 2008). Landslides are commonly caused by earthquakes, volcanic activity, modification of existing slopes by construction activities, or saturation of soils from rainfall, groundwater changes, leaking water pipes, or other events. Landslides can move very slowly (millimeters per year) in the case of soil creep, or can occur extremely rapidly. As a general rule, the steeper a slope, the more susceptible it would be to landslides.

The topography at and near the terminal site is relatively flat, and the total change in elevation across the site is less than 20 feet. As a result, we do not consider landslides to be a hazard at the terminal site.

Nonseismic Subsidence

As discussed in section 4.1.1.2, regional ground subsidence can occur during an earthquake. However, subsidence can result from other causes. Subsidence is a general term that refers to the lowering of the ground surface elevation, which can occur rapidly (such as in a sudden collapse of an underground cavern) or gradually (such as in the settlement of certain types of soils over a period of years). Some of the most common causes of subsidence include the large-scale extraction of groundwater or petroleum deposits, the dissolution of carbonate rocks (resulting in karst topography), and mining activity.

The terminal would not be in an area where large amounts of groundwater or petroleum products are being extracted or in an area of past or current mining activities. Furthermore, the proposed terminal would not be within a region known to contain karst topography (USGS, 2004). As a result, with the exception of seismic-related subsidence previously addressed, we do not consider subsidence to be a potential hazard to the terminal.

Flooding and Coastal Storms

Coastal storms regularly occur along the Oregon coast, mainly during the winter months. The major resulting hazards from such storms include high winds, increased rainfall, and unusually high tides. Hurricanes are not expected to occur along the Oregon coast (USGS, 2005a); however, strong winds as well as heavy rainfall have been recorded in association with previous major storms. These include the storms below.

- The October 12, 1962, Columbus Day Storm. The maximum sustained wind speed recorded at the Astoria Airport was 20 to 45 miles per hour (mph), with gusts ranging from 50 to 96 mph (data from the National Climatic Data Center).
- The December 1 to 3, 2007, Pacific Northwest Storm. Two storms brought 14.5 inches of rainfall and gusts up to 129 mph, causing major flooding and landslides in the southwestern part of Washington and the northwestern part of Oregon. Wind gusts in Astoria were reported to be 85 mph (Read, 2008).

On the basis of the October 1962 and December 2007 storms, Astoria has experienced category 1 (75 mph) to category 2 (96 mph) hurricane winds. Oregon LNG has designed the terminal facilities to withstand such wind conditions. For the LNG storage tanks, LNG process facilities, and the control building, the design wind velocity is a 150 mph sustained wind. For other site buildings, the design wind velocity is a 100 mph 3-second gust.

According to flood maps produced by the Federal Emergency Management Agency (FEMA), the terminal site is within the 100-year floodplain (FEMA, 2010). The earthen berm would protect the LNG storage tanks and process area from flooding. Oregon LNG would construct the berms to resist scouring from floodwaters or a tsunami, including use of armor. In addition, Oregon LNG has designed the stormwater system at the terminal to handle a 100-year storm.

Executive Order 11988 requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Because the terminal would be dependent on having an LNG marine carrier berth with access to the Columbia River navigation channel, there would not be a practicable alternative to siting the terminal within the river's floodplain.

Sea level is expected to rise due to climate change, which may result in expansion of the floodplain. Mote et al (2008) calculated several ranges of possible sea level rise that could occur in the vicinity of the terminal. The medium and most likely range projects a rise of almost 5 inches by 2050 and over 11 inches by 2100. A 30 percent safety factor was figured into the design of the terminal berm and we conclude that would accommodate potential sea level rise.

Shoreline/Bank Erosion and Scour

The shoreline at the terminal would probably experience some degree of erosion over time as a result of the constant wave action from tidal fluctuations and LNG marine carriers that dock at the facility. A Shoreline Erosion Control Plan would be developed and implemented for the terminal site to minimize impacts of soil and shoreline erosion. The design of the facility would include shoreline stabilization measures such as bank armoring and/or vegetation as necessary to address the potential for shoreline erosion. In addition, Oregon LNG would monitor for shoreline erosion as described in section 4.1.3.2.

Propeller wash from vessels operating in the turning basin at the terminal could cause scour of the bottom slope of the dredged area. A hydrodynamic modeling study of the turning basin(Coast and Harbor Engineering, 2009) determined that no scour of the dredged slope and adjacent bottom would occur due to propeller wash from the LNG marine carrier main propulsion system and tug boats maneuvering in the basin; however, scour due to propeller wash from the LNG marine carrier bow thruster may occur in the vicinity of the dredged slope at two localized areas during extreme operational conditions (i.e., during less than 1 percent of unberthing maneuvers). No scour would occur at the adjacent native bottom slope during these extreme conditions. The model estimated the maximum depth of scour on the dredged slope to be 5 feet relative to the design dredged configuration. Because extreme events of the dredged slope scour would be so rare, many years would be required for the scour to reach the maximum depth.

The hydrodynamic modeling also analyzed the possible effects of wakes from LNG marine carriers at the turning basin. Results of the study indicate that the pressure field effects and vessel wakes generated by the deep-draft LNG marine carriers would be similar to existing conditions and would not require mitigation.

Shoreline erosion along the Columbia River is caused by river currents, wind waves, and ship wakes. River currents can erode banks and carry sediment away from the shoreline. Wind waves and ship wakes can also erode banks, but will only move sediment locally within the shallow water zone near the shore. The amount of erosion that occurs at a particular location depends on the interaction between the eroding forces of river currents and waves and the resisting forces of the river banks.

Large waves contain more energy than small waves and, thus, have a greater ability to erode river banks. The size of waves produced by a vessel passing through a channel depends on the characteristics

and speed of the vessel and the characteristics of the channel. An analysis undertaken for the USACE concluded the size of ship-produced waves in the Columbia River depends on the blockage ratio, which is the ratio of the cross-sectional area of the ship to that of the channel (USACE, 2003).

A study commissioned by NorthernStar Energy LLC for its proposed Bradwood Landing Project (FERC, 2007) compared wave generation by an Aframax tanker, representative of a large ship that works the Columbia River, with an LNG tanker. The Aframax tanker had an overall length of 761.2 feet, a beam or breadth of 137.8 feet, a loaded draft of 39.7 feet, and a submerged or blockage area of 5,471 square feet. The LNG marine carriers examined in the study had an overall length of 944.6 feet, a beam of 148.3 feet, a loaded draft of 38.4 feet, and a submerged or blockage area of 5,695 square feet. The study indicated that waves generated by LNG marine carriers would be slightly larger than those generated by an Aframax tanker operating at the same speed. There is a possibility for larger Q-MAX tankers to visit the Oregon LNG terminal, which have an overall length of 1,132 feet, a beam of 180 feet, and a loaded draft of 40 feet.

Regardless of which type of vessel is used by the project, LNG marine carriers would be larger than most of the deep-draft ships currently using the Columbia River. Because the blockage ratio of the LNG marine carriers would be greater than that of most of the deep-draft ships currently traveling the Columbia River, the LNG marine carriers could produce larger waves than most of the current ships operating at the same speed. However, Oregon LNG indicates that LNG marine carrier speeds in areas of the lower Columbia River where the navigation channel is close to the shoreline would likely be in the range of 3.5 to 5.2 knots, which is slower than typical deep-draft ship traffic. The slower speeds would help to reduce the size of waves produced by the LNG marine carriers.

Paleontological Resources

Paleontological resources (i.e., fossils) are considered important scientifically because of their contributions to a greater understanding of geological and biological phenomena. Larger fossil specimens or reconstructions also have intrinsic value as educational tools because of their capacity to capture the attention of the public. Because of their status as a nonrenewable scientific and educational resource, paleontological resources are accorded protection under federal statutes when present on federal lands, or when they may be affected by a project using federal funds or requiring a federal entitlement. The most commonly cited of these statutes is the Federal Antiquities Act of 1906.

During construction at the terminal site, dredged material fill and Quaternary alluvium would be disturbed. Oregon LNG assessed the potential for the Oregon LNG project to impact paleontological resources following the guidelines of the Society of Vertebrate Paleontology (SVP, 1995 and 1996) for assessing paleontological sensitivity of sediments. Based on this assessment, the recent deposits at the terminal site possess low to no paleontological sensitivity, and it is unlikely that any paleontological resources would be encountered during excavations associated with terminal construction.

4.1.1.2 Pipeline

Section 2.1.1.2 describes the pipeline and associated facilities. Construction of the proposed pipeline would primarily involve standard cross-country pipeline construction techniques. Special techniques would be used when constructing the pipelines across rugged terrain, wetlands, waterbodies, roads and railroads, utilities, and agricultural, residential, commercial, and industrial areas. Pipeline construction procedures are described in section 2.1.4.2.

Geologic Setting

From the LNG terminal to the Northwest pipeline interconnect, the pipeline would traverse the relatively flat region of the Columbia River valley, the mountains and foothills of the Coast Range, and the lowlands of the Portland Basin. The physiographic provinces that would be crossed are the Coast Range between about MPs 0.0 and 82.4 and the Portland Basin between about MPs 82.4 and 86.8 (Orr et al., 1999).

The geologic units encountered along the pipeline alignment range from alluvial sediment deposits to outcrops of igneous and sedimentary rock. Quaternary alluvial and terrace sediment deposits are present between about MPs 0.0 and 6.0 of the pipeline route and associated with waterbodies within the Coast Range province. The remaining geologic units within the Coast Range consist primarily of Eocene to Miocene sedimentary rocks with occasional Miocene basalts. The basalts are most prevalent between MPs 65.0 and 78.0. Deposits along the pipeline route in the Portland Basin province consist of Quaternary alluvium, recent fill, and Glacial Lake Missoula flood deposits.

Based on NRCS soil maps, portions of the pipeline alignment between about MPs 6.0 and 78.0 traverse terrain where the depth to igneous and sedimentary bedrock may be less than 5 feet.

Although the pipeline would cross shallow igneous and sedimentary rock, Oregon LNG does not anticipate using blasting for construction of this project. Most areas crossed by the pipeline contain unconsolidated sediments or soft sedimentary rock that can be excavated with conventional track-hoe methods. Areas containing fractured, faulted, or weathered igneous rocks generally can be excavated with ripping and harder rocks can be excavated using a rock hammer that is attached to a track-hoe to break up the rock.

Oregon LNG would conduct a geotechnical investigation to better identify locations where bedrock could be encountered and to obtain information on the hardness and competency of the rock. Should blasting be required, potential effects include temporary and localized impacts on wells and springs and to water quality in wetlands. Blasting could potentially redirect surface water and groundwater flows to and from wetlands. Other potential impacts include local failures of unstable rock and soil, and damage to structures or utilities from blasting vibrations.

As a contingency to mitigate impacts if blasting is required, Oregon LNG would develop a Blasting Plan and include the following measures:

- notify homeowners and business owners in advance of blasting and erect temporary safety barriers or fences, if needed;
- obtain applicable state, county, and local permits;
- use licensed blasting contractors;
- perform a preblast survey and a monitoring program during blasting if the blasting is conducted in the vicinity of existing structures;
- conduct a preblast assessment of the surrounding area and structures where necessary to document the condition of adjacent surface and subsurface structures;
- use proper safeguards, including flags, barricades, and warning signals at all times;
- keep charges at the minimum required to break up the rock;
- use blast mats when needed to prevent injury from flying rock;
- adhere to all federal, state, and local regulations applied to blasting and blast vibration limits with regard to structures and underground utilities; and

- conduct a post-blasting assessment of the surrounding area to determine whether the blasting caused any damage to surface or subsurface structures.

Impacts on topography would be limited primarily to the construction phase, mainly trenching, during which topographic conditions along the mainline would be altered temporarily. Oregon LNG may recontour slopes to accommodate construction equipment. Topographic and drainage conditions along the right-of-way would be restored following construction in accordance with Oregon LNG's Plan. Minor, short-term impacts would result from spreading excess soil from the excavation over the right-of-way. Oregon LNG would attempt to adequately compact the trench backfill so mounding would not be required.

Mineral Resources

Oregon LNG accessed various databases containing information about current and historical mining operations from the DOGAMI Mineral Land Regulation and Reclamation Program, USGS, DNR, and Clatsop County. The records indicate 18 quarries/mineral resource areas and 1 oil/gas well are within about 0.25 mile of the pipeline. These mineral resources are listed in table 4.1.1-3.

Table 4.1.1-3

Mineral Resources Within 0.25 Mile of Oregon LNG Pipeline

MP	Feature Type	Status	Operator	Approximate Distance from Pipeline Centerline (feet)	Direction
3.9	Sand and Gravel	Current Production	Crown Zellerbach Corporation	1,100	West
11.2	Stone (Basalt) (Olson Quarry)	Unknown	M. Nygaard Logging Company	600	North
20.6	Oil/Gas Well	Closed and Plugged	Diamond Shamrock Corp.	1,200	North
24.0	Borrow Pit	Unknown	Unknown	900	Southwest
43.8	Stone	Unknown	Unknown	1,100	South
45.8	Clay (Keasey Expandable Shale)	Occurrence [a]	Unknown	400	South
47.4	Stone	Past Producer	ODOT	700	Southeast
50.9	Stone	Current Production	Longview Fiber	800	Southeast
51.4	Gems (Clear Creek Agate Area)	Unknown	Unknown	1,200	Southeast
52.2	Stone	Past Producer	Longview Fiber	1,200	East
52.3	Stone	Unknown	Longview Fiber	500	East
52.6	Stone (Rocky Point)	Current Production	Longview Fiber	600	East
68.4	Unknown	Current Production	Unknown	200	Southeast
71.8	Ferruginous Bauxite	Unknown	Unknown	Crosses	—
79.2	Stone	Current Production	Longview Fiber	1,300	North
79.2	Stone	Past Producer	Longview Fiber	700	North
79.3	Iron	Occurrence	Maple Hill Iron	1,000	North
80.5	Stone (Tide Creek Pit)	Current Production	Tide Creek Rock, Inc.	700	North
80.5	Sand & Gravel	Past Producer	ODOT	500	North
80.3-81.5	Gravel	Current Production	Knife River Corp.	Crosses Mine Buffer Zone at 80.3-80.8	—

[a] Occurrence = The mineral resource was identified, but the grade, tonnage, and extent of mineralization are unknown. No production has occurred.

The oil/gas well near MP 20.6 is now closed. When the well was operational, reserves were drawn from between about 3,200 and 4,800 feet below the surface.

According to a mineral resource map of Oregon (DOGAMI, 1984), the pipeline would cross a large deposit of ferruginous (iron-rich) bauxite in eastern Columbia County between the Clatskanie River and Columbia City for a distance of about 8 miles between MPs 71.0 and 79.0. The map indicates that this deposit contains a mixture of aluminum oxide, iron oxide, titanium oxide, and silicon dioxide. This deposit could be mined in the future if extraction becomes economically feasible and environmental requirements would reasonably allow such activity.

From about MP 80.3 to 80.8, the pipeline would cross an active gravel quarry operation. Oregon LNG worked with the owner to route the pipeline through a mining buffer zone at the edge of the property that cannot be used for mineral extraction purposes. Blasting is not used at the quarry, nor is it allowed as part of the mining permit. The closest the pipeline would be to the active quarry area is about 500 feet near MP 81.3.

The pipeline would be within 200 feet of an unpermitted quarry at MP 68.4. Based on satellite imagery, this quarry appears to have been active since at least 1994. No information is available from DOGAMI regarding this particular quarry. However, for unpermitted quarries, the maximum allowable land disturbance in any 12-month period must be less than 1 acre and/or less than 5,000 cubic yards of material may be generated and used off site. An unlimited amount of material can be generated if the material is used on the same piece of property or an adjacent piece of property that is owned by the same owner.

The presence of the Oregon LNG pipeline would preclude future development of mineral resources within and immediately adjacent to the permanent right-of-way. Based on our review of the known mineral resources relative to the proposed pipeline route, we conclude that impacts from any future mining restrictions would likely be minor.

Seismic-related Hazards and Mitigation

Seismic hazards that may affect the pipeline include earthquakes, soil liquefaction, and tsunamis. Implementation of specific design criteria, ground modification, other construction techniques, and operating procedures would avoid or minimize the potential for seismic hazards to cause damage to the project.

Earthquakes

During the scoping period, a number of comments were received expressing concerns about potential damage to the pipeline from an earthquake. Differential, or shear, movements of fault surfaces can be entirely subsurface, or they can extend to the ground surface as surface fault rupture. The nature of the shear movements at the surface depends on the character of fault movement. In general, surface fault rupture across a pipeline alignment can result in rapid differential ground displacements across the pipeline, with displacement magnitudes ranging from a few inches to several feet.

Oregon LNG determined the horizontal ground shaking that could occur every 10 miles along the pipeline route from a seismic event using USGS National Seismic Hazard Maps (USGS, 2008). The results (as a percentage of g) are shown in table 4.1.1-4. PGAs for soft rock/stiff soil ground conditions are shown for earthquakes with 10 percent probability of exceedance in 50 years, 5 percent probability of exceedance in 50 years, and 2 percent probability of exceedance in 50 years. The highest PGAs would

occur at MP 0.0 (i.e., at the terminal) where the seismic hazard is greatest. PGAs would decrease steadily along the pipeline with distance from the terminal.

Table 4.1.1-4

Peak Ground Accelerations along Oregon LNG Pipeline Route

	Probability of Exceedance in 50 Years		
Milepost	**PGA for 10%**	**PGA for 5%**	**PGA for 2%**
0	0.21	0.38	0.67
10	0.21	0.37	0.67
20	0.21	0.36	0.63
30	0.21	0.35	0.60
40	0.21	0.34	0.56
50	0.21	0.32	0.52
60	0.20	0.31	0.48
70	0.20	0.29	0.45
80	0.20	0.28	0.42
86.8	0.19	0.27	0.41

Data Source: USGS, 2008.

Steel pipelines have a history of performing very well during seismic events because of the restrained, welded joints and the flexibility of the pipeline to move with the earth during ground shaking (Ballantyne, 2008). The pipeline would be designed in accordance with all applicable federal and state safety codes, which would govern pipeline thickness, welding standards for joints, and pipeline strength. We conclude that this would allow the pipeline to withstand nearly all ground shaking that could be anticipated to occur, with the possible exception of ground movement associated with a fault rupture.

Surface Faults

According to the USGS Quaternary fault and fold database (USGS, 2012), the pipeline would not cross any known Quaternary faults. Four Quaternary-aged faults that are within 15 miles of the pipeline. Two of these are known to have movement within the last 15,000 years. These faults are described below (see figure 4.1.1-1).

- Gales Creek Fault Zone (ID number 718 in figure 4.1.1-1): This series of faults that generally trend northwest-southeast south of the pipeline route between about MPs 40.0 and 45.0. The closest distance from the fault zone to the pipeline would be 1,000 feet at MP 42.0. No fault scarps have been identified in Quaternary deposits along the fault zone. It is possible that the Gales Creek fault zone is part of the larger Gales Creek-Mount Angel structural zone. Current mapping indicates an echelon structure along the length of the fault zone. The exact location and seismic history of the Gales Creek fault zone are not precisely known because surface features of the fault have been obscured by landslides and logging activities. There is evidence that the southern part of the fault zone has been active within Quaternary time, and it is assumed that the rest of the fault has as well (Wells, 2013).
- Unnamed Offshore Fault (ID number 785 in figure 4.1.1-1): This unnamed fault is part of a group of faults in the forearc of the CSZ. These faults are mapped as left-and-right-lateral strike-slip faults and normal and reverse faults, but most have strikes oblique to the Cascadia deformation front, suggesting a strong lateral component of slip. As with other folds and faults in the Cascadia forearc, it is unknown if coseismic displacements

on these faults are always related to great megathrust earthquakes on the subduction zone, or whether some independent displacements are related to smaller earthquakes in the overriding North American plate. This unnamed fault would be about 7 miles west of MP 7.0, and it is believed to have ruptured within the last 15,000 years.

- Fault H (ID number 790 in figure 4.1.1-1): This 30-mile-long normal and/or left-lateral fault is mapped as multiple fault strands in poorly consolidated accretionary wedge sediments on the continental shelf in the forearc of the CSZ. As with other faults and folds in the Cascadia forearc, it is unknown if coseismic displacements on these faults are always related to great megathrust earthquakes on the subduction zone, or whether some independent displacements are related to smaller earthquakes in the overriding North American plate. This fault would be about 13 miles southwest of MP 11.0, and it is believed to have ruptured within the last 15,000 years.

- Portland Hills Fault (ID number 877 in figure 4.1.1-1): The 30-mile-long northwest-striking Portland Hills Fault is part of the Portland Hills-Clackamas River structural zone, which controlled the deposition of Miocene Columbia River Basalt Group lavas in the region. The sense of displacement on the Portland Hills Fault is poorly known and controversial. No fault scarps on surficial Quaternary deposits have been described along the fault trace, but some geomorphic and geophysical evidence suggest Quaternary displacement. MP 75.0 of the pipeline would be about 13 miles north of this fault.

Despite the geologic evidence, the actual surface traces of most of the faults are not precisely known. In some cases, the faults have not ruptured young sediments and, therefore, no recent fault scarps are present. Where fault scarps are present, they may be hidden by vegetation cover. Additionally, sediments from the Lake Missoula Floods, which occurred between 15,000 and 13,000 years ago, bury some of the fault traces, and the sediments have not been offset by the faults—thus, the fault traces remain concealed at the surface. Therefore, the exact surface traces of most of the faults are inferred. Limited geologic field reconnaissance has been completed to-date, and has focused primarily on areas that might be susceptible to landslide activity, rather than identifying the exact location of faults.

While the proposed pipeline route would not cross known active faults, Oregon LNG has indicated it would hire a qualified geologic inspector to observe trench excavation and it may perform more detailed geotechnical investigations in the area along and adjacent to the proposed pipeline corridor to further evaluate the potential for geologic hazards during construction. Therefore, **we recommend that:**

- **<u>During pipeline construction</u>, Oregon LNG should include in its weekly status reports any observed stratigraphic offsets potentially related to ground rupture that could affect the pipeline. In addition, <u>prior to commencement of service</u>, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, a design mitigation report that documents measures Oregon LNG implemented specific to the location and milepost of any observed stratigraphic offsets observed during pipeline construction.**

<u>Soil Liquefaction</u>

Soil liquefaction and lateral spreading are defined in section 4.1.1.1. The potential for the pipeline to undergo movement, including buoyancy, because of liquefaction is high. This movement would result in increased stress in the pipeline and possible damage.

Because of the horizontal displacement involved, lateral spreading associated with liquefaction can be destructive to linear features such as pipelines. Lateral spreading can be especially damaging to pipelines when the ground movement occurs perpendicular to the axis of a pipeline. Along the proposed pipeline route, potential liquefaction-induced lateral spreading would be largely confined to areas adjacent to the banks of waterbodies, as soil moves toward the waterbody channels.

Liquefaction hazard mapping is available only for the area crossed by the first 3.8 miles of the pipeline; Tillamook County, Oregon; and Cowlitz County, Washington. The relative hazard from MP 0.0 to MP 3.8 (and possibly through about MP 6.0 based on similar conditions) would be "high." There would be no hazard along the portion of the route that crosses Tillamook County (MPs 44.1 to 47.4). In Cowlitz County, the liquefaction hazard would be "moderate to high" for a total of 3.4 miles crossed by the pipeline route, primarily between MPs 82.6 and 86.0, and "very low" for the remainder of the route. For the areas where mapped data are not available, liquefaction would be most likely to occur along the waterbodies where unconsolidated sediment has been deposited and is saturated at relatively shallow depths. Areas where the surficial geology consists of rock outcrops or where the soil is not saturated would not be susceptible to liquefaction.

Welded steel pipelines have a history of performing well in locations where liquefaction occurs because the restrained, welded joints and flexibility of the pipe allow it to deflect with the moving earth and withstand a tremendous amount of strain without rupturing (Ballantyne, 2008). Oregon LNG has identified the following general measures to reduce the risks to the pipeline from liquefaction.

- Avoid areas with liquefaction potential that are adjacent to waterbodies through HDD crossings. Oregon LNG would cross the largest waterbodies (Lewis and Clark River, Nehalem River, Rock Creek, Clatskanie River, and Columbia River) using HDD.
- Where the pipeline travels through potentially liquefiable soil, implement counter-buoyancy measures such as using a thicker (heavier) steel pipe, using a concrete coating, or installing weights.
- Minimize the risk of pipeline damage from lateral spread by aligning the pipeline to travel parallel to the ground slope instead of placing it across the slope.
- The greatest stress in the pipeline resulting from post-liquefaction settlement would occur where the thickness of liquefiable soil varies significantly over small lengths of pipeline. Such conditions are not known to exist along the pipeline route. However, if additional evaluations or conditions during construction suggest a rapid transition from very stiff ground conditions (such as bedrock) to deep deposits of potentially liquefiable materials, Oregon LNG has identified the following mitigation measures:
  - Construct the pipeline with additional joints and/or horizontal bends over the transition to allow for more flexibility for pipeline movement.
  - Remove potentially liquefiable soil and replace with soil material not susceptible to liquefaction.
  - Improve potentially liquefiable soil beneath the pipeline to limit the magnitude of seismically induced settlement.
  - Install piles beneath the pipeline and provide support between each pile to limit the magnitude of differential settlement to acceptable levels.

Oregon LNG has stated that additional evaluation of the potential for liquefaction and associated lateral spread should be performed for areas along major waterbody crossings to assess the risk of lateral spread resulting in pipeline rupture. In some areas, ground improvement, or horizontal or vertical

realignment of the pipeline, may be warranted. We agree that the potential for liquefaction or lateral spread requires further evaluation. Therefore, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file a pipeline design geotechnical report with the Secretary, for review and written approval by the Director of OEP, that includes an evaluation of liquefaction hazards along the pipeline route and necessary location-specific mitigation measures by milepost.**

Tsunami

Most of the first 6 miles of the pipeline route is within the mapped tsunami inundation boundary (DOGAMI, 2013b). The pipeline cover would be at least 3 feet and much greater than 3 feet at four HDD crossings in this area. In the event that scour occurs over the pipeline from a tsunami, Oregon LNG would replace the cover to the designated thickness.

Other Geologic and Natural Hazards

Volcanism

The closest Cascade volcanoes to the pipeline area and their distances are: Mount St. Helens, 30 miles; Mount Rainier, 80 miles; Mount Adams, 60 miles; and Mount Hood, 60 miles. The pipeline would not cross any of the hazard areas for lava flows, pyroclastic flows, or lahars from these volcanoes. Ash would not affect the buried pipeline. Therefore, we do not consider volcanic activity to be a hazard to the proposed pipeline.

Landslide Susceptibility

The pipeline would cross a variety of terrain types, some of which have steep slopes that could be susceptible to landslides. The characteristics of slopes that have the potential to be unstable are generally complex. Factors potentially affecting slope instability include lithology (rock or soil type), slope angle, slope length, vegetative cover, and land use. Active landslides, those that are in an active state of movement, are obvious hazards. Inactive and dormant slides also have the potential to reactivate and once again become unstable. Indications of past or ongoing landslide activity can be determined from evaluation of terrain features, vegetation, and drainage.

Steep slopes and unstable underlying geologic formations are common in the Coast Range (crossed by the pipeline between MPs 6.0 and 80.0). This area has the greatest potential for landslides and the associated risks that may result from a significant landslide event (e.g., potential pipeline rupture and associated fire risk). The risk from slow-moving landslides is lower than the risk from rapidly moving landslides because slow-moving landslides allow for the monitoring of movement and strain in the pipeline and provide opportunities for mitigation. In addition to landslides posing a potential risk to the pipeline, construction of the pipeline has potential to trigger a landslide in an unstable area through vegetation removal, drainage alteration, and earthmoving activities.

Oregon LNG identified 85 landslide hazard areas along the pipeline route, ranging from existing mass movement or landslide topography to potential gullying, erosion, or debris flows. These hazard areas were determined from published geologic hazard maps along with LIDAR mapping prepared specifically for the project. Results are provided in appendix G2. Of these 85 areas, Oregon LNG identified 56 locations along the pipeline route between MPs 6.6 and 63.9 and 3 areas between MPs 86.0 and 86.8 with potential for landslides based on slope steepness. Twenty-five locations crossed by the route were identified that had documented evidence of previous landslides or topography suggesting previous landslide activity.

Oregon LNG selected the pipeline route to avoid steeply sloping areas and mapped landslide hazard areas to the greatest extent practical. For example, between MPs 35.0 and 37.0, the pipeline route was adjusted to avoid the Oswego Creek slide complex, as recommended by state and local agencies.

Where steeply sloped areas or mapped landslide hazard areas could not be reasonably avoided, efforts were made to align the pipeline parallel to the maximum fall of the ground rather than parallel to the slope to minimize the potential for damage.

Removal of most forms of vegetation would have short-term impacts (generally 1 to 3 years) on slope stability because Oregon LNG would perform restoration using seed mixtures that would ensure rapid revegetation. Because trees generally have deeper root systems than other plants, the impacts from tree removal may be longer lasting. The most significant impact on slope stability resulting from vegetation removal would be expected to occur during the first year after construction of facilities, with impacts generally decreasing each subsequent year after construction. Climate change is expected to produce more frequent extreme precipitation events, which could lead to an increased risk of landslide on steep slopes maintained in a nonforested condition.

Prior to pipeline construction, Oregon LNG would perform more detailed geotechnical investigations in the area along and adjacent to the proposed pipeline corridor to further evaluate the potential for geologic hazards such as landslides. Professional geotechnical engineers and/or geologists would perform ground reconnaissance and, where specific landslide features or potential landslide hazards are identified, the ground reconnaissance may include a preliminary subsurface exploration program in the vicinity of known or suspected geologic hazards. The evaluation of large or complex landslide hazards may require a more robust geotechnical field exploration program and installation of specialized instrumentation to obtain data on the extent of these landslide hazards. Oregon LNG would perform slope stability analyses for critical and complex landslide hazards which are identified to be within proximity of the proposed pipeline alignment and which could be negatively impacted by construction of the pipeline.

In addition to the preconstruction site investigation and evaluation activities, a registered professional geotechnical engineer, geologist, or engineering geologist would be involved during the construction process to further evaluate known geologic hazards and observe mitigation measures. This individual or group of individuals would also identify the potential for new hazards when vegetation is removed during the construction process.

We received scoping comments regarding the potential for damage to pipelines during landslide events, such as those triggered by earthquakes. In 2008 a team that included the USGS, the California Geological Survey, and the Southern California Earthquake Center evaluated a scenario of a hypothetical major earthquake occurring in Southern California. The project included an evaluation of oil and gas pipelines and the risk of rupture due to both seismic ground shaking and associated risks, such as landslides. The report (Ballantyne, 2008) concluded that modern steel pipelines with electric arc welded joints perform much better than pipelines with oxy-acetylene welded joints (typically pre-1930 construction). Steel pipelines have performed well when subjected to ground displacements of about 24 inches, but sometimes fail when displacements reach 3 feet or more. Further, high pressure gas lines can rupture when subjected to permanent ground deformation due to landslides, and explode if an ignition source is available. A pipeline rupture due to a landslide has potential to cause injury or death and can lead to forest fires. Additional information on pipeline reliability and safety is provided in section 4.1.13.10.

We also received comments relating to concerns about the potential for construction activities to exacerbate the risk of landslides and questions relating to what types of design and construction methods

might be employed in areas of high landslide risk. Based on current information and past histories of other pipeline projects, the potential for relatively small and shallow slumps during construction is moderate to high. These are the types of land movements that would have little impact on surrounding land and that can be easily mitigated during construction. These small slumps would also not be sufficiently large to cause damage to the large diameter welded steel pipelines associated with the Oregon LNG project. The risk of landslides would continue to be dependent predominantly on storm and large rainfall events with the general trend being a diminishing risk after initial construction and over time.

To minimize impacts from construction activities on slopes and to prevent soil erosion that could cause a landslide, Oregon LNG would follow good construction practices and implement its Plan. The Plan specifies the use of terraces, water bars, mulching, and revegetation of disturbed areas. Cuts into side slopes would be limited to avoid triggering slides in unstable terrain. In areas where landslides are a concern, Oregon LNG would restore topographic and drainage conditions along the right-of-way following construction to the extent possible.

In areas where the pipeline would cross extremely steep slopes or areas that are prone to landslides, Oregon LNG would implement additional mitigation on a case-by-case basis, including installation of equipment to monitor ground and pipeline movement, or stabilization of landslides by reducing the forces that tend to cause movement or increasing the forces to resist movement. Mitigation measures may include installation of subsurface drains; construction of buttresses, counterweight fills, or toe berms; structural retention systems; soil stabilization or reinforcement; or removal of sliding soils. The specific techniques employed for stabilizing landslide hazards would depend on the individual characteristics of each hazard and the location of the pipeline facilities relative to the hazard. At some locations, the pipeline would be installed using the HDD method, which would minimize the potential for damage due to landslides.

Oregon LNG has stated it would conduct additional assessment, including field investigation, of landslide hazards along the proposed pipeline route and determine location-specific mitigation measures. Therefore, **we recommend that:**

- **<u>Prior to pipeline construction</u>, Oregon LNG should include the following in its pipeline geotechnical report:**
  - **a. results of investigations necessary to support final pipeline routing/mitigation measures through geologically hazardous areas; and**
  - **b. a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan.**

Monitoring and necessary maintenance would also be conducted routinely throughout the operating life of the project as part of Oregon LNG's standard operating procedures. Oregon LNG would provide training to operational personnel in identification of signs of soil and bank erosion, landslide movement, and scour. Monitoring would occur during the yearly right-of-way maintenance activities, normally during late summer or early fall. Oregon LNG plans to identify specific locations along the pipeline that would require more frequent monitoring, including areas where:

- soil erosion has been corrected;
- streambank erosion or stream scour has been mitigated;
- landslide hazards have been identified; and
- landslide mitigation has been performed.

Oregon LNG would also implement a monitoring program associated with landslide 'triggering' events such as intense rainfall, rapid snowmelt, volcanic eruption, and earthquake shaking. The triggering events that would result in specific pipeline alignment monitoring are listed below; those associated with rainfall events are based on ODF recommendations:

- rainfall exceeding 3 inches in any 24-hour period;
- rainfall exceeding 4 inches in any 48-hour period;
- rainfall exceeding 7 inches in any 7-day period;
- rain on snow where the rainfall exceeds 2 inches in 24 hours combined with warming temperatures that cause rapid snowmelt leading to a major flooding event;
- facilities within a 10-mile radius of a seismic event having a moment magnitude greater than 5;
- facilities with a 20-mile radius of a seismic event having a moment magnitude greater than 6; and
- facilities within a 30-mile radius of a seismic event having a moment magnitude greater than 7.

Monitoring after a trigger event would first focus on known problem or hazard areas and then progress to other areas of the project facilities. Additional geologic investigations and slope stability analyses may be performed after construction of the pipeline if the monitoring and maintenance programs identify areas where slope movement is occurring. With the above measures, we conclude that potential impacts associated with landslides would be minimized.

Subsidence

No karst topography is known along the pipeline route and neither limestone nor dolomite is identified on geologic maps in the vicinity of the proposed pipeline. The pipeline would not cross areas where oil extraction, high-volume groundwater pumping, subsurface mining, or similar activities that could cause ground subsidence have been identified. Therefore, subsidence is not a significant hazard to the pipeline.

Flooding and Bank Erosion

The pipeline would cross FEMA-mapped 100-year floodplains at 13 different locations (FEMA, 1996 and 2009). As indicated above, Executive Order 11988 requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Because of its linear nature, it would not be possible for the pipeline to entirely avoid crossing floodplains. In the about 8.4 miles of the pipeline that would be within 100-year floodplains, the pipeline would be installed below the ground surface, and the surface of the right-of-way would be restored and stabilized following construction, which would minimize environmental impacts and modification of floodplains. The aboveground pipeline facilities at the terminal (meter station, pig launcher and receiver, and MLV) and the MLV at MP 4.7 also would be within the 100-year floodplain. The nature of the terminal (dependent on access for LNG marine carriers) and needed spacing between MLVs make avoiding all floodplains with aboveground facilities impracticable. The pipeline siting process and proposed measures to minimize environmental impacts and modification of floodplains that would be crossed would meet the intent of Executive Order 11988. The locations of floodplain crossings are summarized in table 4.1.1-5.

Table 4.1.1-5

Portions of the Oregon LNG Pipeline Route Within the 100-Year Floodplain

Begin MP	End MP	Approximate Crossing Length (miles)
0.0	1.5	1.5
2.2	6.0	3.8
11.0	11.1	0.1
33.4	33.9	0.5
57.7	57.9	0.2
63.7	63.9	0.2
70.7	70.8	0.1
72.9	73.0	0.1
74.5	74.6	0.1
74.8	74.9	0.1
80.2	80.3	0.1
81.4	82.9	1.5
86.5	86.6	0.1
Total		**8.4**

Source: FEMA, 1996 and 2009.

The major waterbody crossings are the most susceptible areas to flooding along the pipeline. The pipeline would be installed at the largest waterbody crossings (Lewis and Clark River, Nehalem River, Rock Creek, Clatskanie River, and Columbia River) and certain other waterbody crossings using HDD techniques or other trenchless technology construction methods. The pipeline would be buried much deeper than for standard trench techniques where it is installed using HDD techniques. In areas where the pipeline would cross flood zones, Oregon LNG would also implement counter-buoyancy measures such as using a thicker (heavier) steel pipe, using a concrete coating, or installing weights.

Bank erosion may occur over time as the waterbodies experience periodic flooding and possible changes in course. Oregon LNG would monitor for streambank erosion along the pipeline during operation of the project, particularly in those areas with steep slopes, highly erosive soils, or high potential for liquefaction. Scour and lateral channel migration at waterbody crossings are addressed in section 4.1.3.2.

Paleontological Resources

Oregon LNG determined that the Hamlet Formation, which would be crossed by the pipeline, has moderate paleontological sensitivity. The following geologic units have a high paleontological sensitivity: undifferentiated Oligocene marine sediments and the Astoria, Keasey, Pittsburg Bluff, Troutdale, and Cowlitz Formations. In addition, the pipeline would cross Quaternary sediments which, as described in section 4.1.1.1, may have moderate paleontological sensitivity depending on their depth and their topographic and geologic context.

Direct impacts on paleontological resources may occur during construction, including mechanical damage to fossils or vandalism to fossils exposed by an excavation. These impacts could result in the loss of scientifically important data on the stratigraphic context and nature of the fossil assemblage, as well as loss of data on the fossil specimen(s) themselves. No impacts on paleontological resources would be anticipated during the operational phase of this project.

In the unlikely event that paleontological resources are encountered during construction of the project, Oregon LNG would notify FERC staff and implement preservation measures to ensure that any significant paleontological resource discovery is protected. Should it become necessary at that time, Oregon LNG would prepare a Paleontological Resources Monitoring and Mitigation Plan (PRMMP) prior to any continued construction in the affected area. Measures proposed to mitigate impacts on paleontological resources would comply with Society of Vertebrate Paleontology standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP; 1995, 1996). The PRMMP would summarize and provide measures for construction monitoring and coordination, emergency discovery procedures, requirements for sampling and data recovery, if needed, museum storage coordination for any specimens and data recovered, a program for preconstruction and construction-phase coordination, and reporting. Because Oregon LNG would implement a PRMMP if paleontological resources are encountered, we conclude that the pipeline would be unlikely to have significant impacts on paleontological resources.

4.1.1.3 Compressor Station

The geology at the compressor station location is Quaternary cataclysmic flood deposits consisting of coarse grained (gravel) sediments. Two aggregate mines are about 0.4 mile northwest of the compressor station location (Tide Creek Rock, Inc. and Oregon Department of Transportation [ODOT]) and the compressor station would be near the Knife River Corporation gravel mine but at least 500 feet away from active operations (see table 4.1.1-4).

Because the compressor station would be along the pipeline route (at about MP 80.9), the geologic hazards that may affect the proposed compressor station would be the same as the geologic hazards for that portion of the pipeline as discussed above (see section 4.1.1.2) and include earthquakes and liquefaction. The compressor station location has a 2 percent probability of exceeding a peak horizontal ground acceleration of 0.35 to 0.46 g in 50 years. Liquefaction susceptibility data are not available for the compressor station location; however, available data for similar geologic conditions within 1 mile to the south suggest a low to moderate susceptibility for liquefaction. To adequately minimize the potential for liquefaction hazards at the compressor station, **we recommend that:**

- **Oregon LNG should include in its pipeline design geotechnical report an evaluation of liquefaction hazards at the compressor station and necessary mitigation measures.**

The compressor station would not be on or close to steep slopes susceptible to potential landslides. As described in previous sections, implementation of specific design criteria, ground modification, other construction techniques, and operating procedures would avoid or minimize the potential for geologic hazards to cause damage to the project.

We conclude that the Oregon LNG Project would not have significant impacts on geologic resources. In addition, with the implementation of Oregon LNG's proposed mitigation measures and our recommendations, the geologic risk to project facilities would be minimized.

4.1.2 Soils and Sediments

We used the USDA's NRCS Soil Survey Geographic (SSURGO) database and NRCS Soil Survey Reports to obtain information about soils in the project area and identify the physical properties of soils affected. The SSURGO database is a digital version of the original county soil surveys developed by the NRCS for use with geographic information systems (GIS). It provides the most detailed level of

soils information for natural resource planning and management. SSURGO provides information on physical properties, chemical properties, and interpretive groupings.

The soil characteristics and limitations that could affect project construction or increase the potential for construction-related soil impacts were determined from the attribute data for the soil mapping units using SSURGO. We evaluated the following soil characteristics and limitations: potential for shallow bedrock, percentage of stones/rocks, compaction potential, erosion potential (wind and water), revegetation potential, and designation as Important Farmland (i.e., Prime, Unique, or of Statewide Importance).

During the scoping process, we received comments expressing concerns about impacts on soil resources, including potential soil contamination, soil compaction, and loss of soil productivity and porosity (due to topsoil and subsoil mixing) from agencies and members of the public. Scoping comments also indicated concerns related to increased erosion potential from vegetation clearing during pipeline construction and requests for the implementation of erosion control measures to be considered during all phases of the project. These concerns are addressed below.

4.1.2.1 Terminal

Existing Environment

The Skipanon Peninsula was created from deposition of dredged material in the late 1920s and 1930s (NOAA, 1987). As discussed in section 4.1.1.1, dredged fill material makes up the top 10 to 15 feet of the area proposed for the LNG terminal site. Table 4.1.2-1 describes the two soil units mapped at the terminal site. Construction of the terminal facilities would convert most of the site and existing soil resources to a permanent industrial facility.

Table 4.1.2-1

Soil Units at Terminal

Soil Unit	Description [a]
Coquille-Clatsop	Deep to very deep, very poorly drained soils with slow permeability. Soils are on floodplains and typically have slopes ranging from 0 to 1 percent. The Coquille series formed in recent alluvium over bay sediments and occur in slightly higher areas of tide-influenced floodplains. Coquille soils have a permanent high water table at or near the surface. Clatsop series formed in recent alluvium over marine bay sediment and occur in depressional areas of tide-influenced floodplains. When protected by dikes and levees, the major soils are used for permanent pasture. In unprotected areas, soils are well suited for wetland wildlife habitat.
Tropopsamments	Very deep, excessively drained soils consisting entirely of sand. Formed in stratified alluvium and on floodplains. Slopes range from 0 to 15 percent.

[a] The soil unit descriptions are based on information from the NRCS online soil survey for Clatsop County and the official NRCS soil series descriptions.

Soil Characteristics and Limitations

Table 4.1.2-2 summarizes characteristics and limitations of the soils that would be affected by construction of the onshore terminal facilities. Additional discussion of each soil attribute and its relevance to the project is provided below.

Table 4.1.2-2

Characteristics of Soils Affected by Construction at the Terminal [a]

Facilities	High Compaction Potential [b]	High Erosion Potential from Water [c]	High Erosion Potential from Wind [d]	Poor Revegetation Potential [e]	Important Farmland Soil [f]
Terminal Onshore Facilities	6.7	64.2	43.2	64.1	0.0
Permanent Access Road	0.8	5.5	3.0	5.5	2.8
Terminal Total	**7.5**	**69.7**	**46.2**	**69.6**	**2.8**

[a] In acres rounded to the nearest tenth. Soil units may be included in more than one characteristic.

[b] Includes soils in somewhat poor-to-very poorly drainage classes with surface textures of sandy clay loam or finer; includes all areas covered with water or seasonally ponded.

[c] Soils with Land Capability Class of 3 through 8 and a subclass of "e" indicating main limitation would be risk of erosion unless close-grown cover would be maintained; includes all areas covered with water or seasonally ponded.

[d] Soils with a Wind Erodibility Group (WEG) of 2 or less. Group 1 includes very fine sand, fine sand, sand, or coarse sand. Group 2 includes coarse-textured surfaces (fine sand, loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, very fine sandy loam, and silt loam with 5 or less percent clay and 25 or less percent very fine sand; sapric soil materials, except Folists.

[e] Soils with Land Capability Class of 4 or higher and difficult to revegetate under normal management practices. Includes surface textures of fine sand or coarser and a drainage class of well, somewhat excessively, or excessively drained.

[f] Includes Prime, Unique, and Farmland of Statewide Importance, as designated by the NRCS and the State of Oregon.

Soil Compaction and Rutting

Heavy construction equipment traffic can compact soils, resulting in degraded soil structure and reduced soil porosity. This may increase runoff potential or result in rutting during wet soil conditions. Fine-textured soils with poor internal drainage that are moist or saturated during construction are the most susceptible to compaction and rutting. About 7.5 acres of the onshore terminal site that would be affected by construction (including the access road) contain soils classified with a high compaction potential.

In areas of the terminal that would be restored to vegetated conditions, Oregon LNG would minimize compaction and rutting impacts by using measures outlined in its Plan and Procedures (e.g., construction from timber mats or use of low ground-weight equipment) during construction in soft or saturated soils. Oregon LNG's Plan prohibits working in conditions that cause excessive rutting by limiting the use of heavy equipment during wet conditions.

Water and Wind Erosion

Erosion is a continual natural process that can be accelerated by human disturbance. During terminal construction, existing vegetation would be removed and the risk of erosion from water or wind may increase. This could result in a loss of fertile topsoil and increase sediment transport to surface water.

For the terminal facilities, about 69.7 acres of soils would be susceptible to water erosion, and 46.2 acres would be susceptible to wind erosion. These amounts do not include the aquatic areas in the project footprint. During construction, Oregon LNG would implement erosion controls, including sediment barriers (i.e., silt fence), seeding, and mulch, in accordance with its Plan and Procedures. Permanent erosion control measures would be applied after final grading for stabilization, as specified in Oregon LNG's Conceptual Mitigation Plan (see appendix F3).

The shoreline at the terminal would likely experience some degree of erosion over time as a result of the wave action and from tidal fluctuations. During operation of the facility, erosive forces would likely be similar to the current conditions although, due to climate change, sea level is expected to rise. Mote et al. (2008) calculated several ranges of possible sea level rise that could occur in the vicinity of the

terminal. The medium and most likely range projects a rise of almost 5 inches by 2050 and over 11 inches by 2100. A 30 percent safety factor was figured into the design of the terminal berm and we have determined that would accommodate potential sea level rise.

LNG vessels would produce negligible shoreline impact at the terminal because they would move slowly under limited maneuvering power with tug assist. Tugs would be high powered and have potential to cause shoreline erosion when pointing their screws at the shore. However, the terminal dock is almost 2,000 feet from dry land, so the probability of increased shoreline erosion caused by tugs is low. Tidal mudflats are closer to the dock and more exposed; however, the probability of increased erosion at mudflats is low outside the dredged area. We conclude the impact would be minimal.

Currently, ships traveling along the LNG marine waterway produce swells; the resulting waves run up onto the beach slope, causing shoreline erosion, which would continue during construction and operation of the terminal. As discussed in section 4.1.1.1, the LNG marine carriers could potentially produce larger waves than most of the current ships operating at the same speed. However, the LNG marine carriers would travel at speeds slower than typical deep-draft ship traffic. The LNG marine carriers would increase the number of ship transits in the vicinity of the terminal and would therefore increase the time period over which ship-induced waves are generated with the potential to increase shoreline erosion.

Oregon LNG would monitor the shoreline for the first five LNG marine carrier visits and thereafter at least once every 90 days (quarterly) for signs of erosion. Should the monitoring determine that potentially damaging erosion is occurring as a result of operations (rather than from significant storms or natural wave action), Oregon LNG would implement appropriate stabilization measures pursuant to federal and state removal/fill approvals to reduce erosion potential. The stabilization measures may include the installation of soft armoring techniques, such as increasing vegetation present along the shoreline and the use of brush layering, as an adaptive management strategy.

Revegetation Potential

The clearing and grading of soils with poor revegetation potential could result in a lack of adequate vegetation following construction of the terminal, which could lead to increased erosion and a reduction in wildlife habitat. At the terminal site, about 69.6 acres of soils that would be affected by construction have poor revegetation potential.

Most of the terminal site would be occupied by permanent structures, roadways, parking, and landscaped buffers. Substrate under the process facilities and around the LNG storage tanks would be covered with gravel and not revegetated. The exterior side and top portions of the berm surrounding the terminal would be armored with riprap. However, the interior portion of the berm would be planted with the same seed mix used for other nongraveled areas suitable for planting. About 90 percent of the seed mix would consist of California brome, sickle keeled lupine, slender wheatgrass, gallardia, and Spanish clover. Soils that are disturbed outside of the berm and around the flare would be disked and ruts would be removed. This area is mostly estuarine wetlands and would be allowed to revegetate naturally from the existing seed bank and rhizomes, according to our Plan and Procedures. Section 4.1.6.1 provides additional details regarding revegetation of the terminal site after construction.

Important Farmland

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. Unique farmland is used for production of specific high-value food and fiber crops. Farmland of statewide

importance is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. We combined these three categories into one category, Important Farmland, to assess project impacts on agricultural soils. Potential impacts on Important Farmland soils would include mixing of topsoil and subsoil, and compaction and rutting. Permanent impacts would include removal of Important Farmland from availability for agricultural production.

The existing land use within the proposed terminal site is not agricultural and no Important Farmland would be affected within the terminal boundaries. However, 2.8 acres of the land that would be affected by construction of the terminal access road is designated as Important Farmland if irrigated. This land would become unavailable for use as potential farmland for the life of the terminal.

Soil Contamination

Based on the EPA's environmental database (EPA, 2014) and the ODEQ Environmental Site Cleanup Information (ESCI) database (ODEQ, 2014), no documented landfills, spill sites, or hazardous waste sites would be at or within 0.25 mile of the terminal. Furthermore, the only historical use of the site has been for placement of dredged material. Although it is possible for dredged material to contain contaminants, such contamination is not documented in the EPA database. Therefore, contaminated soils are not expected to be encountered during construction of the terminal facilities. Oregon LNG states that it would develop a Plan for the Unanticipated Discovery of Contaminated Environmental Media before starting construction of the pipeline. However, even though the potential for contaminated soil is low at the terminal, we conclude that the plan should be inclusive of the terminal facilities. Therefore, **we recommend that:**

- **Prior to construction of the Oregon LNG Project, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, its Plan for the Unanticipated Discovery of Contaminated Environmental Media for both the terminal site and pipeline facilities.**

The potential for contaminated sediments in the offshore area proposed for dredging at the terminal site and results of chemical testing are addressed in section 4.1.3.2.

Operation and maintenance of construction vehicles and equipment during terminal construction has the potential to create leaks or spills of fuels or hazardous wastes. To provide controls that would prevent spills and to guide response procedures if a spill were to occur, Oregon LNG would implement its Spill Prevention, Control, and Countermeasures Plan (SPCC Plan) (see appendix F1) to ensure the safe and timely cleanup of potential contaminants, and to protect waterbodies threatened by a spill event. We have reviewed this plan and conclude it is adequate. Before beginning operations, Oregon LNG would prepare a spill plan for operation of the terminal that would meet state and federal agency requirements. Implementation of this plan would reduce the potential for spills of fuels and hazardous materials at the terminal.

We conclude that with Oregon LNG's proposed mitigation measures and our recommendations, impacts on soils from the construction and operation of the terminal would be minor.

4.1.2.2 Pipeline and Associated Facilities

Existing Environment

Information regarding soils along the pipeline route is based on the Soil Surveys of Clatsop County, Oregon (NRCS, 1988), Tillamook County, Oregon (NRCS, 2013a), Columbia County, Oregon (NRCS, 1986), and Cowlitz County, Washington (NRCS, 2012). The pipeline would cross numerous different soil units throughout these four counties. The predominant soils units in each county are described in table 4.1.2-3. Predominant soils include any soil series which occurred on more than 1.0 mile of pipeline. Soils at the contractor and pipe storage yards, compressor station, and other aboveground facilities are described in Table 4.1.2-4

Table 4.1.2-3

Soil Units Crossed by the Oregon LNG Pipeline

Soil Unit	Total Miles	Description [a]
Clatsop County		
Coquille-Clatsop complex	4.1	The Coquille and Clatsop series consist of very deep to deep, very poorly drained to poorly drained soils that formed in mixed alluvium along tidal influenced flood plains. Protected and drained areas are typically used for pasture and hay. Slopes range from 0 to 1 percent slopes.
Grindbrook silt loam	1.4	The Grindbrook series consists of very deep, moderately well drained soils formed in mixed alluvium on terraces. Soils are typically crops or woodland and have slopes of 3 to 30 percent.
Hebo silty clay loam	1.5	The Hebo series consists of very deep, poorly drained soils that formed in alluvium of mixed materials. Soils are typically crops and have slopes of 0 to 3 percent.
Klootchie-Necanicum complex	1.3	The Klootchie and Necanicum series consists of deep and very deep, well drained soils formed in colluvium from volcanic rock on mountains. Soils are mainly wooded and have slopes of 30 to 60 percent.
Rinearson silt loam	10.9	The Rinearson series consists of deep, well drained soils that formed in colluvium weathered from siltstone. Soils are mainly wooded and have slopes of 3 to 60 percent.
Skipanon gravelly silt loam	8.3	The Skipanon series consists of deep and very deep, well drained soils formed in mass movement deposits. Soils are mainly wooded and have slopes of 3 to 60 percent.
Templeton and Templeton-Ecola silt loams	5.6	The Templeton and Ecola series consists of moderately deep to deep, well drained soils that formed in colluvium and residuum weathered from sedimentary rocks. Soils are typically wooded with slopes of 3 to 60 percent.
Tillamook County		
Rinearson silt loam	1.0	See above.
Scaponia-Braun silt loams	1.1	The Scaponia and Braun series consist of moderately deep to deep, well drained soils that formed in colluvium weathered from siltstone. Both are typically used for timber production and have slopes of 30 to 60 percent on slopes.
Tolke medial silt loam	1.1	The Tolke series consists of very deep, well drained soils that formed in mixed colluvium from weathered volcanic or tuffaceous sedimentary rocks. Tolke soils are used mainly for timber production and have slopes are 5 to 30 percent.
Columbia County		
Bacona silt loam	9.2	The Bacona series consists of deep, well drained soils that formed in eolian material mixed with colluvium weathered from sedimentary bedrock. Bacona soils are typically used for timber production and have slopes of 3 to 30 percent.
Braun-Scaponia and Scaponia-Braun silt loams	6.4	See above.

Table 4.1.2-3

Soil Units Crossed by the Oregon LNG Pipeline

Soil Unit	Total Miles	Description [a]
Glohm silt loams	2.0	The Glohm series consists of moderately deep to fragipan, well drained soils that formed in eolian material over mixed, old alluvium or residuum. Glohm soils are typically used for timber production and have slopes of 3 to 30 percent.
Mayger silt loams	2.7	The Mayger series consists of deep, somewhat poorly drained soils that formed in residuum and colluvium wheathered from shale. Mayger soils are typically used for timber production and have slopes of 0 to 30 percent.
Multnomah loam	1.0	The Multnomah series consists of deep, well drained soils that formed in gravelly alluvium. Multnomah soils are typically crops and have slopes of 0 to 3 percent.
Murnen silt loam	3.7	The Murnen series consists of very deep, well drained soils formed in material weathered from basalt with an admixture of volcanic ash. Murnen soils are typically used for timber production and have slopes of 3 to 30 percent.
Vernonia silt loams	4.6	The Vernonia series consists of deep, well drained soils that formed in residuum and colluvium weathered from siltstone or shale. Vernonia soils are typically used for timber production and have slopes of 3 to 30 percent.
Cowlitz County		
Maytown silt loam	1.4	The Maytown series consists of very deep, moderately well drained soils formed in mixed alluvium on flood plains and low terraces. They have slopes of 0 to 3 percent and are typically used for crops.

[a] The soil unit descriptions are based on information from NRCS map unit information from the online soil survey for each county, and the official NRCS soil series descriptions.

Table 4.1.2-4

Soil Units at Oregon LNG Pipeline Aboveground Facilities and Contractor/Pipe Storage Yards

Facility	Soil Unit	Description [a]
Meter Stations [b]		
Woodland	Kelso	Very deep, moderately well drained soils with slow permeability. Slopes range from 0 to 50 percent. These soils are used for timber, home sites, hay and pasture.
	Klootchie	Deep to very deep, well drained soils with moderate permeability. Slopes range from 3 to 30 percent. These soils are typically used for timber production, recreation, and home sites.
Compressor Station	Multnomah	Deep, well drained soils with moderate permeability. Slopes range from 0 to 60 percent. These soils are used mainly for truck crops, nursery stock, grain, fruit production, pasture, home sites, and wildlife habitat.
	Xerochrepts	Deep, somewhat poorly drained to well drained soils with moderate to moderately slow permeability. Slopes range from 20 to 50 percent. These soils are used mainly for timber production, pasture, and wildlife habitat.
Contractor and Pipe Storage Yards		
Area 1 (Tongue Point)	Tropopsamments	Very deep, excessively drained soils consisting entirely of sand. Formed in stratified alluvium and on floodplains. Slopes range from 0 to 15 percent.
Area 2 (Hwy 26 and Northwest Timber Road)	Vernonia	Deep, well drained soils with moderate permeability and slopes ranging from 3 to 30 percent. These soils are typically used for timber production, recreation, wildlife, and pasture.
Area 3 (off of Pittsburg Road)	Hapludalfs-Udifluvents	Very deep, moderately well to well drained soils. Slopes range from 0 to 3 percent. These soils are used mainly for timber production and wildlife habitat.
	Treharne	Very deep, moderately well drained soils with moderately slow permeability. Slopes range from 0 to 3 percent. The soils of this map unit are used for hay, pasture, timber production, recreation, home site development, and wildlife habitat.
Area 4 (off of Pittsburg Road)	Murnen	Very deep, well drained soils with moderate permeability. Slopes range from 3 to 65 percent. These soils are used for timber production, wildlife habitat, and watershed.
Area 5 (Hwy 30 and Dike Road) Rail Siding near Compressor Station	Multnomah	See above.
	Xerochrepts	See above.
Area 6 (off of Port Road in Kalama)	Schneider-Rock Outcrop	Shallow to deep, well drained soils with moderate permeability. Slopes range from 15 to 65 percent, and the potential for water erosion is severe. The soils of this map unit are used for woodland, wildlife habitat, recreation, and watershed.
	Udifluvents-Hapludalfs	Very deep, somewhat excessively and well drained soils with moderate permeability. Slopes range from 0 to 15 percent. These soils are used for wildlife habitat and woodland.

[a] The soil unit descriptions are based on information from NRCS map unit information from the online soil survey for each county, and the official NRCS soil series descriptions.

[b] Other aboveground facilities are within the permanent pipeline right-of-way, compressor station footprint, or terminal footprint.

Soil Characteristics and Limitations

Table 4.1.2-5 summarizes attributes of the soils affected by construction of the pipeline facilities.

Stony/Rocky and Shallow to Bedrock Soil

Soils identified as containing bedrock or coarse fragments to a depth of 5 feet or less from the surface may introduce rock or stone into topsoil through construction activities. The presence of rock or stones in topsoil may damage agricultural equipment or affect agricultural productivity by reducing the soil water holding capacity and permeability.

About 39.3 miles (45 percent) of the pipeline route would occur in soils classified as having a shallow depth to bedrock. The majority of these soils are between MP 10.0 and MP 70.0 within the Coast Range in Clatsop and Columbia Counties. Rocky or shallow to bedrock soils would be encountered at some of the contractor and pipe storage yards.

Oregon LNG would minimize the potential for introducing rock from the subsoil into the topsoil in agricultural lands and residential areas by segregating topsoil and keeping it separate from subsoil during construction. Excess rock would be removed from at least the top 12 inches of segregated topsoil, and the size, density, and distribution of rock would be similar to adjacent areas that have not been disturbed by construction. Landowners would be able to approve other provisions in writing. Oregon LNG could use excess rock to backfill the trench, but only to the top of the existing bedrock profile. After the trench is backfilled, the topsoil would be replaced. Where additional soil would be necessary to restore the original soil contours as a result of the removal of excess rock from the trench backfill, imported soil would be used but would not be allowed within the surface 12 inches of backfill.

Soil Compaction and Rutting

Soil compaction and rutting caused by heavy equipment during pipeline construction may increase runoff and reduce yields of agricultural crops. Approximately 4.7 miles, or 5 percent, of the pipeline would cross soils prone to compaction. These soils are within low-lying areas in Clatsop, Columbia and Cowlitz Counties. No soils in the contractor and pipe storage yards would have high compaction potential.

Table 4.1.2-5

Characteristics and Limitations of Soils Affected by Construction of the Oregon LNG Pipeline Facilities [a]

Facilities	Shallow Depth to Bedrock or Coarse Fragments [b]	High Compaction Potential [c]	High Erosion Potential from Water [d]	High Erosion Potential from Wind [e]	Poor Revegetation Potential [f]	Important Farmland Soil [g]
Pipeline						
Clatsop	322.0	41.8	461.1	3.9	455.1	131.6
Tillamook	0.0	0.0	10.0	0.0	10.0	0.0
Columbia	173.9	5.1	249.5	7.1	258.6	140.0
Cowlitz	0.0	8.3	10.8	0.0	0.0	50.9
Pipeline Subtotal	**495.9**	**55.2**	**731.4**	**11.0**	**723.7**	**322.5**
Meter Station (Woodland, Cowlitz County) [h]	0.0	0.0	0.0	0.0	0.0	0.5
Compressor Station (Columbia County)	0.0	0.0	0.0	0.0	6.3	0.0
Contractor and Pipe Storage Yards (Clatsop, Columbia, and Cowlitz Counties)	5.9	0.0	30.4	28.0	30.4	13.9
Total	**501.8**	**55.2**	**761.8**	**39.0**	**760.4**	**336.9**

[a] In acres rounded to the nearest tenth.

[b] Soils identified as containing bedrock or coarse fragments to a depth of 5 feet or less from the surface.

[c] Includes soils in somewhat poor-to-very poorly drainage classes with surface textures of sandy clay loam or finer; includes all areas covered with water or seasonally ponded.

[d] Soils with Land Capability Class of 3 through 8 and a subclass of "e" indicating main limitation would be risk of erosion unless close-grown cover would be maintained; includes all areas covered with water or seasonally ponded.

[e] Soils with a WEG of 2 or less. Group 1 includes very fine sand, fine sand, sand, or coarse sand. Group 2 includes coarse-textured surfaces (fine sand, loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, very fine sandy loam, and silt loam with 5 or less percent clay and 25 or less percent very fine sand; sapric soil materials, except Folists.

[f] Soils with Land Capability Class of 4 or higher and difficult to revegetate under normal management practices. Includes surface textures of fine sand or coarser and a drainage class of well, somewhat excessively, or excessively drained.

[g] As designated by the NRCS. Includes Prime, Unique, and Farmland of Statewide Importance.

[h] Other aboveground facilities are within the permanent pipeline right-of-way, compressor station footprint, or terminal footprint.

Oregon LNG would minimize compaction and rutting impacts during pipeline construction by using measures outlined in its Plan and Procedures (e.g., construction from timber mats, or low ground-weight equipment) during construction in soft or saturated soils. Oregon LNG's Plan prohibits working in conditions that cause excessive rutting by limiting the use of heavy equipment during wet conditions. In residential and agricultural areas that are disturbed by construction activities, topsoil and subsoil would be tested for compaction potential at regular intervals using cone penetrometers or other similar devices. Agricultural areas that have been severely compacted would be plowed with a paraplow or other deep tillage equipment. In areas where the topsoil has been segregated, the subsoil would be plowed before the topsoil is replaced. In addition, arrangements could be made with the landowner to plant and plow under a "green manure" crop (i.e., vetch or rye) to reduce soil bulk density and improve soil structure. Soil compaction mitigation would also be performed in severely compacted residential areas.

Water and Wind Erosion

During pipeline construction, existing vegetation would be cleared, increasing the risk of erosion from water or wind. This could result in a loss of fertile topsoil and reduced agricultural productivity.

About 57.5 miles (66 percent) of the pipeline route would cross soils with high potential for water erosion. Approximately 0.8 mile (1 percent) of the pipeline would cross soils with high risk of wind erosion, including one area outside the terminal and another on the west side of the Columbia River. As shown in table 4.2.2-2, proposed contractor and pipe storage yards would be located on soils subject to water and wind erosion, the majority of which (25.5 of 33 acres) are at Yard 1 on Tongue Point in Clatsop County.

Oregon LNG would implement erosion controls, including sediment barriers (i.e., silt fence) and mulch in accordance with its Plan and Procedures. Oregon LNG would use dust control measures under conditions of high wind erosion potential, including routine wetting of the construction workspace where soils are exposed. Soils would be permanently stabilized through revegetation as discussed in section 4.1.6.2.

Revegetation Potential

The clearing and grading of soils with poor revegetation potential could result in a lack of adequate vegetation following construction and restoration of the right-of-way, which could lead to increased erosion, a reduction in wildlife habitat, and negative visual impacts.

Approximately 56.7 miles (65 percent) of the soils along the proposed pipeline route have been classified with poor revegetation potential. The majority of these soils are in Clatsop and Columbia Counties. Poor revegetation potential is anticipated at the compressor station site and all but one of the contractor and pipe storage yards.

Following construction, Oregon LNG would revegetate soil surfaces as appropriate for the land use. At a minimum, soils would be restored to preconstruction contours and soil conditions, and permanent erosion control seeding would be applied to disturbed soil areas for stabilization. Oregon LNG would revegetate the noncultivated portions of the project's construction areas in accordance with its Plan. Revegetation would be guided by the terms and conditions of applicable permits and regulatory guidance, *The Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000), and landowner requests. Oregon LNG would monitor revegetation results for two growing seasons to determine success. Revegetation in nonagricultural areas would be considered successful if, upon visual survey, the density and cover of nonnuisance vegetation is similar to adjacent undisturbed areas. In

agricultural areas, revegetation would be considered successful if crop yields are similar to adjacent undisturbed portions of the same field.

Important Farmland

Potential impacts on Important Farmland soils during pipeline construction would include mixing of topsoil and subsoil, and compaction and rutting. These impacts would result primarily from trench excavation and backfilling, and vehicular traffic along the construction right-of-way. Permanent impacts would include removal of Important Farmland from availability for certain types of crops.

Approximately 25.1 miles (29 percent) of the pipeline would cross Important Farmland soils, mainly within Clatsop, Columbia, and Cowlitz Counties. The compressor station and the Woodland meter station would be in and would permanently impact 3.6 acres of Important Farmland soils. The contractor and pipe storage yards would comprise about 13.9 acres of Important Farmland soils; however, they have been previously disturbed.

Along the pipeline, the large majority of the impacts on Important Farmland soils would occur during construction and would be temporary. These impacts would be mitigated through implementation of Oregon LNG's Plan and Agricultural Impact Mitigation Plan (see appendix F2). During excavation in agricultural areas, Oregon LNG would strip topsoil to a depth of up to 24 inches, segregate it in a separate stockpile, and replace it after backfilling the trench with subsoils (see section 4.1.9.2). Measures to minimize soil compaction, rutting, and erosion would be implemented as described in the sections above. As further addressed in section 4.1.9.2, crops would be allowed within the permanent right-of-way, with the exception of certain deep-rooted plants, such as trees, that could not be grown directly over or adjacent to the pipeline. The pipe and contractor storage yards could return to their original use after construction ends.

Soil Contamination

Based on the EPA's environmental database (EPA, 2014), there is one documented site with contamination within 0.25 mile of the pipeline alignment. The site is the Astoria Marine Construction Company Superfund site (Registry ID 110043437769) approximately 300 feet northeast of MP 3.2 at the Lewis and Clark River crossing. Soils, groundwater, and sediments in the Lewis and Clark River and Jeffers slough have been impacted by contaminants including metals and several organic compounds (Ecology and Environment, 2010). Because the Lewis and Clark River would be crossed with an HDD, contaminated sediments, which are near the surface, would not be disturbed. Additional information on the Astoria Marine site is included in section 4.1.9.2.

Oregon LNG would develop a Plan for the Unanticipated Discovery of Contaminated Environmental Media before starting construction of the pipeline. The plan would include procedures to test for contaminants if suspect soils are encountered. Any soils found to be contaminated would be managed according to Oregon LNG's SPCC Plan and applicable regulations. This would include disposal of contaminated soils at a licensed disposal facility.

As with the terminal, the operation and maintenance of construction vehicles and equipment creates the potential for a fuel or chemical spill during pipeline construction. Oregon LNG would implement its SPCC Plan to provide controls that would prevent spills and to guide response procedures that would minimize any impacts if a spill were to occur.

We conclude that implementation of Oregon LNG's Plan, SWPPP, and other project-specific plans would effectively mitigate the impacts of pipeline construction and operation on soil resources.

4.1.3 Water Resources

4.1.3.1 Groundwater

Regional Setting

Regional aquifer systems that directly underlie the project facilities include unconsolidated deposit aquifers, pre-Miocene aquifers, and the Columbia River basalt aquifer (USGS, 2005b). The aquifers receive recharge primarily from infiltration of precipitation and surface waters. The amount of annual rainfall varies from 80 inches in coastal Oregon to 46 inches in the Columbia River floodplain near Longview, Washington. Groundwater loss in the unconsolidated-deposit aquifers includes evapotranspiration, water supply wells, and discharge to surface waterbodies.

Groundwater in unconsolidated-deposit aquifers along the Columbia River may exhibit naturally occurring elevated arsenic, iron, and manganese concentrations. Locally, groundwater quality may be degraded by human activities such as irrigation (i.e., increased salt loading caused by evaporation of applied irrigation water), use of fertilizers and pesticides, landfills and other hazardous waste sites, and use of industrial and residential heat exchangers. The pre-Miocene sedimentary and volcanic rock aquifers are generally low yielding with poor-to-saline groundwater quality.

Under Section 1424(e) of the Safe Drinking Water Act, the EPA defines a sole or principal source aquifer as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, and for which there are no other reasonably available alternative drinking water source(s) that could physically, legally, and economically supply all those who depend on the aquifer for drinking water should the aquifer become contaminated. The nearest EPA-designated sole-source aquifer to the project is the Troutdale aquifer system north of Portland in Washington, about 90 miles east-southeast of the terminal site and about 0.5 mile southeast of the Oregon LNG pipeline route in Cowlitz County, Washington (EPA, 2010). None of the project facilities would cross this aquifer, and it would be separated from the pipeline by the Lewis River.

Terminal

Existing Conditions

The terminal facilities would overlie an unconsolidated-deposit aquifer that consists primarily of sand, silt, and clay. The unconsolidated aquifer near the terminal has a limited lateral extent and thins to the south (Baker, 2002).

Groundwater was encountered at depths of approximately 5 to 8 feet below ground surface (bgs) during geotechnical borings at the terminal site (CH2M HILL, 2008). The groundwater flow toward surface water near the terminal is likely influenced by tidal fluctuation, and varies seasonally with tidal and river stages.

Groundwater Use and Water Supply Wells

Data provided by OWRD and ODEQ indicate that no wellhead or source water protection areas are present at or within 150 feet of the terminal site. The OWRD and ODEQ databases also indicated that no domestic or public water supply wells are present at or within 150 feet of the proposed construction footprint of the terminal. Oregon LNG would not use groundwater during construction of the terminal and would not install wells at the site for use during operation.

Groundwater Impacts and Mitigation

We conclude that no water wells, sole source aquifers, wellhead protection areas, or source water protection areas would be impacted by construction or operation of the terminal. Dewatering needed for excavation during construction would temporarily impact groundwater flow. Shallow groundwater could experience disturbance from changes in overland flow and recharge caused by clearing, soil compaction, grading of the proposed terminal footprint and installation of impervious surfaces. Stormwater within the LNG terminal area would discharge to the POTW.

Soil modifications and subsurface structures needed at the terminal site could alter the local groundwater hydrology. Impervious surfaces created after construction would alter localized groundwater infiltration as well. Oregon LNG would use CDSM and stone columns for soil improvement at the terminal to make the ground more resistant to soil liquefaction and settlement. Driven steel piles would support the LNG tanks, pipe rack/spill containment trough, spill containment basin, flare, and building and equipment slab foundations. The storage tanks would not require a permanent dewatering system.

We received comments regarding the risk of contaminants from handling wastes associated with the feed gas pretreatment process. These wastes are described in section 2.1.1.1. Oregon LNG would be required to comply with hazardous waste storage and disposal regulations and permit requirements. Therefore we conclude that contaminants from these wastes would be unlikely to reach the groundwater or surface water.

Refueling and storage of fuel during construction and operation pose a potential hazard to groundwater from inadvertent spills. Oregon LNG would avoid or minimize potential impacts by using appropriate construction and hazardous material handling practices as specified in its SPCC Plan for construction (see appendix F1). Before beginning operations, Oregon LNG would prepare a spill plan for operation of the terminal that would meet state and federal agency requirements.

In summary, we expect shallow groundwater impacts from construction and operation of the terminal to be minor and minimized through best management practices. We do not expect groundwater to be permanently affected.

Pipeline and Associated Facilities

Aquifers Crossed

The pipeline would overlie unconsolidated-deposit aquifers, pre-Miocene aquifers, and the Columbia River Basalt aquifer. The unconsolidated-deposit aquifers are locally significant aquifers used for domestic water supply and irrigation. In general, the unconsolidated-deposit aquifers are found where recent (Quaternary to Holocene) sediment valley-fill overlies older bedrock along waterbodies (Whitehead, 1994). Unconsolidated-deposit aquifers are crossed between MPs 0.0 and 11.0.

The pipeline would cross pre-Miocene aquifers in the Coast Range mainly between MPs 11.0 and 63.0. The pre-Miocene aquifers receive recharge primarily in the form of infiltration of precipitation and locally from discharge of connate saline water from deeper groundwater bearing zones. Regionally, groundwater flows toward streams and is discharged to the streams through springs and seeps. Groundwater discharge varies seasonally, but contributes to base flow year-round. Saltwater contamination is common in pre-Miocene aquifers in the project area, but where aquifers contain freshwater, withdrawals are used mostly for domestic and commercial purposes (Whitehead 1994).

The Columbia River Basalt aquifer consists of multiple flood basalt layers 10 feet to 100 feet thick (Vaccaro et al., 1997). In the project area, the basalts are exposed along a faulted, asymmetric anticlinal ridge along the pipeline route mainly between MPs 63.0 and 86.8. The aquifer is recharged primarily from precipitation and surface water filtration in upland areas. Discharge occurs as groundwater flow into unconsolidated aquifers and springs or through groundwater extraction. Yields from the aquifer vary widely. In areas where the basalts crop out or are not overlain by thick unconsolidated sediments, groundwater can be shallow and suitable for most uses (Woodward et al., 1998).

Critical Aquifer Recharge Areas

The State of Washington's Growth Management Act (GMA) requires the designation and protection of "Critical Areas" to prevent harm to the community from natural hazards and to protect natural resources. The goal of establishing critical aquifer recharge areas (CARAs) is to protect the functions and values of a community's drinking water by preventing pollution and maintaining supply.

Cowlitz County defines CARAs as areas with prevailing geologic conditions associated with infiltration rates that create a high potential for contamination of groundwater resources or contribute significantly to the replenishment of groundwater. CARAs are categorized according to the following standards (*Cowlitz County Code* 19.15.160):

- **Severe Aquifer Sensitivity:** areas that provide rapid recharge with little protection, having highly permeable soils.
- **Moderate Aquifer Sensitivity:** areas with aquifers likely present but that have a surface soil material that encourages runoff and slows water entry into the ground.
- **Slight Aquifer Sensitivity:** areas whose soil series are derived from basaltic, andesitic, or sedimentary rock or ancient glacial till, which are parent material for soils with more clays at the surface. These geological formations do not provide abundant groundwater.

The CARAs crossed by the pipeline are listed by milepost in table 4.1.3-1.

Table 4.1.3-1

Critical Aquifer Recharge Areas Crossed by the Oregon LNG Pipeline, Cowlitz County, Washington

Beginning Milepost	Ending Milepost	Aquifer Recharge Category
82.6	82.9	Severe
82.9	83.0	Moderate
83.0	83.5	Slight
83.5	86.9	Moderate

Groundwater Use and Water Supply Wells

Table 4.1.3-2 lists wells within 150 feet of the pipeline construction right-of-way, as identified by Oregon LNG through its review of the OWRD databases, conversations with landowners, and field surveys. Of these, two wells would be within 50 feet of the construction right-of-way. No public drinking water supply wells or wellhead protection areas would be within 150 feet of the pipeline route (OWRD, 2013; ODHS, 2013; Ecology, 2012a; Washington Department of Health, 2012a).

Table 4.1.3-2

Water Wells Within 150 Feet of Oregon LNG Pipeline Construction Right-of-way

Milepost	Well ID [a]	Well Use [a]	Depth (feet) [a]	Well Within 50 Feet of Workspace
5.9	CLAT 53157	Not provided	100	No
9.8	CLAT 52440 or CLAT 52719 or CLAT 52724	Domestic	Not provided	No
9.8	CLAT 52440 or CLAT 52719 or CLAT 52724	Domestic	Not provided	No
9.8	CLAT 52440 or CLAT 52719	Domestic	Not provided	No
9.9	CLAT 50951	Domestic	405	No
33.4	—	Not provided	Not provided	Yes
33.5	CLAT 52268	Domestic	11.7	No
33.6	—	Not provided	Not provided	No
33.6	—	Not provided	Not provided	Yes
33.7	CLAT 50577	Domestic	55	No
40.9	CLAT 53121 or CLAT 53122	Not provided	Not provided	No
40.9	CLAT 53121 or CLAT 53122	Not provided	Not provided	No
42.9	CLAT 53143 or CLAT 53144	Not provided	Not provided	No
43	CLAT 53143 or CLAT 53144	Not provided	Not provided	No
73.9	COLU 389	Domestic	25	No
73.9	COLU 390	Domestic	25	No
80.7	COLU 1191	Industrial	30	No
81.2	COLU 53658	Domestic	28	No
82.8	WL15F1	Domestic	15	No
86.7	9435	Domestic	40	No

[a] Well ID, Well Use, and Depth obtained from the OWRD Well Log Query at http://apps2.wrd.state.or.us/apps/gw/well_log/Default.aspx, the OWRD Groundwater Rights Data GIS shapefile, and Ecology's Environmental Information Management (EIM) system at http://www.ecy.wa.gov/eim/index.htm. In instances where the two OWRD sources have conflicting data, the Well Log Query is assumed to take precedence.

Properties with residential structures within 50 feet of the construction right-of-way were assumed to have a water well. In many instances, not enough information was available from water well reports to positively identify wells with current landowner, tax lot, or public land system coordinates; therefore, this list should be considered preliminary until all properties are accessible to Oregon LNG for survey.

As described further in section 4.1.3.2, Oregon LNG would obtain water necessary for construction of the pipeline primarily from municipal or surface water sources.

Groundwater Impacts and Mitigation

Although pipeline construction activities could affect groundwater resources, Oregon LNG would avoid or minimize most potential impacts by implementing its Plan, Procedures, and SPCC Plan. Shallow aquifers could sustain minor impacts from changes in overland water flow and recharge caused by clearing and grading of the right-of-way. Near-surface soil compaction caused by heavy construction vehicles could reduce the soil's ability to absorb water, which could increase surface runoff and the potential for ponding. Water infiltration, which is normally enhanced by vegetation, would be temporarily reduced until vegetation is reestablished. These impacts would be temporary and would not significantly affect groundwater resources. Upon completion of construction, Oregon LNG would restore the ground surface as practicable to original contours and revegetate the right-of-way to ensure restoration of preconstruction overland flow and recharge patterns.

Refueling and storage of fuel during construction poses a potential hazard to groundwater should leaks or spills occur. Oregon LNG would avoid or minimize impacts on groundwater from spills through use of appropriate fuel and hazardous material handling practices, such as storing hazardous materials only at designated staging areas and implementing the spill response measures in its SPCC Plan. The SPCC Plan states that contractors would refuel equipment and transfer material at least:

- 150 feet from any surface water sources (including wetlands, ephemeral streams, seasonal streams, lakes, and rivers);
- 200 feet from any private water supply well; and
- 400 feet from any municipal water supply well.

Construction of the pipeline would require trenching and backfilling to a depth of approximately 7 feet bgs. In areas where the water table is near the ground surface, trench excavation could intersect the water table, requiring trench dewatering. Trench dewatering may result in localized, minor lowering of the water table. Because pipeline construction at a given location would be completed within a short period of time, potential impacts from dewatering would be temporary and we would expect water table elevations to quickly reestablish after construction. Oregon LNG would push, pull, or float the pipeline into place at locations where the trench may be continually flooded and dewatering would not be feasible. Disturbances to shallow groundwater during trenching and backfilling could increase turbidity but these impacts would be very localized and of short duration.

Alteration of the natural soil strata would result in new migration pathways for groundwater, particularly in wetland areas (see section 4.1.4 for further discussion of wetlands). However, backfilling with previously excavated materials and the installation of trench breakers at the edge of waterbodies, in wetlands, and in any other areas where the trench would be below the water table would prevent groundwater migration along the pipeline. We do not anticipate any long-term water table changes or changes/impediments on groundwater flow as a result of pipeline construction or operation.

Oregon LNG does not anticipate using blasting for construction of this project; however, should blasting be required, it would implement its blasting plan. Potential effects related to blasting include temporary and localized impacts on wells and springs. The measures that Oregon LNG would implement to mitigate impacts from blasting are described in section 4.1.1.2.

We received comments expressing concern about impacts on water supply wells and springs. Oregon LNG would monitor any private or domestic water wells that are within 150 feet of the construction right-of-way during construction, and inspect these wells for water quality and flow characteristics both before and after construction, as allowed by the landowner. If adverse effects on a

groundwater supply occur that are shown to be a result of construction activity, Oregon LNG would provide a temporary source of water to those affected and would compensate for damages or repair the water supply.

To address the concerns of well owners and avoid or minimize impacts on water supply wells and springs, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, the following:**
  - **a. final field-verified list of all water wells and springs used for water supply within 150 feet of the construction right-of-way, including the distance from the construction right-of-way;**
  - **b. measures for marking and protecting any water supply wells within or immediately adjacent to the construction right-of-way; and**
  - **c. details of preconstruction and post-construction well monitoring such as timing and parameters.**

Compressor Station and Other Aboveground Facilities

Data provided by OWRD and ODEQ indicate that no water wells, wellhead protection areas, or source water protection areas are present within 150 feet of the proposed compressor station. In general, impacts on groundwater resources from construction and operation of the compressor station and other aboveground facilities associated with the pipeline would be similar to those described above for the LNG terminal. In particular, construction of those facilities may alter localized shallow groundwater infiltration due to soil compaction and new impervious surfaces, and potential hazardous material spills could occur. However, we expect these impacts would be localized and minor, and would be minimized by Oregon LNG's implementation of its Plan, Procedures, and SPCC Plan.

Overall, we expect shallow groundwater impacts from construction of the project to be minor, temporary, and minimized through best management practices, such as the measures in Oregon LNG's Plan, Procedures, and SPCC Plan. Groundwater impacts during operation of the project would not be significant.

4.1.3.2 Surface Waters

Surface Water Regulations and Standards

The water resource permits required for construction and operation of the proposed project are discussed in section 1.5.1.

Construction of project facilities that affect waters of the United States would be regulated by the USACE under the RHA and CWA. Section 10 of the RHA prohibits the creation of any obstruction to the navigable capacity of any waters of the United States without specific approval of the USACE. The modification or crossing of levees and/or dikes is addressed under 33 U.S.C. 408. Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the United States.

In addition to the USACE permitting requirements, Oregon LNG's proposed pipeline installation, terminal development, and dredging activities would need to comply with Section 401 of the CWA. Oregon LNG would be required to obtain a Section 401 water quality certification demonstrating that the

discharges associated with the project comply with federal and state water quality standards. The ODEQ is responsible for Section 401 water quality certifications in Oregon and WA Ecology is responsible in Washington.

The states of Oregon and Washington identify receiving waterbodies as water quality limited through a state biennial assessment report, as required by Section 305(b) of the CWA. Section 303(d) of the CWA requires that states (e.g., ODEQ and WA Ecology) periodically prepare a list of all surface waters in the state for which beneficial uses, such as drinking, recreation, aquatic habitat, and industrial use are impaired by pollutants. The most recent list approved by the EPA for Oregon was in 2010 (ODEQ, 2012) and for Washington was in 2012 (WA Ecology, 2013).

Terminal

Existing Surface Water Resources

The terminal would be on the Columbia and Skipanon Rivers. The Columbia River is the largest river in the United States to enter the Pacific Ocean and has a drainage basin of about 258,000 square miles that includes portions of four states and Canada (Tetra Tech, 1992). The Skipanon River is approximately 6 miles long and has a drainage basin of 18,000 acres. The terminal would be in the Columbia River estuary where the channel is over 4 miles wide and river flows are influenced by tides and salt water intrusions. Upstream dams regulate the flows of the Columbia River, but overall there is a general pattern of low flows during the winter months and sustained, high flows during the spring and early summer. Beneficial uses for the waterbodies within the lower Columbia River watershed and Skipanon River watershed include public water supply, salmonid fish spawning, private domestic water supply, resident fish and aquatic life, industrial water supply, wildlife and hunting, irrigation, fishing, livestock watering, boating, anadromous fish passage, water contact recreation, salmonid fish rearing, and aesthetic quality. Estuaries within the lower Columbia have all the same uses as freshwater except public water supply and private domestic water supply, irrigation, and livestock watering.

Water quality is impaired in the Lower Columbia River because of exceedances of criteria for nutrients (nitrogen and phosphorus), bacteria, polychlorinated biphenyls (PCBs), and arsenic, and water temperature (E&S Environmental Chemistry, Inc. and Youngs Bay Watershed Council, 2000; ODEQ, 2012). Temperature may also be a problem during summer months in the lower reaches of the waterbodies near the mouth of the Columbia River. Water quality is impaired in the Skipanon River because of exceedances of criteria for dissolved oxygen and bacteria (E. coli/fecal coliform) (ODEQ, 2012). Based on preliminary data, moderate impairment in temperature is present for the lower reaches of the Youngs River during summer months. However, Youngs River and Youngs Bay are not currently 303(d) listed waterbodies (ODEQ, 2012).

Surface Water Impacts and Mitigation

Activities associated with construction and operation of the terminal that would affect surface water resources include dredging of the ship berth and maneuvering area, dredged material placement, water appropriation and discharge, site grading and creation of impermeable surfaces, access road construction, and potential spills or leaks of fuels and hazardous materials. Impacts on surface water resources could also result from activities associated with operation of the LNG marine carriers, including cooling and ballast water intake and discharge, accidental spills of fuels, accidental or emergency discharges of sewage, grey water or garbage from ships, ship wakes, and propeller wash. All in-water construction activity at the terminal would occur within Oregon boundaries. Impacts and mitigation associated with each of these activities is described below.

Dredging of the Ship Berth and Maneuvering Area

To create the berthing area and turning basin, Oregon LNG would dredge to depths of -48 and -43 feet MLLW, respectively, with 2 additional feet allowed for overdredging in both cases. A total of 1.2 million cubic yards of sediment would be dredged.

Oregon LNG proposes to use a hopper dredge for the berth and turning basin. Hopper dredges generally do not produce large amounts of turbidity because of the suction action of the dredge pump and the fact that the drag-arm is buried in the sediment. Because the sediments at the terminal were determined by analysis to be 99 percent sand, the downstream release of fine sediment would be very small, ranging from near 0 milligrams per liter (mg/L) to less than 1 mg/L, far lower than the natural turbidity in the area.

In addition to the initial dredging, future maintenance dredging would be required over the expected life of the terminal. The frequency and quantities of required maintenance dredging would depend primarily on the magnitude and rate of sediment deposition in the berthing and turning basin areas. Oregon LNG estimates that maintenance dredging would be conducted once every 3 years, with an estimated volume of approximately 200,000 to 300,000 cubic yards per maintenance cycle. Oregon LNG conducted a hydrodynamic and sediment transport modeling study for the turning basin (Coast and Harbor Engineering, 2009) and found that, once complete, the proposed modifications would have only a small and localized effect on current velocities and suspended sediment.

In 2007 and 2008, Oregon LNG conducted sampling of the sediment in the area to be dredged for chemical analysis in accordance with guidance from the USACE's Regional Sediment Evaluation Team and its interim final guidelines, *Sediment Evaluation Framework for the Pacific Northwest* (USACE et al., 2006), for the Lower Columbia River Management Area. Tested contaminants of concern included butyltins, selected trace metals, organochlorine pesticides, PCBs, phthalates, phenols, and miscellaneous semi-volatile organic compounds, including polyaromatic hydrocarbons (PAH). Evaluation of the chemical data indicated no exceedances of the sediment quality guidelines for any of the individual analyses. Because the results were below screening levels, biological testing of sediment samples and sediment elutriate were not required, per the sediment evaluation guidelines.

In 2013, the Portland Sediment Evaluation Team; which includes the USACE, EPA, NMFS, FWS, ODEQ, and WA Ecology; reviewed the Oregon LNG sediment test results. The team recommended that because samples were collected in May 2008, the dredge prism would need to be reevaluated by May 2015 if initial dredging has not been completed (USACE et al., 2013). While we are not aware of any point sources providing contaminants in the project area, given these surveys are now over 5 years old, we agree with the evaluation team's conclusion. Therefore, **we recommend that:**

- **<u>Prior to the close of the draft EIS comment period,</u> Oregon LNG should prepare a plan for reevaluating the sediments within the dredge prism in consultation with the Portland Sediment Evaluation Team, and file the plan with the Secretary.**

Dredged Material Placement

The sediments in the turning basin and berth area consist mostly of fine to medium sand that is suitable for open water disposal. Dredged material placement would create temporary increases in turbidity at the Deepwater Site disposal location but the sand would settle fairly rapidly. Section 2.1.1.1 describes the Deepwater Site in further detail and sections 4.1.5.2 and 4.1.5.3 include further discussion of the effects of dredged material disposal on water quality at this location.

Stormwater Runoff

Stormwater runoff during construction can transport pollutants and sediment from the construction site and staging areas to nearby surface waters. Soil compaction from heavy equipment operations can result in an increase in runoff due to reduced infiltration. Potential contaminants from construction equipment include petroleum products, heavy metals, and hazardous materials. Efforts to minimize effects associated with stormwater runoff during construction of the terminal, are discussed in detail in the SWPPP, which also contains an Erosion Prevention and Sediment Control Plan and the SPCC Plan (see appendix F1). Examples of these measures include fuels and hazardous materials handling procedures, erosion prevention using mulch or plastic sheeting, and sediment control using sediment fences or check dams.

During terminal operation, stormwater that falls onto impervious surfaces at the terminal would be conveyed to the stormwater treatment system, which would consist of a 4,000-gpm stormwater oily water separator system. The treated water would then be used as makeup water for the cooling tower. When the volume of the treated water exceeds what is needed for cooling, the excess would be discharged to the POTW outfall. Stormwater from nonprocess areas of the terminal within the berm would be routed directly to the raw water storage tank, collected in the wastewater sump, and then pumped to the POTW outfall.

Water Use and Discharge

During scoping, several comments were received related to the quantity of surface water needed for construction and operation of the project. Oregon LNG estimates that about 161 million gallons of water would be needed for terminal construction activities, as detailed in table 4.1.3-3.

The majority of the water needed for construction would come from the City of Warrenton. Where needed, Oregon LNG would apply for a Limited Water Use License from OWRD. Oregon LNG has applied for water rights from OWRD to use up to 3,280 million gallons of water annually from the Columbia River during terminal operations.

Table 4.1.3-3

Water Needs for Construction of the Terminal

Use	Water Source	Water Demand (million gallons)	Discharge Location
Terminal Construction		**(total)**	
Hydrostatic Testing—LNG Tanks	City of Warrenton	35.0	Hold some in raw water storage tanks and discharge rest to POTW
Soil Improvements	City of Warrenton	55.7	Land Applied
General Cleaning, Toilet Use, Drinking Water	City of Warrenton	23.5	City sanitary sewer system
Concrete Structures	City of Warrenton/Columbia River	30.9	Not applicable
Firewater Loop	Skipanon River (Nonconsumptive use)	0.2	Skipanon River
Dust Control	City of Warrenton/Columbia River	2.9	Land Applied
Road Building	City of Warrenton/Columbia River	5.0	Land Applied
Utility Trenches	City of Warrenton/Columbia River	2.3	Land Applied
Compaction of Fill	City of Warrenton/Columbia River	4.6	Land Applied
Pump Test	Columbia River	1.4	Columbia River
Total		**161.5**	

Table 4.1.3-3

Water Needs for Construction of the Terminal

Use	Water Source	Water Demand (million gallons)	Discharge Location
Terminal Operations		**(per year)**	
Cooling Water, Pretreatment	Columbia River	2,628.0	Columbia River via POTW
Domestic Facility Needs	City of Warrenton	5.7	Sanitary Sewer
Fire Suppression Testing	Skipanon River	1.7	Skipanon River
Reclaimed Water Credit	POTW	-334	
Total Annual Water Use		2,301.4	

Potable water for the terminal would be supplied by the City of Warrenton water system through a new 10-inch-diameter potable water pipeline, which would connect to an existing 18-inch-diameter potable water pipeline.

During operations the largest water use would be cooling water and make-up for the cooling water tanks. A portion of the 2.6 billion gallons of process cooling water needed annually would be supplied by treated stormwater (when available) and effluent from Warrenton's POTW. The majority of the water would come from the Columbia River with water from Warrenton's municipal water supply only when available. Domestic water use at the terminal would account for about 5.7 million gallons of water a year. Domestic water use includes toilets, drinking water, and landscape irrigation. This water would come from the Warrenton municipal water supply.

Oregon LNG would collect sanitary wastewater from the terminal in building sumps and pump it to the City of Warrenton's sewage system at a maximum rate of 61 gpm via a 3-inch-diameter pipeline routed within the access road right-of-way. The pipeline would be about 4,000 feet in length and connect to an existing city sewer main in East Harbor Street. Oregon LNG would construct the pipeline and would be responsible for operation and maintenance of the pipeline and pump system.

As described in section 2.1.1.1, the terminal fire protection system would use water from the Skipanon River. About 1.7 million gallons per year of river water would be required for weekly and annual testing of the deluge fire suppression system. The test water would be withdrawn from the Skipanon River via a screened intake about 200 feet from the riverbank, outside the navigation channel. The screen would be supported by a pile, with the top of the screen set about one foot below the lowest water elevation on record. The approximate location is shown in figure 2.1.1-3. Testing of the deluge fire suppression system is a nonconsumptive use of water, as all water would be returned to the river. The intake structure would also serve as the water outlet following testing. Because the water would simply be re-circulated through the piping over the course of 30 minutes weekly and once per year for 2 hours, we would not anticipate any temperature increases or introduction of contaminants. Oregon LNG would obtain a surface water appropriation permit from the OWRD and screen the intakes to meet NMFS and ODFW fish screening criteria.

Accidental Spills and/or Leaks of Hazardous Materials

During terminal construction, accidental spills and leaks of hazardous materials could have an adverse impact on surface water quality. Implementation of Oregon LNG's SPCC Plan would help prevent spills and should a leak or spill occur, minimize the potential for contaminants to reach surface waters.

Fuel (e.g., diesel) used for vessel propulsion or auxiliary/emergency generators on an LNG marine carrier could potentially spill or leak. However, fuel on each carrier is protected by the vessel's double hull. Furthermore, each LNG marine carrier would maintain a Shipboard Oil Pollution Emergency Plan (SOPEP) as required by international convention. The SOPEP would comply with MARPOL (International Convention for the Prevention of Pollution from Ships) 73/78 Consolidated Edition 2002 Annex 1 Regulation 26, which requires every oil tanker of 150 tons gross and above, and every vessel of 400 tons gross and above to carry an approved SOPEP. All LNG marine carriers would also be required to comply with state spill prevention and contingency plans, including the applicable requirements in Chapter 317-40 of the WAC – Bunkering Operations.

In the event that LNG is spilled into the water from an accidental or intentional breach of an LNG marine carrier during transit, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Being less dense than water, LNG would float on the surface before vaporizing. Because LNG would not be soluble in water and would completely vaporize shortly after being spilled, the LNG would not mix with or contaminate the water.

LNG marine carriers would be prohibited from discharging sewage, grey water or garbage within 1 nautical mile of shore under CWA or MARPOL regulations, depending on the vessel registration or county of origin. However, emergency or accidental discharges could occur. These discharges would not be expected at a higher rate than other commercial vessels which already travel through the area. The anticipated increase in vessel traffic would be about 125 vessels per year which represents a 3 to 4 percent increase over existing traffic. The ODEQ has concluded that the risk for environmental harm from passenger vessel discharges is low (ODEQ, 2011). Therefore we conclude the risk from LNG marine carriers would also be low, particularly given that the LNG marine carriers would have fewer people on board compared to the large passenger vessels analyzed by the ODEQ.

Shoreline Erosion and Propeller Wash from LNG Ships and Tugs

During scoping, concern was expressed about potential impacts on aquatic habitats through alterations of nearshore environments at the terminal. Modifications to aquatic habitats, such as decreases in wetlands, shoreline erosion, or scouring, could cause adverse impacts on water quality. Based on the anticipated activities during terminal construction and operation, Oregon LNG does not propose any special shoreline stabilization measures, such as hard armoring of the shoreline. Berm construction and maintenance would occur above the high tide elevation, and site rehabilitation measures for temporary impacts generally would occur away from the shoreline environment. The berm design would accommodate the expected rise in sea level due to climate change.

In the terminal area, LNG vessels would move relatively slowly under limited maneuvering power with tug assist and the terminal dock is almost 2,000 feet from shore. Therefore, we conclude it is unlikely that nearshore and shoreline habitats would be detrimentally affected by LNG marine carrier movements.

Oregon LNG has committed to monitor the shoreline for the first five LNG marine carrier shipments and thereafter at least once every 90 days (quarterly) during operations for signs of erosion. Should the monitoring determine that potentially damaging erosion is occurring as a result of operations and that stabilization measures would reduce erosion potential, Oregon LNG would implement appropriate protective measures pursuant to federal and state removal/fill approvals. Protective measures would include soft armoring techniques, such as vegetation and brush layering, as an adaptive management strategy.

Ship Ballast and Cooling Water Withdrawals

Ballast and cooling water systems vary between vessels, including vessels of similar size and capacity. In general, most of the LNG marine carriers in the world are under 150,000 m^3 and steam-powered, while many of the newer ships with capacities greater than 150,000 m^3 are diesel-powered. The expected annual water requirements for LNG marine carriers are summarized in table 4.1.3-4 and discussed in more detail below.

The majority of vessels that would dock at the facility are export vessels that are not expected to take on ballast water during the loading process. The small number of import vessels that would dock at the facility would take on ballast water during unloading to offset the tonnage lost and to correct for any trim, list, or structural considerations. The intake of ballast water is necessary to maintain safe operations and provide a constant freeboard between the vessel and marine terminal.

Whether loading or unloading, the LNG marine carriers would take on water for cooling engines while docked at the terminal. Diesel- and steam-powered vessels differ in the amount of cooling water required. A steam-powered vessel requires a large quantity of water to cool the condensers, even while the vessel is docked, because the vessel is still producing steam while docked. Cooling water is also required for the ship's equipment (e.g., generators), but at a much lower flow rate. A diesel-powered ship requires cooling water primarily for the ship's equipment, and the quantity of seawater required is substantially less for larger diesel-powered ships. The cooling water system operates independently of the ballast water system; however, the cooling water system can, and sometimes does, utilize the same seawater intakes as the ballast water system.

Table 4.1.3-4

LNG Marine Carrier Ballast and Cooling Water Requirements

Annual Number of LNG Marine Carriers Anticipated at Terminal	LNG Marine Carrier Class (m^3)	Ballast Water Flow (m^3/hour)	Cooling Water Flow (m^3/hour)	Time at Terminal for Ballast/Cooling Water (hours)	Annual Total Ballast Water Intake (MG) [a]	Annual Total Cooling Water (MG)	Annual Total Water Requirement (MG)
50: Export	148,000	0	2,478	0/21	0	6.9	6.9
75: Export	173,000	0	2,040	0/21	0	8.5	8.5
2: Import	173,000	6,600	2,040	15/21	52.3	0.2	0.8
Annual Total Water Use					**52.3**	**15.6**	**16.2**

[a] MG = million gallons

A typical steam-powered vessel uses a large pump rated at 10,000 m^3/hour for the main condenser cooling water and a smaller pump rated at 3,000 m^3/hour for the ship's equipment. The total flow that is actually used is normally less than the maximum capacity of the pumps.

Cooling water intake and discharge scenarios for the classes of LNG marine carriers that would be docked at the terminal are summarized as follows:

- **148,000 m^3 LNG Marine Carrier**—2,478 m^3/hour cooling water flow rate; discharge water temperature 44°F greater than intake water temperature; and
- **173,000 m^3 LNG Marine Carrier**—2,040 m^3/hour cooling water flow rate; discharge water temperature C 48°F greater than intake water temperature.

Cooling water would be discharged at a horizontal angle orthogonal to ambient currents from a 1.5-foot-diameter port at a depth of 20 feet. Oregon LNG conducted water temperature and diffusion modeling to assess the potential effects of cooling water discharge (CH2M HILL, 2008). On the basis of this modeling, the worst-case scenario for mixing to 0.25°F above ambient would be a mixing zone extending 68.8 feet from the discharge point to a maximum depth of approximately 19.7 feet below the discharge point. Presuming discharge ports could be on both sides of the LNG marine carriers, the plume could extend either toward or away from shore. This would result in a thermal plume occupying from 0.26 to 0.36 percent of the total cross-sectional area of the Columbia River.

Considering the volume of water in the Columbia River estuary and tidal mixing, the discharge of cooling water from LNG marine carriers would not sustainably increase the water temperatures of the Columbia River. However, the lower Columbia River is on Oregon's 303(d) list of impaired waterbodies for temperature. The water quality standards section on the implementation of the temperature criteria and human use allowance for insignificant additions of heat to waterbodies (OAR 340-041-0028(12)) restricts a single NPDES point source that discharges into temperature water quality limited waters. The discharge may not cause the temperature of the waterbody to increase more than 0.5 °F above the applicable criteria after mixing with a maximum of either 25 percent of the stream flow, or the temperature mixing zone, whichever is more restrictive.

Assuming the LNG marine carrier discharge of cooling water would be treated as an NPDES point source, then the cooling water discharge would not be allowed to cause the temperature of the waterbody to increase more than 0.5 °F at the boundary of a defined temperature mixing zone (if a zone is defined).

In addition, Oregon has antidegradation policy guidance: Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and Section 401 Water Quality Certifications (ODEQ, 2001). This antidegradation policy provides direction for permit approval of thermal sources into water quality limited waters (WQLW). The antidegradation policy directive states that for WQLWs that are limited for temperature, a surface water temperature management plan must be developed and implemented if the proposed discharge would increase temperature by 0.25 °F or more outside of a mixing zone. However, the ODEQ may be petitioned for an exception if the following stipulations are met (see OAR 340-041-0026(3)(a)(D)-(H)):

- demonstrates that the discharge would result in less than 1.0 °F increase at the edge of the mixing zone;
- provides the necessary scientific information describing how no designated beneficial uses would be adversely impacted; and
- demonstrates that it is implementing all reasonable management practices, its activity would not affect beneficial uses, and the environmental cost of treating the parameter to the level necessary to ensure full protection would outweigh the risk to the resource.

Based on the information provided by Oregon LNG, we conclude that LNG marine carrier cooling water discharge would likely comply with Oregon's antidegradation guidance; however, ODEQ would make its own determination on whether or not to grant a permit.

Pipeline and Associated Facilities

Existing Surface Water Resources

The pipeline would cross four major watersheds, defined by 4th Field Hydrologic Unit Codes, in the project area. These watersheds are Lower Columbia, Lower Columbia-Clatskanie, Lower Willamette, and Nehalem. Existing water quality in the watersheds traversed by the pipeline is good overall. However, several waterbodies have impairments in water quality based on seasonal and year-round variations in pH, temperature, dissolved oxygen, mercury, chlorophyll A (total phosphorous) and toxins (iron, manganese, and arsenic). Beneficial use of the surface water sources include public domestic water supply, salmonid fish spawning, private domestic water supply, resident fish and aquatic life, industrial water supply, wildlife and hunting, irrigation, fishing, livestock watering, boating, anadromous fish passage, water contact recreation, salmonid fish rearing, and aesthetic quality (ODEQ, 2004).

Appendix G1 contains a listing of all the waterbodies that would be crossed by the pipeline and Oregon LNG's proposed crossing methods. Table 4.1.3-5 shows the main 303(d)-listed waters that would be crossed by the pipeline. No surface water intakes for public water supply would be located within 3 miles downstream of any waterbody crossings.

Table 4.1.3-5

303(d) Waterbodies Crossed by the Oregon LNG Pipeline [a]

Name	MP	County	Status [b]	Beneficial Uses [c]	Affected Section (RM)	Reason	Seasonal Impairment
Lewis and Clark River	3.1 and 5.5	Clatsop	303 (d)	SG	0.0 to 8.5	Fecal Coliform	Year-round
Lewis and Clark River	11.1	Clatsop	303 (d)	AE, LW, WCR, DW, FSH	10.8 to 27.5	Chlorophyll A	Summer
Nehalem River	33.5	Clatsop	303 (d)	WCR	14.7 to 92.4	Fecal Coliform	Fall-Winter-Spring
South Fork Rock Creek	43.1	Clatsop	303 (d)	SFR, AFP	0.0 to 4.3	Temperature	Summer
Columbia River	81.8	Columbia	303 (d)	FA, DW, AFP, SFM	35.2 to 98.0 0 to 306.1	Dioxins, arsenic, lead, mercury temperature	Year-round

[a] Upstream tributaries of affected waterbody sections classified as Category 4 and 5 (303(d)) streams are not included in this table. Appendix G3 provides a complete listing of classification for tributaries of water quality limited streams.

[b] Status as listed in the ODEQ Oregon Water Quality Assessment Database (ODEQ, 2012: Category 5 – 303(d), total maximum daily load (TMDL) needed Category 4A – TMDL approved, Category 4C – water quality limited, no TMDL required.

[c] Beneficial Use: Aesthetics (AE); Anadromous Fish Passage (AFP), Domestic Water Supply (DW), Fish and Aquatic Life (FA), Livestock Watering (LW), Salmonid Fish Rearing (SFR), Wildlife Fishing and Hunting (FSH), Water Contact Recreation (WCR).

No federally designated Wild and Scenic Rivers or state-designated State Scenic Waterways would be crossed by the pipeline. Based on available information from the ODEQ and WA Ecology, no state-designated "outstanding resources waters" are in the project area.

Eleven dikes would be crossed by the pipeline and are listed in table 4.1.3-6.

Table 4.1.3-6

Flood Control Dikes Crossed by the Oregon LNG Pipeline

Dike Location	Pipeline Milepost	County	Ownership	Diking District	Crossing Method
Skipanon Peninsula at Youngs Bay	0.1	Clatsop County, OR	Port of Astoria	City of Warrenton Diking District 2	HDD
Skipanon Peninsula at Youngs Bay	0.4	Clatsop County, OR	Port of Astoria	City of Warrenton Diking District 2	HDD
Skipanon Peninsula – East of Highway 101	0.9	Clatsop County, OR	Steadfast LLC	City of Warrenton Diking District 2	HDD
West of Lewis and Clark River and East of Warrenton Astoria Highway	2.9	Clatsop County, OR	private	Clatsop County Diking Districts 11 and 5	HDD
East of Lewis and Clark River	3.3	Clatsop County, OR	private	Clatsop County Diking Districts 11 and 5	HDD
East of Lewis and Clark River	5.2	Clatsop County, OR	Clatsop County	Clatsop Diking District 8	HDD
East of Lewis and Clark River	5.3	Clatsop County, OR	private	Clatsop Diking District 8	HDD
East of Lewis and Clark River	5.7	Clatsop County, OR	private	Clatsop Diking District 8	HDD
West of Lewis and Clark River	5.8	Clatsop County, OR	private	Clatsop Diking District 8	HDD
Deer Island – West of Columbia River	81.7	Columbia, County, OR	Dyno Nobel, Inc.	Deer Island Drainage District	Cross Over and Build Up Levee [a]
Dike Access Road – East of Columbia River	82.9	Cowlitz County, WA	Cowlitz County CDID #2	Cowlitz County Consolidated Diking Improvement District 2	Bore

[a] The pipeline would cross over the existing dike on Deer Island and fill would be placed to provide the required cover over the pipeline and increase the height and width of the dike.

Surface Water Impacts and Mitigation

Several comments received during the scoping process expressed concerns relevant to water resources regarding pollution, sedimentation, and construction impacts. Activities associated with the pipeline route that could affect surface water resources include waterbody crossings, water appropriation and discharge associated with hydrostatic testing and HDD crossings, vegetation clearing, stormwater runoff, accidental spills of fuels or hazardous materials, and operation and maintenance of the pipeline.

Waterbody Crossings—General

As discussed in section 1.5, before beginning flume and open-cut waterbody crossings, Oregon LNG would need to obtain an ODSL Removal-Fill Permit, as well as comply with Sections 401 and 404 of the CWA administered by the USACE.

The pipeline would cross 184 waterbodies including 96 perennial, 87 intermittent, and 1 classified by Oregon LNG as perennial/intermittent. These numbers include crossings of the same waterbody at multiple locations. A description of waterbody crossing methods is included in section 2.1.4.2. Specific descriptions of impact locations for major waterbody crossing are below. A summary of waterbody crossings, including type of stream, width of crossing, water quality classification, fishery type, and crossing method is provided in appendix G1.

Scoping comments expressed concerns regarding effects of the project on waterbody channels, including channel migration, erosion, and sedimentation. A concern was also raised in agency comments that clearing riparian vegetation could cause an increase in surface water temperatures, and that issue is addressed in section 4.1.5.2.

Waterbody crossings could affect surface waters in several ways. Clearing and grading of stream banks, instream trenching, trench dewatering, and backfilling could result in modification of aquatic habitat, increased sedimentation, turbidity, decreased dissolved oxygen concentrations, and introduction of chemical contaminants such as fuel and lubricants (Reid and Anderson, 1999). Oregon LNG would mitigate these short-term, construction related impacts by implementing its SWPPP, Procedures, and by following conditions of applicable ODEQ NPDES permit or 1200-C permits. Oregon LNG would also implement streambank and streambed restoration measures. Following construction, waterbody crossings would be restored to preconstruction contours and elevations, and streambanks would be revegetated to prevent or minimize erosion.

Oregon LNG would avoid in-channel disturbance at 20 waterbodies crossed by 11 HDDs. Other waterbodies would be crossing using flume or open-cut methods. In-channel excavation for pipeline placement and subsequent backfilling and restoration could simplify habitat, remove important spawning gravel, or disconnect the stream from its floodplain. Conceivably, these localized impacts could propagate upstream, downstream, or laterally into the floodplain (Castro et al., 2014) and hinder the stream's ability to naturally adjust laterally or vertically overtime to changing flow, sediment, and vegetation conditions (Skidmore et al., 2011). Thus, disruption to habitat forming processes could cause long-term impacts at or near the proposed waterbody crossings. To minimize the risk of the pipeline interfering with natural geomorphic processes, Oregon LNG would bury the pipeline at least 3 feet below the maximum scour depth for the width of the channel migration zone (see discussion of Oregon LNG's scour analysis below). Buried at this depth, the pipeline would be outside the areas where waterbodies could vertically and laterally adjust.

The method for crossing each waterbody (as listed in the waterbody crossing table in appendix G1) was determined in part based on the expected width and condition of the waterbody at the time of construction. Oregon LNG also obtained input from state and federal agencies. In general, Oregon LNG would construct waterbody crossings so they are as perpendicular to the axis of the waterbody channel as engineering and routing conditions allow. Additionally, Oregon LNG would reduce the amount of clearing on streambanks as necessary, maintain ambient downstream flow rates, and limit the amount of equipment and activities in waterbodies as necessary to construct the crossing. Crossing methods would be in accordance with ORS 509.580 through ORS 910 and approved by ODFW prior to construction.

Oregon LNG would cross intermittent and ephemeral waterbodies that are dry at the time of crossing using conventional upland construction techniques. Flowing waterbodies would be crossed using the most practical techniques identified based on the condition of the waterbody at the time of construction and in compliance with regulatory permits and approvals. Waterbody crossing construction methods are described in detail in section 2.1.4.2. Oregon LNG would schedule construction activities so the proposed pipeline trench is excavated immediately prior to pipeline-laying activities. For open-cut waterbodies, the duration of construction would be limited to 24 hours across minor waterbodies (10 feet wide or less) and 48 hours across intermediate waterbodies (between 10 and 100 feet wide). Oregon LNG would stockpile excavated in-stream spoils at least 10 feet from the edge of the waterbody and install appropriate erosion control devices.

Construction of the pipeline would generally result in temporary impacts, the magnitude of which would be reduced through mitigation measures. Examples of mitigation measures Oregon LNG would implement include placing spoil at least 25 feet from the water's edge or in additional temporary workspaces and using sediment barriers to prevent the flow of spoil or heavily silt-laden water into any waterbody. Climate change is predicted to increase extreme precipitation events which could increase runoff and the velocity and energy in streamflows. This could increase the risk of scouring and erosion of

streambeds. Oregon LNG has committed to burying the pipeline under streams at a depth that would minimized the risk of exposing the pipe in the event of streambed scouring or channel migration.

Oregon LNG conducted additional geomorphic analysis to evaluate the risk of channel response at crossing locations of waterbodies that support federally listed fish species under the ESA (see appendix F of Oregon LNG's Conceptual Mitigation Plan in F3). By comparing channel gradient, channel confinement, and valley width, waterbodies were ranked on relative potential for vertical channel scour and lateral channel migration (see table 4.1.3-7). Over half of these streams are predicted to have no vertical scour potential as they are low gradient, unconfined streams that typically associated with fine sediment deposition rather than scour. The others have a slight to moderate potential vertical scour potential, and one waterbody (Little Clatskanie River) has a higher risk ranking of moderate to severe potential. To account for the greater scour potential at moderate or severe ranked crossings, Oregon LNG would bury the pipeline at least 5 feet below the predicted vertical scour elevation, which is 2 feet greater than typical waterbody crossings. Oregon LNG would determine the specific depth that would be required at such crossings on a site-specific basis, which would require additional detailed information on substrate characteristics, expected peak flow conditions, local bed slope, and upstream and downstream conditions. Oregon LNG would acquire these data prior to final design of the high-risk crossings.

Table 4.1.3-7

Vertical Scour and Lateral Channel Migration Potential at Waterbody Crossings that Support Federally Listed Fish

MP	Waterbody	Crossing Method	OHW Width (feet)	Valley Width (feet)	Channel Confinement	Gradient (percent)	Vertical Scour Potential	Lateral Channel Migration Potential
1.0	Adair Slough	HDD	110	5,258	Unconfined	<1	None	Slight
1.5	Vera Creek	Flume	20	4,960	Unconfined	<1	None	Slight
3.1	Lewis and Clark River	HDD	1250	5,808	Unconfined	<1	None	Slight
4.5	Barrett Slough	Flume	12	3,844	Unconfined	<1	None	Slight
5.7	Lewis and Clark River	HDD	340	2,261	Unconfined	<1	None	Slight
7.9	Heckard Creek	Flume	10	1,139	Unconfined	<1	None	Slight
11.0	Lewis and Clark River	HDD	35	1,365	Unconfined	<1	None	Slight
25.4	Little Fishhawk River	Flume	15	104	Unconfined	<1	None	Slight
31.4	Alder Creek	Open cut	15	421	Unconfined	3.6	Moderate	Severe
33.5	Nehalem River	HDD	120	3,601	Moderately confined	<1	None	Slight
41.0	Rock Creek	HDD	20	470	Unconfined	2.2	Moderate	Severe
43.1	South Fork Rock Creek	Flume	15	2,302	Unconfined	3.0	Moderate	Severe
47.5	Bear Creek	HDD	12	436	Unconfined	2.3	Moderate	Severe
50.5	North Fork Wolf Creek	Flume	30	143	Unconfined	1.0	Slight	Moderate
50.5	Clear Creek	Flume	30	780	Unconfined	2.1	Moderate	Severe
55.7	Cedar Creek	Flume	10	976	Unconfined	1.6	Slight	Moderate
57.7	Rock Creek	HDD	30	1,157	Unconfined	<1	None	Slight
63.8	Nehalem River	HDD	30	113	Moderately confined	<1	None	Slight
70.7	Clatskanie River	Open cut	19	219	Unconfined	<1	None	Slight
71.8	Little Clatskanie River	Open cut	2	244	Unconfined	4	Moderate/Severe	None
73.0	Milton Creek	Open cut	12	317	Unconfined	3.2	Moderate	Severe
76.4	Merril Creek	Open cut	1	376	Unconfined	1.1	Slight	Moderate
81.6	Deer Island Slough	Flume	38	780	Unconfined	2.1	Moderate	Severe
82.4	Columbia River	HDD	3,300	5,637	Unconfined	<1	None	Slight

To prevent exposure of the buried pipeline from bank erosion and channel migration, Oregon LNG would extend the minimum 3-foot crossing depth (or greater for waterbodies with moderate or high risk scour potential) for 2.2 times the waterbody channel width for all open-cut and flumed waterbody crossings with a gradient of less than 4 percent. According to the WDNR Watershed Assessment Methodology Channel Response Matrix (CH2M HILL, 2014) and Rosgen (1996) only waterbodies with gradients of less than 4 percent have the potential for significant lateral scouring at the reach level, and the spacing of 2.2 channel widths is representative of the greatest channel meander that could occur at such waterbodies. Streams with a greater than 4 percent gradient have no functional floodplain and therefore have no, or little, potential for lateral channel migration at the reach scale. Appendix G3 includes site specific waterbody crossing drawings for the waterbodies listed in the table above, and appendix F3 contains drawings of typical minor waterbodies.

Vertical scour or lateral channel potential for crossings of intermittent or ephemeral waterbodies was not evaluated because these waterbodies have a lower likelihood of deep scour as they convey less water. Ephemeral drainages usually do not have a well-defined channel and may be vegetated. Therefore, ephemeral waterbodies are not considered to have vertical or lateral scour potential. Most of the minor waterbodies surveyed by Oregon LNG (a large portion remain unsurveyed due to access issues) have gradients greater than 4 percent, and therefore are unlikely to exhibit lateral channel migration. Intermediate waterbodies crossed by the pipeline may still experience mass wasting events that could create deeper than normal scour but these types of events are infrequent and Oregon LNG would bury the pipeline at least 3 feet from the predicted maximum vertical scour depth (which considers mass wasting events). Considering Oregon LNG's proposal to bury the pipeline outside the potential zone for vertical or horizontal stream adjustment, we conclude that there would be a low probability of scour that could expose the pipeline.

During operation, Oregon LNG would inspect the pipeline regularly by aerial patrols or on-the-ground personnel to observe general right-of-way conditions and to identify any conditions that could present a safety hazard or require preventive maintenance or repairs. Should channel subsidence, bank erosion, channel scour, or other negative long-term effects of pipeline construction become apparent during post-construction monitoring, Oregon LNG would address issues using bioengineering, such as plantings or LWD placement, and only resort to bank or streambed hardening with rock as a last resort. Remedial actions requiring in-water work may require additional permits and associated agency consultation at that time.

Oregon LNG would cross waterbodies that support coldwater fisheries using dry crossing methods unless approved by the ODFW. The in-water work window is June 1 though September 30 for coldwater fisheries unless otherwise authorized or restricted by ODFW. Oregon LNG would adhere to the ODFW recommended in-water work windows unless extensions are approved by ODFW. Surface-water crossing methods for each waterbody were determined based on field surveys, review of fisheries data, and review of waterbody data. Where withdrawal of water is proposed, intake pipes would be screened to ODFW fish screening criteria. Appendix G3 provides site-specific waterbody crossing drawings, based on surveys completed by Oregon LNG, for intermediate and major - waterbodies that support federally listed fish.

Sensitive and Major Waterbody Crossings

With the exception of Deer Island Slough, all of the major waterbody (i.e., greater than 100 feet wide) crossings would be completed using HDD installation techniques, which are described in section 2.1.4.2. The HDD method would avoid direct disturbance to waterbodies, but has the potential to impact water quality in the event of an inadvertent release of drilling fluid. Drilling fluid typically consists of a

mixture of bentonite, water, and soil cuttings. This mixture would not be hazardous or toxic, but it could affect water quality by increasing turbidity if it were introduced to a waterbody. Inadvertent releases can occur at any place along any point of an HDD installation, although they are more likely to be observed at the entry and exit points (locations where the drilling head is shallow).

Oregon LNG's HDD inadvertent release contingency plan, which is contained in its SWPPP (see appendix F1) has several preventative measures to minimize impacts from a possible inadvertent release that would be implemented before drilling begins. HDD crossings would be conducted only during recommended in-water work periods to minimize impacts from potential releases of drilling fluid. Oregon LNG would use nontoxic bentonite-clay mixtures of drilling mud to ensure that, if an inadvertent release occurred, it would not result in toxicity to aquatic life in the stream.

Prior to drilling, Oregon LNG would define and flag the limits of the work areas, which would not exceed 10 feet on either side of the centerline of the proposed boring. Erosion and sediment controls (including silt fence, straw wattles, and temporary sediment trap) would be installed at the entrance/exit pits. As a contingency, Oregon LNG would keep additional materials to respond to an inadvertent release on-site at a designated location, and verify the presence of these materials prior to any drilling activities. These materials would include the following items:

- silt fence;
- straw wattles and bales;
- silt curtain (in-water work);
- submersible pumps and generator;
- specialized filters;
- appropriate hand tools;
- vacuum truck (available on call);
- light towers (for work at night);
- heavy equipment, such as backhoe or dozer, for containment and cleanup of drilling mud; and
- boat for major waterbody crossings to allow for monitoring of inadvertent releases to water.

Oregon LNG would develop more specific procedures during final design for each HDD location based on site-specific conditions.

Oregon LNG has performed preliminary geologic and geotechnical assessments to evaluate the feasibility of proposed HDD installations. At least one boring was advanced near seven of the eight HDD major waterbody crossings. A boring was not advanced near the Lewis and Clark River at MP 5.0 because Oregon LNG was unable to obtain access.

Major waterbody crossings are described below. Site-specific crossing plans are provided in G3 and include the planned depth of cover of the HDD.

Adair Slough

Adair Slough is a 110-foot wide waterbody that would be crossed at MP 1.0 as part of the HDD that would cross Hwy 101. Adair Slough contains federally listed species. The slough is tidally influenced and the ground on either side is rather flat. The HDD entry and three ATWS equaling about

1.7 acres would be west of Hwy 101. An ATWS associated with the exit HDD would be east of the slough. The proposed HDD would be about 1,480 feet in length.

Lewis and Clark River

The Lewis and Clark River contains federally listed species and would be crossed by HDD at four locations between MPs 3.0 and 11.0. The first crossing of the Lewis and Clark River would occur at MP 3.1 just south of Jeffers Slough. The river is 1,250 feet wide in this location. The HDD entry point would be in an agricultural field on the east side of the river. The exit point would be on the west side of the river in an area dominated by shrubby vegetation. The HDD would be about 2,970 feet in length.

The second and third crossings of the Lewis and Clark River would be at MPs 5.2 and 5.7. The river is about 340 feet wide in this area. The second crossing would only cross the edge of a bend in the river and would be 2,400 feet long. The entry point would be on the north bank of the river in an agricultural field. The exit point would be in another agricultural field on the same side of the river. Several ATWS equaling about 4.3 acres would be used for the exit points and pull back sections of both the second and third crossing of the Lewis and Clark River, which would be in the same vicinity. The third HDD would be about 2,100 feet long and cross the river. The entry point would be on the south offside of the river. Some clearing may be needed at ATWS.

The fourth crossing of the Lewis and Clark River would be at MP 11.0. The Lewis and Clark River is only 35 feet wide at this crossing location and the HDD length would be about 1,320 feet. The entry point would be in an agricultural field to the east of the river. The exit point would be in a field west of Lewis and Clark Road.

Oregon LNG has committed to obtaining additional geotechnical information at the Lewis and Clark River crossing sites and performing a thorough evaluation of potential inadvertent release of drilling fluid to the river. If an elevated potential for inadvertent release is determined to be present, possible mitigation measures could include additional active monitoring at the site, installation of casing from the surface to beyond the bottom of the stream, use of steeper entry and exit angles, and repositioning of the entry point to allow for more soil cover.

Nehalem River

The Nehalem River contains federally listed species and would be crossed twice by HDD. The first crossing would be at MP 33.5 where the river is 120 feet wide. The HDD entry point would be west of the river in a wooded area. The exit point would be east of the river in an open field. The HDD would be about 2,010 feet in length.

The second crossing of the Nehalem River would be at MP 63.8 where the river is 30 feet wide, but the HDD would also cross Hwy 47. The land in this area is wooded and managed for timber. The HDD entry point would be west of the river and the exit point on the east side. Trees would need to be cleared the exit and entry points. The HDD would be about 3,370 feet in length.

Rock Creek

Rock Creek contains federally listed species and would be crossed by HDD. The pipeline would cross Rock Creek that is about 50 feet wide and two associated side channels that form a braided network at MP 57.7. The HDD entry point would be northeast of the creek and just east of Keasey Road in a wooded area managed for timber. The exit point would be southwest of the creek, also in a timber management area. The HDD would be about 3,000 feet in length. We received a comment from the City of Vernonia expressing concerns about the pipeline crossing Rock Creek in close proximity to the water source for the city and potential impacts on water quality. The city's water intake is 5.4 miles

downstream of the closest pipeline crossing. Because the pipeline would cross Rock Creek by HDD, no impacts on water quality would be expected.

Deer Island Slough

The Deer Island Slough contains federally listed species and would be crossed at MP 81.6 where the slough is about 280 feet wide. Oregon LNG proposes to cross this waterbody by the flume technique.

Columbia River

The Columbia River contains federally listed species and would be crossed at MP 82.5 where the river is about 3,300 feet wide. The HDD entry point would be in a wooded area on the Oregon side of the river. The exit point would be on the Washington side west of Dike Road within a field. The HDD would be about 5,030 feet in length.

Clearing

Clearing of vegetation and surface disturbance during pipeline construction could lead to increased erosion and transport of sediment into surface water. Oregon LNG would implement its Plan and SWPPP to mitigate such impacts, including measures such as revegetating disturbed riparian areas with conservation grasses and legumes or native plant species, preferably woody species. Section 4.1.5.2 addresses potential impacts on water temperatures resulting from removal of riparian vegetation.

Water for Hydrostatic Testing and HDD

Before being placed into service, the entire length of the pipeline would be hydrostatically tested to ensure structural integrity. We received comments about the potential for erosion, temperature changes, and contaminants from discharge of the hydrostatic test water. Concerns associated with the intake of hydrostatic test water include the rate of intake, condition of the source stream, and other impacts on surface water quality. Oregon LNG would apply for a Limited Water Use License from OWRD for the withdrawal of water for hydrostatic testing. Withdrawal source waters, rate of intake, and methods would be reviewed and approved by the appropriate state and federal agencies prior to testing. The total volume and rate of intake would be maintained at the instantaneous rate specified in the Limited Water Use License to prevent impacts on in-stream water rights and downstream surface water right holders.

Hydrostatic testing would occur during the in-water work windows and test water would be discharged back to the source water within 4 days. Oregon LNG would discharge the hydrostatic test water at the same location as the proposed intake structure. To prevent scouring, Oregon LNG would control the discharge rate at less than 0.4 foot/second and discharge into the intake structure so that the inlet screen would distribute the flow into the river.

The volumes of water needed for hydrostatic testing are shown in table 4.1.3-8.

Table 4.1.3-8

Water Demand for Hydrostatic Testing of Oregon LNG Pipeline

Water Source	Water Demand (million gallons)	Discharge Location
City of Woodland or Columbia River MP 82.0	1.5	Columbia River MP 82.0
Columbia River RM 11.5	1.5	Columbia River RM 11.5
Total	**3.0**	

Oregon LNG would analyze the test water before discharge in accordance with its NPDES hydrostatic test wastewater discharge permit. Because the proposed pipeline would be buried at the time of testing and insulated from solar heating, the water temperature at the time of discharge is expected to be similar to the water temperature at the time of intake.

Oregon LNG would not require ATWS for each hydrostatic test facility. No chemicals, such as biocides or preservatives, would be added to the test water. Water would be filtered for suspended solids and tested for water quality prior to introduction into the proposed pipeline. Because the pipe would be new, no contaminants such as oil or grease would be introduced to the test water during hydrostatic testing. If municipal water is used, the hydrostatic test water would be dechlorinated using an appropriate dose of sodium bisulfite (or other approved dechlorination agent or method) per ODEQ guidance (ODEQ, 1997).

Oregon LNG would implement the following measures to avoid or minimize water quality effects on waterbodies from the discharges of hydrostatic test water:

- locate hydrostatic test manifolds outside wetlands and riparian areas as practical;
- withdraw from and discharge to water sources in compliance with appropriate OWRD, ODFW, and ODEQ requirements and recommendations that consider the protection of fishery resources on a case-by-case basis;
- comply with appropriate permit requirements;
- screen the intake to avoid entrainment of fish and aquatic species, using intake structures that comply with ODFW and NMFS fish screening requirements;
- maintain adequate flow rates to protect aquatic life and provide for waterbody uses and downstream withdrawals of water by existing users;
- anchor the discharge pipe for safety;
- discharge test water against a splash plate or other approved energy-dissipating device to aerate, slow, and disperse the flow;
- control the overall rate of discharge at a level that prevents flooding and erosion; and
- discharge test water near the point of diversion to prevent cross-watershed disposal.

In addition to hydrostatic testing, Oregon LNG would need water during pipeline construction for dust suppression and HDD crossings. About 2.3 million gallons of water would be used from various sources for dust control. As detailed in table 4.1.3-9, an additional 6.8 million gallons would be needed for the HDD method. If water for HDD is obtained from the Columbia River, the intake procedures described above would apply. With the mitigation measures described above, we conclude that impacts from hydrostatic testing and HDD activities would be adequately minimized.

Table 4.1.3-9

Projected Water Needs for Horizontal Directional Drilling

HDD Crossing	Water Source	Days to Complete	Water Demand (million gallons) [a,b]
Mainline			
Levee at MP 0.4	City of Warrenton or Columbia River (RM 11.5)	54	0.9
Adair Slough at MP 1.0	City of Warrenton or Columbia River (RM 11.5)	54	0.9
Lewis and Clark River at MP 3.1	City of Warrenton or Columbia River (RM 11.5)	32	0.5
Lewis and Clark River at MP 5.2	City of Warrenton or Columbia River (RM 11.5)	29	0.5
Lewis and Clark River at MP 5.7	City of Warrenton or Columbia River (RM 11.5)	26	0.4
Lewis and Clark River at MP 11.0	City of Warrenton or Columbia River (RM 11.5)	18	0.3
Nehalem River at MP 33.5	City of Warrenton or Columbia River (RM 11.5)	25	0.4
Highway 26 at MP 41.0	City of Warrenton or Columbia River (RM 11.5)	22	0.3
Highway 26 at MP 43.0	City of Warrenton or Columbia River (RM 11.5)	35	0.6
Rock Creek at MP 57.5	City of Warrenton, Columbia River (RM 11.5), or Rock Creek	35	0.7
Nehalem River at MP 63.8	City of Warrenton, Columbia River (RM 11.5), or Nehalem River	35	0.8
Columbia River at MP 82.5	City of Woodland, Columbia River (RM 82)	42	1.4
Total			**6.8**

[a] Work assumed to be completed on a 12-hour schedule. Pumping rates average over 12 hours per day.

[b] Maximum instantaneous rates and/or average withdrawal rates for HDDs would be determined by the OWRD, with input from the ODFW, the FWS, and NMFS during the Limited License for Water Use request process.

Spills or Leaks

During pipeline construction, accidental spills and leaks of fuels and hazardous materials would be mitigated through implementation of the procedures in Oregon LNG's SPCC Plan (see appendix F1). The SPCC Plan contains measures to prevent leaks and spills, should a leak or spill occur, the plan contains cleanup procedures to minimize the potential for contaminants to reach surface waters. Measures include not allowing any storage of fuels or hazardous materials within 150 feet of any surface water and keeping a sufficient supply of sorbent and barrier materials at staging areas to facilitate the rapid containment and recovery of a spill.

Operational Impacts

Several comments received during the public scoping process expressed concern that water supplies could become contaminated in the event of a pipeline leak. Natural gas is composed of methane, which is hazardous because it is flammable and a simple asphyxiant (i.e., it displaces air), but it is not toxic. Furthermore, in the event that a pipeline leak occurred at one of the waterbody crossings, the natural gas would rise to the surface, where it would dissipate into the atmosphere.

Compressor Station and Other Aboveground Facilities

In general, both construction and operational impacts on surface water resources from the compressor station and other aboveground facilities are expected to be temporary and of limited extent and would be similar to those described above for the pipeline. Oregon LNG would avoid or minimize impacts through implementation of measures contained in its Plan and Procedures and SWPPP. The contractor/pipe storage yards have been located to avoid impacts on waterbodies.

Surface Water Impacts and Mitigation Summary

Impacts on surface waters would include short-term impacts from in-water construction activities, waterbody contamination from disturbance to adjacent areas (i.e., agricultural fields, industrial areas,

etc.), and water appropriation and discharge for hydrostatic testing. Oregon LNG would minimize in-water construction impacts and potential waterbody contamination by using measures contained in its Plan and Procedures and SPCC Plan, crossing waterbodies during periods of low water, and complying with in-water work windows. Oregon LNG would minimize water appropriation impacts by using its Plan and Procedures, reusing water where possible, and discharging water through approved dewatering structures.

We conclude that with implementation Oregon LNG's proposed mitigation measures and our recommended mitigation, impacts on surface water during construction would be temporary and localized. During operations, once the right-of-way has been restored, the pipeline would not have measurable impacts on surface water.

4.1.4 Wetlands

Jurisdictional wetlands are defined by the USACE, EPA, and the states of Oregon and Washington as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of wetland vegetation typically adapted for life in saturated soil conditions (USACE, 1987). Wetlands can be a source of substantial biodiversity and serve a variety of functions that include providing wildlife habitat, recreational opportunities, and flood control, as well as naturally improving water quality. The USACE 1987 Wetland Delineation Manual (Manual) requires the presence of three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology for an area to be considered a jurisdictional wetland except in limited instances (USACE, 1987).

Jurisdictional wetlands in the project area are regulated at the federal, state, and local levels. On the federal level, the USACE has authority under Section 404 of the CWA to review and issue permits for activities that would result in the discharge of dredged or fill material into waters of the United States, including wetlands, as defined in Title 33 CFR 328.

In Oregon, the ODSL has authority to regulate wetlands under the Oregon Removal-Fill Law (ORS 196.795-990) and issues Removal-Fill Permits. In Washington, WA Ecology has authority to regulate wetlands under the Water Pollution Control Act (Chapter 90.48 RCW) and associated water quality regulations (WAC 175-201A).

Oregon LNG conducted field surveys using the USACE 1987 Manual and Western Mountains Regional Supplement (USACE, 2010) to identify wetlands in the project area. For the terminal, Oregon LNG delineated wetlands within the entire property boundary in 2005 and field-verified the wetlands in 2007. For the pipeline, Oregon LNG surveyed a 200-foot-wide corridor centered over the proposed alignment in 2007, 2011, and 2012. Data were collected and recorded through field notes, aerial photographs, and by using a geographic positioning system (GPS). Data collected included:

- wetland type and function, based on vegetation, soils, and hydrology;
- the construction easements beginning and ending milepost locations;
- the length of each wetland crossing;
- the width of permanent or temporary easements;
- additional temporary workspace area, if needed; and
- ancillary facilities boundaries.

Approximately 8 miles of the pipeline alignment lacks wetland survey data due to no field access. Wetland information for unsurveyed areas is based on NWI mapping and hydric soil data (CH2M HILL, Inc., 2013c, CH2M Hill, Inc. 2013d). Oregon LNG plans to file a supplemental wetland survey report with FERC and other appropriate agencies once access is granted to the unsurveyed areas (proxy wetlands) and Oregon LNG is able to verify and field delineate wetland boundaries. The ODSL has verified Oregon LNG's wetland delineations at the terminal site and between MPs 0.0 to 3.0 of the pipeline route. At the time of this document, the USACE has not verified Oregon LNG's wetland delineation for the terminal site, pipeline route, or mitigation sites. The USACE is in the process of verifying the wetland delineation for the Oregon LNG Project.

Table 4.1.4-1 lists the Cowardin classification for wetlands occurring within the project area. Agricultural wetland, a non-Cowardin classification, is included as a wetland classification for those areas in agricultural lands that are cultivated and have hydric soils according to NRCS hydric soils data. Farmed or pasture areas with mapped NRCS hydric soil data and no wetland vegetation may still be wetlands regulated by the USACE and ODSL. These areas may have wetland hydrology seasonally or have altered wetland hydrology, but do not have wetland vegetation due to disturbance from farming activities.

Table 4.1.4-1

Cowardin Classifications of Wetlands in the Oregon LNG Project Area

Cowardin Classification	Definition
Estuarine Intertidal Emergent Wetland (EEM)	Wetland adjacent to the subtidal area that are exposed and flooded by tides periodically; includes wetlands not normally flooded associated with the splash zone.
Palustrine Emergent Marsh (PEM)	Vegetation standing in up to 3 feet of water. Dominated by erect, rooted herbaceous freshwater hydrophytic vegetation.
Palustrine Scrub-Shrub (PSS)	Areas dominated by woody vegetation less than 20 feet (6 meters) tall. Woody shrub component consisting of shrubs and small trees.
Palustrine Aquatic Bed (PAB)	Dominated by plants that grow principally on or below the surface of the water for most of the growing season.
Palustrine Unconsolidated Bed (PUB)	Wetlands with at least 25 percent substrate cover of particles smaller than stones and a vegetative cover less than 30 percent.
Palustrine Forested (PFO)	Areas dominated by woody vegetation less than 20 feet (6 meters) tall.
Riverine Tidal Unconsolidated Bottom (R1UB)	Riverine areas extending from the boundary of estuarine systems to the extreme upper limit of tidal fluctuations. 25 percent cover smaller than stones and vegetative cover less than 30 percent.
Agricultural (AW) [a]	Areas currently or recently farmed or tilled with mapped hydric soils.

[a] Not a Cowardin classification.

Using the criteria previously described, Oregon LNG identified a total of 340 wetlands totaling approximately 387 acres in the project area, including agricultural wetlands (see appendix G1). The effects of construction and operation of the project were determined by assessing the functions, locations, acreages, length of crossings, classifications, jurisdictional status, and anticipated crossing methods.

Oregon LNG has developed a Wetland Mitigation Plan (see appendix F4) that included wetland functional assessments to determine necessary mitigation measures. Oregon LNG used the *Hydrogeomorphic (HGM) Assessment Guidebook for Tidal Wetlands of the Oregon Coast* (ODSL, 2006) to evaluate the wetland functions affected by construction and operation of the terminal and the *Guidebook for Hydrogeomorphic (HGM)-based Assessment of Oregon Wetland and Riparian Sites* (Statewide Classification & Profiles) (ODSL, 2001) for the pipeline corridor, as recommended by the

USACE, ODSL, and EPA. The USACE, ODSL, and EPA accept best professional judgment for wetland function assessments.

4.1.4.1 Terminal

Existing Environment

Existing conditions at East Skipanon Peninsula are shown on figure 7 in appendix D. Currently, the East Skipanon Peninsula supports common facultative wetland, and obligate wetland plants in low lying areas. Common wetland plant species identified during the field surveys of the proposed LNG terminal site include Lyngby's sedge, cattail, bulrush, Pacific water parsley, Pacific silverweed, soft rush, velvet grass, and willow.

Wetland classes associated with the terminal site include palustrine forested (PFO), palustrine scrub-shrub (PSS), palustrine emergent marsh (PEM), and estuarine emergent (EEM) wetlands. EEM wetlands typically occupy the intertidal area below the palustrine wetlands types. The deeper water areas below the estuarine wetlands are open water and are jurisdictional waters under USACE regulations, though not considered wetlands.

Wetland Impacts and Mitigation

Construction and operation of the terminal would temporarily impact 2.0 acres of wetland and permanently impact 33.9 acres of wetlands (see table 4.1.4-2 and figure 8 in appendix D).

Table 4.1.4-2

Wetlands Affected by the Terminal

Wetland Classification	Temporary Impacts (Acres)	Permanent Impacts (Acres)
Terminal Facilities		
PEM	<0.1	0.5
PSS	0.1	4.2
EEM	1.3	28.1
Access Roads		
PEM	0.6	0.9
PSS	<0.1	<0.1
PFO	0.0	0.2
Terminal Totals	**2.0**	**33.9**

We received scoping comments expressing concerns about the impacts on estuarine type wetlands at the terminal site. Soil disturbance and removal of wetland vegetation at the terminal site would reduce the capacity of wetlands to buffer flood flows and increase the potential for erosion. Removal of wetland vegetation would also deprive wildlife of a valuable habitat component and encourage the recruitment of less desirable invasive species. Rutting of soils from construction equipment could result in soil mixing and a disruption of surface water flow, which could affect the success of post-construction wetland restoration. Uncontrolled surface runoff from adjacent disturbed upland areas could transfer sediment into off-site wetlands and surface waters. Accidental spills and leaks from construction equipment, storage containers, and fuel transfers could also result in wetland contamination and some loss of wetland values/functions as wildlife habitat would be diminished during construction.

The majority of wetland impacts at the terminal site would be permanent and result in the conversion of wetlands to commercial/industrial uses. Based on the results of the wetland delineation and wetland impact minimization efforts, Oregon LNG has revised the terminal design several times since initiating pre-filing on May 31, 2007. The principles Oregon LNG used in siting the terminal facilities included the following:

- avoiding impacts on low marsh and shallow subtidal habitats that have high functional value for salmon;
- maximizing the use of nonwetland area;
- emphasizing avoidance of estuarine wetlands over avoidance of freshwater (palustrine) wetlands; and
- maximizing the use of existing roads to access the terminal site.

The initial conceptual design for the terminal would have extended the area of fill into the low marsh, mudflats, and shallow subtidal areas on the east side of the northern end of the East Skipanon Peninsula. Subsequent layouts were designed to avoid high value estuarine wetlands because of their importance to salmonids. Additional minor modifications to the site layout were also made to relocate the flare and adjust the placement of vaporizers to avoid estuarine impacts.

Oregon LNG would mitigate construction-related impacts by implementing measures contained in its SWPPP, Plan and Procedures, and by complying with the USACE's Section 404 and ODSL's Section 401 permit conditions. The basic function of the terminal requires a location adjacent to navigable water and, as a result, wetland impacts are unavoidable. Oregon LNG would follow the USACE and ODSL rules and guidance for mitigation, with the goal of no net loss of wetland functions and values. The type of wetland mitigation would be based on the determination of impacts and the evaluation of wetland functions.

For freshwater wetlands, Oregon LNG would rehabilitate temporary impact areas after construction. Rehabilitation would initially involve seedbed preparation and control of noxious weeds. Some vegetation would regenerate naturally from the seedbank and vegetative propagules. Oregon LNG would conduct supplemental hydroseeding of red fescue and pine lupine, and mulching during spring or fall. Supplemental planting of coast willow and Scouler's willow would accelerate woody plant establishment. Oregon LNG would apply temporary irrigation, as needed, during dry periods to ensure sufficient moisture for plant establishment.

Because 33.9 acres of wetlands, mostly EEM, would be permanently impacted, we conclude the adverse impacts on wetland resources at the terminal would be significant. Compensatory wetland mitigation for the terminal site is discussed later in this section.

4.1.4.2 Pipeline and Associated Facilities

Existing Environment

Dominant wetland vegetation along the pipeline route varies by location. In general, wetland vegetation can be grouped in three regions, each with common wetland species: Youngs River and Lewis and Clark River floodplains, the coastal foothills and Coast Range mountains, and the Columbia River floodplain (see table 4.1.4-3).

Table 4.1.4-3

Typical Wetland Plant Species Along the Proposed Oregon LNG Pipeline

Wetland Classification	Typical Dominant Wetland Plant Species
Young River and Lewis and Clark River Floodplains (MPs 0.0-6.0)	
PEM	Soft rush, Kentucky blue grass, common velvet grass
PSS	Willow
PFO	Red alder
Coastal Foothills and Coast Range (MPs 6.0-80.0)	
PEM	Slough sedge, common horsetail, soft rush, creeping buttercup, mana grass, water parsley, lady fern, skunk cabbage
PSS	Salmonberry
PFO	Red alder, western red cedar
Columbia River Floodplain (MPs 80.0-86.5)	
PEM	Bentgrass, common velvet grass, meadow foxtail, reed canary grass, birds foot trefoil
PSS	Red-osier dogwood, willow, Pacific ninebark
PFO	Oregon ash, black cottonwood, western red cedar, red alder
AW	Agricultural crops

Wetland classifications were previously discussed. A list of all wetlands that would be crossed by the pipeline is provided in appendix G1.

Wetland Impacts and Mitigation

We received comments from federal (NMFS, FWS, and EPA) and state (ODF and ODLCD) agencies, as well as private landowners expressing concerns about project impacts on wetlands in regard to loss of habitat function and use for wildlife, soil compaction, depth of pipeline, increased erosion potential, and questions about restoration and revegetation efforts.

The scope of wetland impacts would vary depending on the type of wetland affected. In general, impacts on herbaceous wetlands would be short term, while impacts on scrub-shrub and forested wetlands would be permanent as these wetlands would take decades to recover. Also, some wetlands would be permanently affected as a result of maintenance of the of the pipeline's operational corridor, which would convert the affected wetland to a different wetland type (e.g., converting a forested wetland to an herbaceous wetland). Acres of wetland impacted by construction and operation of pipeline are listed in table 4.1.4-4. Construction impacts on forested wetlands are considered permanent, as well as impacts on scrub-shrub wetlands within the 10-foot wide mow strip over the pipeline (see figure 4.1.4-1). Impacts on other types of wetlands are considered temporary as they would be expected to recover to preconstruction conditions.

Construction of the pipeline would cause short-term impacts on about 84.1 acres of wetlands and permanently impact about 22.8 acres of wetlands in Oregon and Washington. The permanent wetland impacts represent about 2 percent of the total pipeline construction footprint (approximately 1,200 acres). The compressor station and other aboveground facilities associated with the pipeline were sited to avoid wetlands. Similarly, no impacts on wetlands would result from the access roads, temporary contractor storage yards, and pipe storage yards. About 35 percent of the wetlands temporarily impacted by the project would be agricultural wetlands.

We received a comment that wetland impacts should be reported based on watersheds. Watershed locations of impacts would be determined as part of the process of determining final compensatory mitigation acres after a final design has been completed.

Table 4.1.4-4

Wetlands Impacted by Oregon LNG Pipeline Construction and Operation

Wetland Classification [a]	Temporary [b] (acres)	Permanent [c] (acres)
Oregon		
AW	34.5	0.0
PEM	26.5	0.0
PFO	0.0	12.6
PSS	7.1	3.8
PSS/PFO	0.0	6.4
E2USN	5.1	0.0
Total Oregon	**73.2**	**22.8**
Washington		
PEM	10.9	0.0
Total Washington	**10.9**	**0.0**
Total Pipeline	**84.1**	**22.8**

[a] Cowardin Classification System: PEM = palustrine emergent; PSS = palustrine scrub-shrub; PFO = palustrine forested, PSS/PFO= palustrine scrub-shrub/ palustrine forested, E2USN= estuarine intertidal unconsolidated shore, AW = agricultural wetland (not a Cowardin type).

[b] Temporary impacts on wetlands that are expected to recover to preconstruction conditions.

[c] Permanent impacts on wetlands requiring long-term restoration including the functional conversion of forested wetlands to scrub-shrub wetlands, or conversation of scrub-shrub wetlands to emergent wetlands

Oregon LNG would narrow its construction right-of-way width through wetlands to 75 feet to minimize wetland disturbance in accordance with its Procedures. In the event that additional construction right-of-way width is required to accommodate specific wetland site conditions, a variance would be sought. Vegetation within the 75-foot-wide right-of-way would be cut at the ground level. Root systems would remain intact except for directly over the 10-foot-wide pipe trench. Grading and tree stump removal would be limited to the area directly over the trench line unless additional grading or stump removal would be required for worker safety. Figure 4.1.4-1 shows a typical right-of-way cross section for a wetlands crossing. Equipment would be supported on mats, if necessary, to minimize soil compaction and impacts on vegetation.

Following construction, wetlands would be rehabilitated to preconstruction soil and hydrology conditions, and revegetated. Within the construction right-of-way, reestablishment of vegetation would begin within days or weeks of cessation of site work, with the exception of the trench excavation area. In the approximately 10-foot-wide trench area, herbaceous wetlands would recover more slowly as a result of clearing, grubbing, and soil excavation. Restoration efforts would be monitored for a minimum of 3 years or until revegetation is successful.

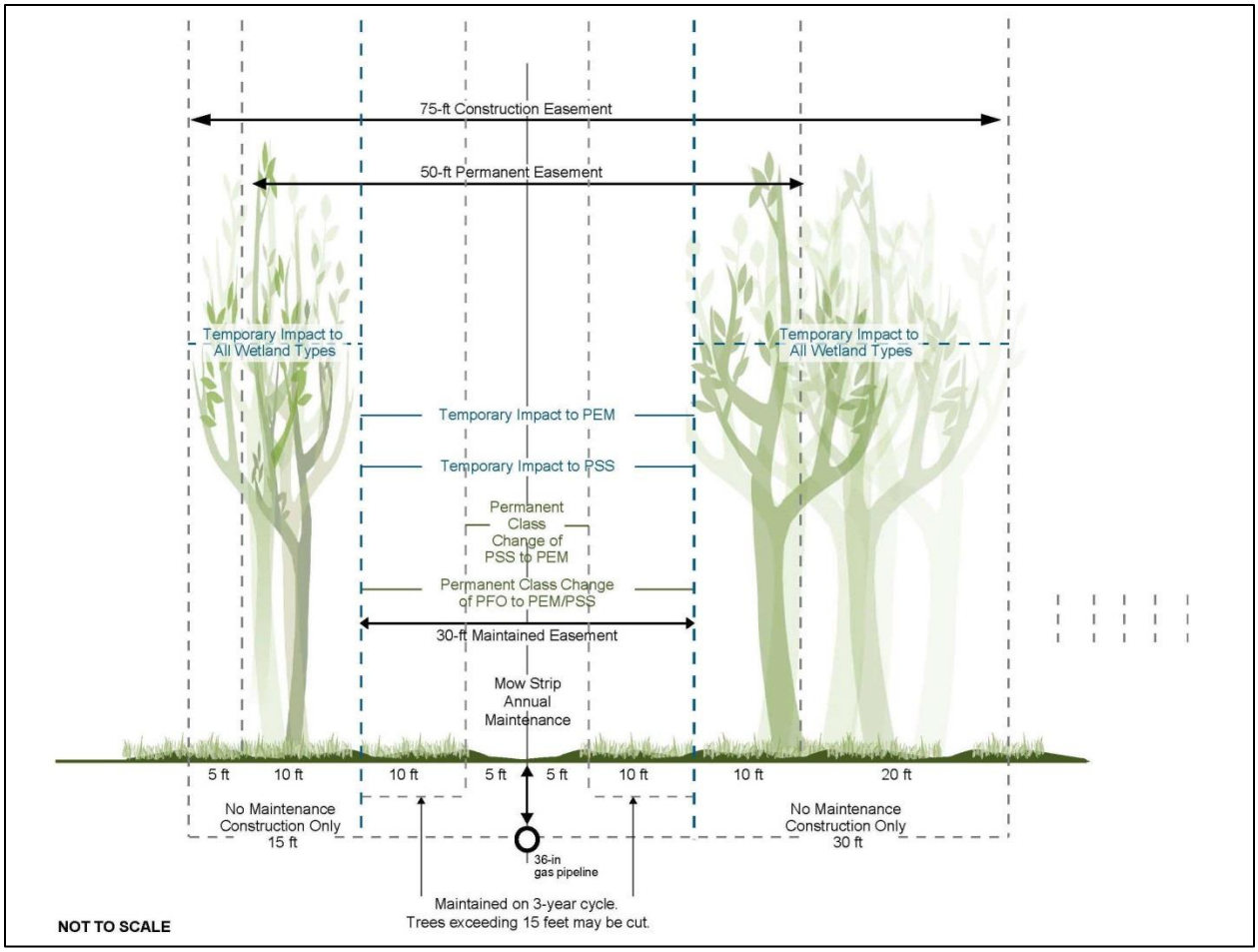


Figure 4.1.4-1: Typical Wetland Construction Right-of-way Cross Section

Operational vegetation maintenance activities would preclude forested wetlands in a 30-foot-wide corridor, and shrub-scrub wetlands from a 10-foot-wide corridor centered over the pipeline. As previously mentioned, the impacts of pipeline construction on wetlands would be mostly temporary but some impacts would be permanent as described below.

- Impacts on emergent wetlands would be short term.
- Impacts on scrub-shrub wetlands would be short term, with the exception of the 10-foot-wide mow strip over the pipeline. Scrub-shrub wetlands within the 10-foot-wide mow strip would retain their wetland hydrology and hydric soil, but the dominant vegetation would shift to mostly herbaceous and trailing woody groundcover. This impact would be permanent.
- Impacts on forested wetlands would be long term. Forested wetlands within the 30-foot-wide maintenance corridor over the pipeline would be permanently impacted as the dominant vegetation would shift to mostly herbaceous and trailing woody ground cover within the 10-foot-wide mow strip and to scrub-shrub wetlands elsewhere in the 30-foot-wide maintenance corridor where trees exceeding 15 feet in height may be cut for pipeline integrity.

The impacts of project-related construction and operation activities on wetlands would vary depending on the timing of construction, construction techniques used, sensitivity of the resources disturbed, and the length of time required for wetlands to be restored. Wetland hydrologic impacts could include bank modifications, siltation, and removal of riparian and aquatic vegetation; however, the primary impact of pipeline construction and right-of-way maintenance activities on wetlands would be the temporary and permanent alteration of wetland vegetation. These effects would be greatest during and immediately following construction.

In general, Oregon LNG would minimize wetland impacts by avoidance, mitigation of impacts, and compensation in accordance with federal, state, and local regulations. Oregon LNG intends to restore wetlands associated with construction and operation of the project as described in its Procedures. Oregon LNG has reduced the magnitude of wetland impacts by locating the pipeline alignment and ATWS away from wetlands to the extent practicable.

For selecting the pipeline route, Oregon LNG sought to avoid high value wetlands with a functional assessment rating greater than 1.5 (on a scale of 0 to 3, using the Oregon Rapid Wetlands Assessment Protocol; ODSL, 2010), PFO wetlands, and wetlands greater than 5.0 acres. With the use of avoidance measures such as route shifts and HDD, Oregon LNG has avoided permanent impacts on 31 high value wetlands and minimized impacts on 28 others. For example, more than 24 acres of high value wetlands associated with the Adams Slough and the Lewis and Clark River area would be avoided using the HDD method from MP 0.4 to MP 1.3 and MP 2.0 to MP 3.3.Approximately one-third of the wetland impact area from the pipeline would be agricultural wetlands. In these areas, we anticipate no significant loss of wetlands because the right-of-way would return to agricultural use following construction. Because agricultural wetlands are typically continually disturbed by farming practices (i.e., plowing, grazing, irrigation), Oregon LNG would not reduce the construction width to 75 feet in agricultural wetlands as it would in other wetland types. Likewise, Oregon LNG would follow upland construction procedures and mitigation measures as they apply to these agricultural wetlands.

Oregon LNG has selected locations for ATWS to avoid and minimize wetland impacts where possible. Extending the distance between ATWS and wetlands or waterbodies reduces the risk of sediments entering the wetland or waterbody. ATWS would be at least 50 feet from wetland and waterbodies unless necessary for certain construction techniques such as HDD and unless approved by FERC staff. Table E4-2 in appendix E4 provides a list of ATWS that would be within 50 feet of wetlands. We have reviewed these ATWS and determined them to be justified.

Construction techniques to cross wetlands along the pipeline route are described in section 2.1.4.2. In areas of steep slopes, the pipeline trench could potentially drain a wetland. To prevent this, clay plugs would be constructed or the trench bottom would be sealed as necessary to maintain the original wetland hydrology.

For any large construction project, construction activities create the potential for spills or leaks of fuels or other hazardous materials from storage containers, equipment working in or near wetlands, and fuel transfers. Where practicable, equipment would be parked, maintained, or fueled 150 feet or greater from any waterbody or wetland and the contractor would implement procedures as described in the SWPPP to prevent spills and provide prompt cleanup in the event of a spill. If a distance of 150 feet could not be maintained because the EI determines there is no reasonable alternative, the contractor would have secondary containment and other spill prevention and cleanup measures in place, as well as written authorization from permitting agencies.

Oregon LNG would encourage natural revegetation of disturbed areas through topsoil segregation and replacement, topsoil management to maintain the viability of the seedbank and vegetative propagules, reconstruction of grades, permanent erosion control seeding with native wetland species, and seedbed preparation where soils are displaced or compared by equipment. Topsoil would be segregated up to 1 foot deep over the trench in nonsaturated wetlands. The segregated topsoil would be replaced when backfilling the trench to promote reestablishment of wetland species by preserving the vegetative propagules (e.g., seeds, tubers, rhizomes, bulbs) in the soil. If hydrologic conditions do not permit this practice, additional native wetland seed mixes would be used to ensure adequate cover by desirable species.

When the existing seedbank and vegetative propagules do not provide sufficient revegetation, Oregon LNG would apply a native wetland seed mix to ensure adequate cover of the site by desirable species. Oregon LNG would use the seed and plant mixtures recommended by the NRCS as a basis for developing a project-specific seed mixture. Measures would be taken to control the spread of noxious weeds following site restoration. Manual and mechanical methods would be preferred in riparian areas and wetlands. Herbicides would be used only if manual and mechanical methods are ineffective in controlling noxious weeds. Oregon LNG would use only EPA-approved herbicides. Our Procedures do not allow the use of herbicides within 100 feet of wetlands or waterbodies unless approved by appropriate state and federal agencies. However, Oregon LNG stated there may be circumstances that it would use spot application of herbicides near wetlands or waterbodies, therefore **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary a plan for the use of herbicides within 100 feet of wetlands or waterbodies, along with documentation of consultation and approval by NMFS, FWS, and appropriate state agencies.**

Following revegetation, there would be little permanent impact on emergent wetland vegetation in the maintained right-of-way because these areas would remain an open and herbaceous community. Herbaceous wetland vegetation in the pipeline right-of-way would not be mowed or otherwise maintained. In most locations, forested wetlands that would become part of the permanent pipeline easement would be revegetated and maintained in an emergent or scrub-shrub state. Scrub-shrub wetlands would be revegetated to their preconstruction condition except for a 10-foot-wide corridor along the pipeline, which would be maintained with herbaceous species in an emergent state.

To avoid or minimize impacts on wetlands, Oregon LNG would implement measures outlined in its Procedures during the construction and operation of the proposed pipeline that include, but are not limited to, the following requirements:

- construction equipment operating within wetlands would be limited to that equipment necessary for clearing, excavation, pipe installation, backfilling, and restoration activities. All nonessential equipment would use upland access roads to the maximum extent practicable;
- equipment operating within saturated wetlands would be low-ground-weight equipment or would operate from prefabricated construction mats;
- temporary erosion and sedimentation control measures would be installed immediately after the initial disturbance of wetland soils and would be inspected and maintained regularly until final stabilization;
- sedimentation controls would be installed across the construction right-of-way within wetlands to contain trench spoil, as needed;

- grading and pulling of tree stumps would be limited to the area directly over the trench line unless required for worker safety; and
- in unsaturated wetlands, the uppermost 12 inches of topsoil along the pipeline trench would be segregated from the underlying subsoil.

Oregon LNG would also mitigate construction- and operation-related impacts by implementing measures contained in its Wetland Mitigation Plan, SWPPP, and by compliance with the USACE's Section 404 and ODSL's Section 401 permit conditions. Compensatory mitigation is described in section 4.1.4.3.

To address scoping comments relating to impacts on forested wetlands, Oregon LNG is proposing additional steps to revegetate forested wetland areas. For natural regeneration of forested wetlands cleared outside the maintained corridor, Oregon LNG would take the following actions:

- to reduce injury to viable roots and shoots, construction traffic would be supported by mats, pallets, or other ground pressure dissipaters in moist or wet soils; and characterized by low ground pressure equipment where terrain allows;
- woody debris, chipped woody vegetation, and unmerchantable logs greater than 12 inches would be salvaged for surface application outside the 30-foot-wide maintenance corridor where existing downed wood is insufficient;
- various site-specific seed mixes would be used for temporary erosion control seeding to avoid conflicts with the permanent cover;
- where compatible with preconstruction woody species, seeds of native woody wetland species would be incorporated into permanent erosion control seed mixes; and
- if annual monitoring during 3 years after construction indicates that disturbed wetland areas are not successfully revegetating with desirable woody plants, supplemental planting would be undertaken.

Restoration and cleanup would begin after the trench is backfilled. The disturbed areas would be graded as closely as practical to preconstruction contours. Trash in the easement would be removed and disposed of in approved areas. Organic refuse unsuitable for spreading over the easement would be disposed of at a state authorized facility. Disturbed areas would be restored as closely as practical to their original condition, permanent erosion control measures would be installed as appropriate, and revegetation measures would be implemented. In addition, line markers would be installed directly above the buried pipelines in accordance with 49 CFR 192 (e.g., marker at each crossing of a public road and railroad).

Oregon LNG has adopted our Procedures for wetland crossings with certain modifications, including proposed alternative measures. These modifications are described in table 4.1.4-5.

Table 4.1.4-5

Differences Between Oregon LNG's Procedures and Our Procedures

Section of Our Procedures	Alternative Measure	Approved	Reason/Explanation
V.B.1.a.: Unless expressly permitted or further restricted by the appropriate federal or state agency in writing on a site-specific basis, instream work, except that required to install or remove equipment bridges, must occur during the following time windows: a. coldwater fisheries - June 1 through September 30	Addition of, "Conduct all in-stream work in consultation with federal and state regulatory agencies. In all events, Oregon LNG will attempt to minimize in-stream impacts by expediting the crossing time and adhering to best management practices for waterbody crossings."	Yes	Oregon LNG would comply with regional in-water work guidelines of local agencies, which would provide an equal or greater level of protection than our Procedures.
V.B.2.a: Locate all extra work areas (such as staging areas and additional spoil storage areas) at least 50 feet away from water's edge, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land.	Oregon LNG would utilize ATWS within 50 feet of wetlands or waterbodies and within wetlands.	Yes	Oregon LNG provided explanations of the conditions for ATWS within 50 feet of a wetland or waterbody. We agree that these ATWS are necessary.
V.B.3.a: Comply with the COE, or its delegated agency, permit terms and conditions.	Oregon LNG would select waterbody crossing method at the time of construction to maintain construction flexibility based on site conditions.	Yes	Oregon LNG states that permit conditions would be met and appropriate agency approvals would be obtained.
VI.D.4: Monitor and record the success of wetland revegetation annually until wetland revegetation is successful.	Addition of, "Oregon LNG proposes to continue revegetation efforts until wetland revegetation is successful as indicated in sections VI.D.4 and VI.D.5 of the Procedures. Oregon LNG proposes to terminate monitoring upon a determination of successful revegetation. However, reports on the status of revegetation efforts will be filed with FERC for 3 years."	Yes	We approve this change; however, if revegetation efforts take more than 3 years, Oregon LNG must continue to file a report annually until wetland revegetation is successful.

4.1.4.3 Compensatory Mitigation

For unavoidable wetland impacts Oregon LNG would provide compensatory mitigation following the USACE, ODSL, and WA Ecology rules and guidance for no net loss of wetland functions and values. Oregon LNG would compensate for temporary impacts on wetlands from pipeline construction through on-site wetland rehabilitation.

Oregon LNG's Wetland Mitigation Plan (see appendix F4) describes compensatory mitigation locations for permanent impacts from the terminal and pipeline construction. Permanent unavoidable impacts from the terminal construction would be compensated by improving a 120-acre parcel of land near the mouth of the Youngs River. This mitigation site is described in more detail in section 2.1.1.3.

Permanent class changes from the pipeline construction would be compensated via purchase of credits in established mitigation banks near the project impacts. These include the Claremont Road Mitigation Bank in Clatsop County, Oregon, and Columbia River Mitigation Bank in Clark County, Washington. Oregon LNG also proposes wetland mitigation on private land in the floodplain of the Nehalem River in Clatsop County, Oregon, as described in section 2.1.1.3.

Oregon LNG would follow the USACE and EPA compensatory mitigation rule (33 CFR Parts 325 and 332 and 40 CFR Part 230), ODSL guidance emphasizing a watershed-level approach to compensation (OAR 141-085-0680 to 141-085-0765), and WA Ecology's compensatory mitigation policies (Chapter 90.84 RCW). Mitigation amounts would be determined as part of the wetland permitting process. The wetland mitigation banks identified have sufficient credits available to provide mitigation at ratios outlined by the USACE, ODSL, and WA Ecology.

At this time the Oregon LNG's proposed compensatory wetland mitigation is conceptual; therefore, **we recommend that:**

- **Prior to construction of the Oregon LNG Project, Oregon LNG should file with the Secretary its final Wetland Mitigation Plan, along with documentation of consultation and approval by the USACE, ODSL, and WA Ecology.**

The Oregon LNG terminal and pipeline combined would cause short-term impacts on about 86.1 acres of wetlands and permanently impact about 56.7 acres of wetlands. Avoidance, minimization, and mitigation efforts would reduce the overall impact of the project on wetlands. Though impacts on specific wetlands would be significant on a localized basis, we conclude that the project would not create a significant, large scale change to overall wetland conditions in the project area.

4.1.5 Aquatic Resources

4.1.5.1 Existing Aquatic Resources

The project area for aquatic resources includes the lower Columbia River estuary near the proposed terminal, dredged material disposal areas, and the numerous waterbodies and wetlands crossed by the proposed pipeline. This section also discusses impacts associated with the nonjurisdictional LNG marine transit route. These areas include diverse freshwater, estuarine, and marine aquatic environments with abundant fish, invertebrate, and marine mammal species.

Terminal and Marine Transit Route

The proposed LNG terminal site and marine transit route provides habitat for a variety of anadromous and resident fish species, and contain deep subtidal/open water habitat, tidal flats and shallow subtidal areas, and both high and low salt marshes.

Deep subtidal/open water habitat plays several important ecological roles in the estuarine ecosystem as juvenile salmonids use the deep subtidal/open water habitat for feeding and movement. During incoming tides the more dense saline marine water tends to follow the deeper channels (such as the federal navigation channel) that allow marine species to move into the estuary for rearing and refuge from large predators. The interaction between overlying freshwater and the deeper, more saline marine waters in some of the deep subtidal/open water habitat contribute to microdetritus concentrations that are very important in the overall dynamics of the estuarine food web (Bottom et al., 2005).

Surveys by Oregon LNG identified marsh habitat at the terminal site. Areas of low marsh habitat were dominated by Lyngby's sedge, cattail, Pacific water-parsley, and bulrush. The high marsh community at the terminal site is characterized by Lyngby's sedge, Pacific silverweed, and soft rush with Lyngby's sedge being the dominant component. Fish may occupy the low marsh habitat during daily high tides. The low marsh is also important in the estuarine food web in that it provides macrodetritus through leaf production and decay. Less than one piece of LWD per acre was found in the low marsh on the eastern side of the East Skipanon Peninsula. Cattails have very low salinity tolerance, indicating that

the low marsh in the project area experiences predominantly freshwater conditions. The high marsh at the terminal location would not provide preferred salmonid habitat because of a complete lack of tidal channels and infrequent inundation. Soils are sandy with a high rate of infiltration. Vertical structure is limited to several small patches of shrubs, while snags and LWD are notably absent.

The tidal flats and shallow subtidal habitat is the combined intertidal and subtidal habitat lying between the lower edge of the low marsh vegetation line and -6 feet MLLW. Primary production in this habitat type is dominated by benthic microalgae, and supports relatively high benthic invertebrate productivity. Tidal flats and shallow subtidal areas provide important rearing habitat for juvenile salmon and a variety of other estuarine fish Oregon LNG did not observe eelgrass beds at the terminal site during habitat surveys, likely because of low salinity. This conclusion is supported by the presence of cattails, a species with low salinity tolerance, on the adjacent low marsh.

The major categories of aquatic resources in the terminal project area include coldwater anadromous fisheries, estuarine fisheries, invertebrate species, marine mammals, and sea turtles. Seventy-six species of fish have been documented in the lower Columbia River estuary; the most abundant species include American shad, Chinook salmon, longfin smelt, Pacific herring, shiner perch, Pacific staghorn sculpin, and starry flounder (Bottom et al., 1984). Fish species distribution in the estuary generally follows salinity gradients. Within a given salinity zone, species composition is influenced by habitat type, including nearshore, bay, shoal, water column, and channel bottom habitats (Bottom et al., 1984).

Fish Species

The lower Columbia River estuary provides habitat for both anadromous and estuarine fish species, several of which commonly occur in the proposed terminal area during most periods of the year (see table 4.1.5-1). In general terms, anadromous fish spend at least a portion of their adult lives in the ocean; the amount of time varies among species. Adults return from the ocean, move through the estuary, and spawn in freshwater rivers and streams. Estuarine fish in the project area use the lower Columbia River estuary for foraging, spawning, and rearing. Most nonanadromous fish in the project area are marine species that use the estuary for part of their life cycle.

Table 4.1.5-1

Fish Species Commonly Found in Terminal Area

Anadromous Species	Nonanadromous Species
Pacific lamprey	Pacific herring
river lamprey	northern anchovy
white sturgeon	Pacific sardine
green sturgeon	surf smelt
American shad	Pacific tomcod
sea-run cutthroat trout	shiner perch
Chinook salmon	Pacific staghorn sculpin
coho salmon	starry flounder
chum salmon	
sockeye salmon	
steelhead trout	
eulachon	
longfin smelt	

Anadromous Fish Species

Adult salmonids use open waters of the mainstem Columbia River during upstream migration to their spawning grounds. The lower Columbia River estuary serves as an anadromous fish migration corridor; however, several species (including Chinook, coho salmon, and summer run steelhead trout) also utilize the lower Columbia River estuary for foraging. Tidal wetlands and estuaries are also important habitats for adult salmon as resting/holding areas during upstream migration. Juvenile salmonids also use the surface waters of the lower Columbia River estuary during their migration to the ocean and as nursery and rearing areas. Juvenile fall Chinook and chum salmon use shallow water habitats for rearing more extensively than do those species with a shorter estuarine residence time.

Pacific eulachon spend most of their lives in coastal water of the Pacific Ocean, where they live for 3 or 4 years. They then migrate to coastal streams to spawn. Adults deposit eggs on gravel, and hatched larvae drift to estuaries from freshwater systems where they are spawned. Pacific lamprey adults migrate from the Pacific Ocean to freshwater tributaries, where they spawn. Juveniles rear in muddy substrate for up to 6 years before migrating to the ocean as subadults. Detailed information regarding fish species listed under the ESA, including salmonids, green sturgeon, and eulachon is presented in section 4.1.8. Section 4.1.8 also discusses special-status species, including state-listed and sensitive species

Estuarine Fish Species

Pacific herring, northern anchovy, Pacific sardine, and starry flounder are either important to recreational or commercial fisheries, or play important roles in the estuarine food web. Larval and juvenile marine fish comprise a significant portion of the offshore planktonic communities. Smelt, tomcod, right-eye flounder, and anchovy are commonly found in offshore communities during the winter and spring. Most of these marine species occur in the estuarine mixing zone or oceanic/plume region of the estuary (brackish to high-salinity waters). The proposed terminal area is primarily within the estuarine mixing zone.

Primary Production

Transitions from fresh to salt water, coupled with relatively high flushing rates, cause freshwater phytoplankton cells being flushed into the estuary from upstream to be broken apart at the freshwater-brackish water boundary. The combined effects of rapid flushing, loss of phytoplankton biomass, and light limitation from elevated turbidity cause the rate of primary productivity in the Columbia River estuary to be one of the lowest in North America (Lara-Lara et al., 1990a, 1990b). Sullivan et al. (2001) found that diatoms, the major phytoplankton group present at the upstream end of the estuary, underwent a bloom in April–June, which contributed particulate organic matter to the estuarine turbidity maximum (ETM). The ETM is an area of the estuary containing elevated levels of suspended matter due to forces created by the influx of tidal saltwater against the outflow of river water.

The Lower Columbia River Bi-State Water Quality Program found that marine phytoplankton taxa dominated the phytoplankton in the Columbia River estuary from Astoria to the mouth, which includes the terminal (Tetra Tech, 1993). The nearest sampling location to the terminal was at the mouth of the Lewis and Clark River (about 5 miles from the proposed terminal), where the phytoplankton community was composed entirely of diatoms. Based on the occurrence of both freshwater and brackish water species, the phytoplankton community was characterized by the Columbia River Estuary Data Development Program (CREDDP) researchers as a benthic community that is tolerant of a large range of salinities, along with freshwater benthic and planktonic species from upstream areas (Simenstad et al., 1984).

Invertebrates

Both benthic (in or on the bottom sediments of a river) and epibenthic (dwelling on top of the riverbed) invertebrates are found in the terminal area. While no site-specific abundance data is available for the deep subtidal habitat at the terminal location, several studies have collected benthic samples in the general vicinity of the proposed terminal and turning basin (Durkin and Emmett 1980; Tetra Tech, 1993). These studies indicated that the most abundant benthic organisms in the Youngs Bay area were Oligochaeta (worms) and Amphipoda (planktonic aquatic crustacean). In the Columbia River shipping channel, researchers found oligochaetes (freshwater worms), polychaetes (marine worms), bivalves (mollusks), crustaceans, nematodes (round worms), and arachnoids (spiders). In general terms, polychaetes dominated the estuarine zone in the higher salinity areas downstream of RM 13. Mollusks and crustaceans were also abundant at some stations in the higher salinity (Tetra Tech, 1993).

Epibenthic organisms inhabit the top centimeter of sediments and first meter of immediately overlying water. Copepods are the two most numerous species of epibenthic zooplankton identified in the lower Columbia River estuary (Fox et al., 1984). The mobile epibenthic macroinvertebrate community is dominated by Dungeness crab, bay shrimp, and opossum shrimp. Dungeness crab is the most important commercial and recreational macroinvertebrates in the lower Columbia River estuary. Additional invertebrate fisheries exist for mud shrimp, ghost shrimp, and red rock crab. Ghost and mud shrimp occur in intertidal, sandy/muddy estuarine areas and are harvested for salmon and sturgeon bait. Red rock crabs are fished recreationally.

Marine Mammals

Twelve species of marine mammals have been recorded within the Pacific Ocean off the coast of Oregon, including eight species of whales and four species of pinnipeds (seals and sea lions) (Carretta et al., 2007). Large numbers of Steller sea lions, California sea lions, and Pacific harbor seals utilize haulout sites along the lower Columbia River. All eight species of whales are federally and state-listed and are discussed in section 4.1.8.1. The remaining marine mammals (sea lions and seals) are protected under the MMPA and are discussed in detail below within the impacts on aquatic resources. The eastern DPS of Steller sea lion was delisted from the ESA in 2013.

Sea Turtles

Four species of sea turtles (green, olive ridley, leatherback, and loggerhead) have been documented off the coasts of Oregon and Washington. Sea turtles occurring off the coasts of Oregon and Washington are protected under the ESA and potential effects on sea turtles are discussed in section 4.1.8.1. Sea turtles are only present in the marine environment and are not found in the lower Columbia River.

Pipeline and Associated Facilities

The major categories of fish along the pipeline route include coldwater anadromous, coldwater resident, and warm water (see table 4.1.5-2). In addition, the pipeline would cross one designated Salmon Anchor Habitat (SAH) basin—Upper Rock Creek. SAHs serve as the core area of salmon recovery efforts for the Tillamook and Clatsop State Forests in Oregon (ODF, 2003). Pipeline construction on state forest land in the Upper Rock Creek Basin would be consistent with the SAH strategy.

Table 4.1.5-2

Representative Fish Species in Waterbodies Crossed by the Oregon LNG Pipeline

Coldwater Anadromous Species	Coldwater Resident Species	Warmwater Species
Pacific lamprey	western brook lamprey	carp
Chinook salmon	rainbow trout	largemouth bass
coho salmon	cutthroat trout	smallmouth bass
chum salmon [a]	largescale sucker [b]	bullhead
steelhead trout	northern pikeminnow [c]	channel catfish
coastal cutthroat trout	peamouth	bluegill sunfish
eulachon [d]	longnose dace	pumpkinseed sunfish
	sculpin	black crappie
		white crappie

[a] Chum salmon are not confirmed to occur in the pipeline project area, but they are included because suitable habitat is present and ODFW is currently reintroducing chum to Oregon tributaries, including Milton Creek (crossed at MP 73.0). Therefore, their presence is assumed.

[b] Present in the Nehalem River but not in other Northern Oregon Coastal Basin drainages.

[c] Not known to occur in Northern Oregon Coastal Basin drainages.

[d] Eulachon distribution in the project area is limited to the Columbia River where crossed by the pipeline.

Resident and anadromous salmonids are present, or assumed present, at many of the proposed crossing locations for the Oregon LNG pipeline (see table 4.1.5-3). Most anadromous salmonids in the project area are listed as threatened or endangered and discussed in section 4.1.8.1. Coastal cutthroat trout exhibit both anadromous and resident life history and are widely distributed throughout the watersheds crossed by the pipeline. Because of their wide distribution and ability to live a wide variety of habitats, coastal cutthroat trout are presumed to occur at many crossings (see table 4.1.5-3).

Table 4.1.5-3

Waterbodies with Anadromous and Resident Salmonid Species Crossed by the Oregon LNG Pipeline

Milepost	Waterbody	Crossing Type	Fish Species Present
1.0	Adair Slough	HDD	Coho, cutthroat trout [a]
1.5	Vera Creek	Flume	Coho, cutthroat trout [a]
4.5	Barrett Slough	Flume	Coho salmon, cutthroat trout [a]
3.1, 5.2, 5.7	Lewis and Clark River	HDD	Chinook (fall), coho, steelhead (winter), cutthroat trout [a]
7.9	Heckard Creek	Flume	Coho, cutthroat trout [a]
11.0	Lewis and Clark River	HDD	Chinook (fall), coho, steelhead (winter), cutthroat trout [a]
16.1	Bayney Creek	Flume	Cutthroat trout,[a] no anadromous fish (barrier downstream)
18.5	Rock Creek	Flume	Cutthroat trout, no anadromous fish (barrier downstream)
19.3	Osgood Creek	Flume	Cutthroat trout, no anadromous fish (barrier downstream)
20.1	Fox Creek	Flume	Cutthroat trout, no anadromous fish (barrier downstream)
21.4	South Fork Youngs River	Flume	Cutthroat trout, no anadromous fish (barrier downstream)
23.4	Fall Creek	Flume	Cutthroat trout, no anadromous fish (barrier downstream)
25.7	Tributary of Little Fishhawk Creek	Flume	Cutthroat trout [a]
25.9	Tributary of Little Fishhawk Creek	Open-cut trench	Cutthroat trout [a]
26.8	Tributary of Little Fishhawk Creek	Flume	Cutthroat trout [a]
27.2	Tributary of Little Fishhawk Creek	Flume	Cutthroat trout [a]
29.5	Tributary of East Humbug Creek	Flume	Cutthroat trout [a]
31.4	Alder Creek	Flume	Coho, cutthroat trout [a]
33.5	Nehalem River	HDD	Chinook (spring, fall), coho, steelhead (winter), cutthroat trout
36.2	Tributary of Nehalem River	Flume	Cutthroat trout [a]
41.0	Rock Creek	HDD	Coho, steelhead (winter)
42.3	Tributary of South Fork Rock Creek	Flume	Cutthroat trout [a]
43.1	South Fork Rock Creek	HDD	Coho, cutthroat trout [a]
43.4	Bear Creek	HDD	Coho, cutthroat trout [a]
44.8	Tributary of Wolf Creek	Open-cut	Cutthroat trout [a]
47.6	North Fork Wolf Creek	Flume	Chinook (spring), coho, steelhead (winter), cutthroat trout [a]
50.5	Clear Creek	Flume	Coho, cutthroat trout [a]
55.7	Cedar Creek	Flume	Coho, cutthroat trout [a]
57.7	Rock Creek	HDD	Chinook (spring), coho, steelhead (winter), cutthroat trout [a]
63.8	Nehalem River	HDD	Chinook (spring), coho, steelhead (winter), cutthroat trout
70.7	Clatskanie River	Flume	Coho, steelhead (winter), cutthroat trout [a]
71.8	Little Clatskanie River	Flume	Coho, cutthroat trout [a]
73.4	Apilton Creek	Flume	Cutthroat trout,[a] no anadromous fish (steelhead and coho downstream)
76.4	Merrill Creek	Flume	Coho salmon, steelhead (winter), cutthroat trout
78.2	Tributary to Merrill Creek	Flume	Coho salmon, cutthroat trout
81.6	Deer Island Slough	Flume	Coho salmon, steelhead (winter), cutthroat trout
82.2	Columbia River	HDD	Chinook (fall, summer and spring), coho, chum, sockeye, steelhead (winter and summer), cutthroat trout
83.3	Burris Creek	Flume	Cutthroat trout, no anadromous fish (barrier downstream)

[a] Presence presumed

With the exception of the Columbia River, which would be crossed using the HDD method, no significant commercial fisheries were identified within the pipeline project area. Commercial fishing in the Columbia River is discussed above for the terminal area. Recreational fishing for coho and Chinook salmon, steelhead trout, coastal and resident cutthroat trout, resident rainbow trout, and warmwater species occurs in many of the waterbodies that would be crossed by the project.

4.1.5.2 Aquatic Resources Impacts and Mitigation

Terminal Construction

During the scoping process, state and federal agencies expressed concerns about impacts on aquatic wildlife (mammals, birds, fish, and invertebrates) from construction activities such as dredging and in-water pile driving at the LNG terminal. Specific topics related to dredging and effects on aquatic resources included: impact on rearing habitat of fish, benthic habitat, and species; potential contaminated sediment release; volume and area proposed for dredging, sediment suspension and deposition outside the dredging footprint area; and future river movement and patterns following dredging.

Three general phases of terminal construction, plus other miscellaneous terminal construction activities, have potential to affect aquatic resources. These include:

- dredging of the berth and turning basin, including vessel use;
- construction of the pier, dolphins, and access trestle; and
- construction of the onshore facilities, including hydrostatic testing of LNG storage tanks.

Dredging

As described in section 2.1.4.1, Oregon LNG would likely use a hydraulic hopper dredge to create a berth and turning basin for the LNG marine carriers. Initial dredging of 1.2 million cubic yards would occur in deep subtidal/open water habitat, where the shallowest predredging depths are approximately 20 feet below MLLW. The dredged depth of the turning basin and berth would range from 45 to 50 feet below MLLW.

Oregon LNG proposes to dredge the turning basin and berth area during the period between June 1 and September 30, depending on the availability of dredge vessels. Oregon LNG's proposed dredging time period is outside the standard in-water work window recommended by ODFW and WDFW for the Columbia River (November 1 through February 28); therefore, Oregon LNG would request a timing modification from NMFS, WDFW, and ODFW. Oregon LNG would request this work window modification to allow for safe vessel operation and navigation across the Columbia River Bar, because the standard winter work window presents significant safety concerns for transporting barges at the Bar. The June through September proposed timeframe is generally consistent with the timeframe the USACE has used to conduct maintenance dredging from the mouth of the Columbia River (RM -3) to RM +3.

Potential impacts on aquatic resources from the initial dredging activities include:

- direct mortality of fish, benthic organisms, and epibenthic organisms;
- increased turbidity and sediment transport;
- resuspension and dispersion of sediment contaminants;
- physical habitat modification;

- changes to hydrology and salinity regime;
- impacts associated with disposal of the dredged material;
- food web effects;
- introduction of exotic species; and
- dredge noise.

Direct Mortality

Fish

It is assumed that any fish entrained during dredging activities would perish. Fish species likely to occur in the terminal area during the June through September dredging window, and potential effects on those species, are discussed below. Impacts on federally listed fish are discussed in section 4.1.8.1.

Bottom-dwelling fish common in the summer in the lower Columbia River estuary include: Pacific tomcod, Pacific staghorn sculpin, starry flounder, shiner perch, Butter sole, sand sole, English sole, and speckled sanddab. However, because of the large populations of demersal fish in the estuary, the limited amount of entrainment that has been demonstrated in previous studies (e.g., Reine et al., 1998), and the very small percentage of available habitat to be dredged, large numbers of these species would not be entrained regardless of dredging technique. Therefore, we conclude that dredging in the project area would not have measurable population level effects in the estuary.

Northern anchovy suffered the highest rate of entrainment during hopper dredging in the Columbia River Estuary reported by Nightingale and Simenstad (2001), and are more prevalent during the proposed summer dredging period than during the WDFW and ODFW-approved work window. However, northern anchovy are primarily an open ocean fish and there is no evidence to suggest that dredging in the Columbia River has any effect on these populations.

The effects of dredging the berth and turning basin are likely to be similar in type to the effects of annual federal navigation channel maintenance dredging, but on a smaller scale. NMFS (2005) concluded the following in its biological opinion regarding the navigation channel maintenance (which annually dredges a volume nearly six times that of the initial dredging proposed by this project):

"Dredging would entrain benthic infauna and epibenthic fauna, reduce benthic infauna and epibenthic fauna abundance, alter benthic infauna and epibenthic fauna species composition, and remove and alter substrate composition modifying benthic infauna and epibenthic fauna habitat. Dredging is likely to temporarily reduce the suitability of the sediment for recolonization by *C. salmonis* by reducing the organic matter content of the sediments and altering the sediment particle size. However, these changes in prey availability are unlikely to be of a magnitude or extent that would appreciably diminish forage resources in the action area." We concur that Oregon LNG's proposed dredging would temporary diminish benthic infauna and epibenthic fauna abundance.

Dungeness Crab

Dredging of the proposed berth and turning basin would occur during the period of the year when juvenile Dungeness crab may be present (McCabe et al., 1988). Therefore, dredging would result in injury or mortality to entrained crabs. The primary concern with loss of juvenile Dungeness crab is the potential effect that such losses would have on commercial and recreational crab fisheries. Estimated entrainment rates at the terminal location (based on salinities) are less than 0.0005 crab/cy from December through June and about 0.001 crab/cy from July through November. The proposed June-

September dredge period overlaps both of those periods, suggesting that between 0.0005 and 0.001 crabs would be lost per cubic yard or about 600 to 1,200 crabs. This entrainment would be similar to that for dredging during the WDFW- and ODFW-approved in-water work period of November – February. The proposed dredging would have a minimal permanent impact on the overall crab population.

Following completion of dredging for the proposed berth and turning basin, we anticipate that the dredged area would be rapidly recolonized by age 0+ recruits or juvenile crab from surrounding habitat. The newly created deepwater, off-channel habitat in the berth and turning basin should provide rearing opportunities for juvenile crab because of its uniform depth and substrate composition, and its slightly higher salinity than predredging conditions. However, because crabs seem to prefer shallower estuarine habitat, densities may be reduced following dredging. Use may also be reduced by vessel transit and potential sediment displacement. We conclude that dredging may cause localized changes in crab distribution and abundance but changes would not be significant compared to the available habitat in the lower Columbia River.

Other Benthic and Epibenthic Invertebrates

The potential for entrainment of benthic invertebrates during the proposed dredging period would be less than for the state preferred winter in-water work window. Durkin and Emmett (1980) found that polychaetes are most abundant near the proposed terminal in fall and winter, slightly less abundant in spring, and rare in summer. Mollusks are most abundant in winter, somewhat less abundant in spring and fall, and rare in the summer. Benthic and epibenthic organisms entrained during dredging would suffer complete mortality. However, recovery of the shorter lived benthic invertebrate populations, such as *A. salmonis* would likely occur the spring following dredging. Some of the longer-lived benthic macroinvertebrates (for example, mollusks and the larger polychaete worm species) would recover at a slower rate, but they are not typically major food resources for benthic feeding fish in the lower Columbia River estuary. Numerous studies (Bennett et al., 1993; Pool and Ledgerwood, 1997; USACE and Bennett, 2001) have shown that disturbed areas are rapidly recolonized after dredging. McCabe et al. (1998) studied a ferry channel at RM 44 before and after dredging and found no significant effects on benthic invertebrate densities or benthic invertebrate community structure. Other studies have shown that rates of benthic in-fauna recovery range from several months for estuarine muds up to 2 to 3 years for sands and gravels (NMFS, 2003). Recovery is expected to begin immediately after dredging, with epibenthic prey organism abundance largely recovering by the following spring.

Some minor changes in the species composition and relative abundance of the benthic fauna are likely because changes in salinity, temperature, substrate conditions, and water currents would result from increasing the depth in the dredged area. However, the berth and turning basin are already at significant depth (predredging) with comparatively low densities of benthic organisms. Because the entire dredge prism is essentially sand, initial recovery of immobile benthic invertebrates may trend towards longer periods and would be affected by subsequent maintenance dredging that is anticipated to occur every 3 years. However, benthic species with planktonic larval stages and/or species that move into the water column (e.g., *A. salmonis*) are expected to rapidly recolonize the site. These are typically the organisms that provide the food base for epibenthic feeding fish species.

We conclude that impacts on other benthic and epibenthic invertebrates from the initial dredging would be significant but temporary and limited to the dredge area and close proximity. Long-term impacts would result from periodic disturbance every 3 years for maintenance dredging.

Marine Mammals

Seals and sea lions transit through the area proposed for dredging. Whales transit near the mouth of the Columbia River, rarely entering the estuary. There are no haulouts in the area proposed for dredging. The probability of whale strikes by a dredge vessel is low because of the relatively low speeds at which the vessels travel. Summer/early fall dredging would occur outside the primary migratory period when most whales migrate through coastal waters off the Columbia River estuary (e.g., gray and humpback whales). Therefore, we conclude that dredging would not directly impact marine mammals, regardless of season.

Increased Turbidity and Suspended Sediment

Turbidity generated during dredging could reduce light transmission, feeding efficiency and food availability (Kerr, 1995). Suspended sediment and sedimentation can clog gills, smother eggs and invertebrates, and decrease feeding efficiency. Sherwood et al. (1984) found that natural turbidity in the lower Columbia River can be high due to the tidal influence fluctuating river currents in the estuary. A number of studies have compared the amount of turbidity generated by clamshell and hydraulic dredges (Hayes, 1986; Anchor Environmental, 2003) and found that hydraulic cutterheads generate less turbidity than does standard clamshell dredging. During clamshell dredging, material is not only resuspended near the bottom, but potentially throughout the water column as the bucket is raised. Mean TSS concentrations above background values measured at 47 mechanical dredging locations varied between 0 and 404 mg/L (Anchor Environmental, 2003). Hopper dredges generally do not produce large amounts of turbidity during dredging because of the suction action of the dredge pump and the fact that the drag-arm is buried in the sediment. Because the sediments at the terminal were determined by analysis to be 99 percent sand, the downstream release of fine sediment would be very small, ranging from near 0 mg/L to less than 1 mg/L, far lower than the natural turbidity in the area.

Oregon LNG would monitor dredging operations and meet conditions of its project specific CWA Section 401 Water Quality Certificate (administered by ODEQ) during dredging. Conditions of the 401 Water Quality Certificate are designed to be protective of fish and their food resources. Daily monitoring of total suspended solids (among other parameters), and reporting of turbidity would likely be required by ODEQ for dredging operations in the lower Columbia River and estuary, and these requirements should prevent negative effects on phytoplankton production from excessive turbidity. Long-term increases in turbidity reduce the amount of light in the water column, decreasing phytoplankton production (USACE, 2001); however, the effects of dredging on turbidity would be temporary. As demonstrated by previous dredge operations (e.g., shipping channel and Astoria Harbor dredging), ODEQ's regulatory standards can be met using modern dredging equipment and containment measures.

As described in section 4.1.3.2, chemical analytical results for the sediments in the proposed berth and turning basin were below screening levels and therefore dredging would not release contaminants that would affect the aquatic environment. While we are not aware of any point sources providing contaminants in the project area, we have recommended that Oregon LNG prepare a plan for reevaluating the sediments because samples were collected in 2008.

Physical Habitat Modification

The dredging operation would change physical conditions of the bottom, locally altering the bathymetry and potentially altering the morphology and water currents. Dredging of the berth and turning basin would modify about 109 acres of deep subtidal slope and channel habitat. The greatest changes would occur nearest the shoreline, where depths approach 20 feet below MLLW. Oregon LNG would convert this estuarine slope habitat to deepwater channel, bottom-type habitat with little or no slope.

Dredging would not affect submerged aquatic vegetation (such as eel grass) because water depths in the proposed dredge area are too deep to support vegetation.

We also received comments about the potential loss of eel grass at the terminal site because submerged aquatic vegetation occurs in many parts of the estuary and is likely important for juvenile salmon. Surveys conducted by Oregon LNG did not identify eel grass at the terminal site. Judd et al. (2009) modeled the habitat suitability for eel grass in the lower Columbia River estuary to identify restoration areas where eel grass could be replanted. One site that Judd et al. (2009) considered for transplanting eel grass was along the east side of the Skipanon Peninsula, but this site was not selected because it was too deep. As mentioned above, the estuarine slope habitat impacted by dredging would be too deep to support eel grass as these areas would not receive enough light. Hydrodynamic modeling of the turning basin developed for the project determined that dredging would not alter local sedimentation. Therefore we conclude that, if present, nearby eel grass would be not be affected.

Because dredging effects on current velocities would be minor and localized, the proposed dredging would not affect conditions that control the ETM. Therefore, we conclude that aquatic resources would not be measurably affected in the ETM.

Changes to Hydrology and Salinity Regime

Oregon LNG modeled dredging effects and determined that dredging of the turning basin would have a small and localized effect on current velocities in proximity to the terminal area. This localized change of current velocities would occur mostly in deep water (deeper than 30 feet) and would not have an effect on shallow water habitat. No changes to current velocities outside of the turning basin would be expected after construction of the turning basin. The modeling predicts that the turning basin, once constructed, would have no effect on tidal and river flow velocities on a local or regional scale nor would it cause changes in sediment transport at the downstream boundary.

Hydrodynamic modeling indicated that post-construction bottom salinities would be well within the range currently experienced at the proposed berth and turning basin. Surface salinities showed no measurable differences between pre-project and post-project conditions. In addition, extreme river flow conditions would result in more mixing near the turning basin and lower overall salinity values. We would not expect changes in species composition/relative abundance to be large because the site routinely experiences wide fluctuations in salinity.

Food Web Effects

As discussed above (see *Direct Mortality*), dredging would result in the temporary loss of epibenthic and benthic invertebrates but these species would be expected to recover rapidly from effects of dredging because of their particular life cycles. In its biological opinion regarding navigation channel maintenance NMFS (2005) stated:

"…some prey species for rearing and migrating juvenile salmonids are likely to be lost for a given year's age class of juvenile salmonids per year of maintenance dredging, with the potential to reduce survival of some individual juvenile salmonids. However, these changes in prey availability are unlikely to be of a magnitude or extent that would appreciably diminish forage resources in the action area."

Benthic sampling conducted in May 2008 by Oregon LNG at the proposed dredge basin indicated that dredging of the berth could reduce the amount of prey available, including Baltic clam and polychaete. Species that could be affected include English sole, and to a lesser extent Dungeness crab,

starry flounder, eulachon, and Pacific tomcod, over the long term. However, English sole and starry flounder also feed on the same amphipods as juvenile salmonids, which are not expected to be significantly impacted by the dredging. Further, Baltic clams and polychaetes are abundant throughout the estuary and there is no data suggesting that the populations of Dungeness crab, English sole, or starry flounder are limited by food resources. Considering these factors, combined with the relatively small size of the proposed dredge prism, the potential long-term reduction in Baltic clam and polychaete production within the dredge prism is unlikely to have any effect on the health or functioning of the lower Columbia River estuary.

We conclude that dredging of the turning basin and berth would not alter food web relationships in other parts of the estuary. The changes in bathymetry and hydrology at the site would cause minor localized changes in the food web. However, no changes to the fundamental processes that support the existing food web (i.e., formation and distribution of microdetritus in the ETM) are anticipated.

Introduction of Exotic Species

Introduction of invasive species due to barges and support vessels using the work dock could affect aquatic species in the area. However, barges and tugs used for dredging would not discharge ballast water. In addition, local vessels would be used during construction of the terminal and the potential for invasive species introduction via hull attachment on these vessels would be negligible. Therefore, we do not anticipate the introduction of invasive species during dredging or other construction of the terminal.

Dredging Noise

Dredging activities would generate underwater sound pressure levels that could elicit responses in some fish and other aquatic organisms (Richardson et al., 1995). The intensity of the sound pressure levels from dredging activities, including tugs and barges, generally range between 112 to 160 decibels (dB) re: 1 microPascal (µPa) (Richardson et al., 1995, as referenced in FERC, 2007). These sound intensities may influence organism behaviors or perceptions, but would be unlikely to cause physiological damage (Richardson et al., 1995; NMFS, 2009b, Hanson et al., 2003).

Dredging Mitigation Measures

Oregon LNG would employ the following measures to avoid, minimize, and mitigate for potential effects on aquatic resources, particularly salmonids, during dredging activities:

- Dredging would occur in relatively deepwater areas and, therefore, avoid areas where subyearling Chinook and chum salmon are more likely to be present.
- Hopper dredge dragheads would be maintained in the substrate no more than 3 feet above the river bottom.
- The transition between the near-shore shallow-water habitat and the turning basin would be constructed so that the final slope is 5 horizontal to 1 vertical or flatter. This would minimize the potential for bank slumpage and potential loss of productive near-shore shallow water habitat where most of the juvenile salmonid use of the area occurs.
- Maintenance dredging frequency would be minimized by overdredging 2 feet in those areas of the dredge prism where sediment deposition is most likely. Post dredging monitoring of sediment deposition in the turning basin and berth would be conducted to better define the areas that require overdredging for subsequent maintenance dredging.

- Dredge operations would be monitored to ensure that activities are compliant with ODEQ regulations designed to protect fish and other aquatic resources.

Dredged Material Disposal

Oregon LNG has completed a draft Dredge Material Management Plan (CH2M HILL, 2013b) that describes dredging methods and equipment alternatives for the project, identifies and evaluates dredged material placement alternatives, and makes recommendations regarding dredged material management options. As described in section 2.1.1.1, dredged material would be disposed of at an existing permitted offshore disposal location known as the EPA Deepwater Site.

During the permitting process for existing disposal sites, the USACE examined the potential effects of disposal (EPA and USACE 2011). The potential effects investigated included burial of benthic invertebrates, temporary, negative impacts on water quality (both from resuspension of contaminants and high suspended solids), and noise and disturbance from the disposal activity. The analysis concluded that benthic food organisms would quickly recolonize the dredged material, and the reduction of available food would be inconsequential; the material for disposal is clean (uncontaminated) sand with low fines content and thus would not resuspend contaminants or clog fish gills; and salmonids could easily avoid the in-water disturbance with no adverse effects on growth or survival. Therefore, we conclude that all of the potential negative effects on nearshore ocean species have been thoroughly evaluated and there would be no measurable adverse effects on aquatic resource from Oregon LNG's use of this previously permitted disposal location.

Construction of Pier, Dolphins, and Access Trestle

The pier, access trestle, and dolphins would require the installation of 150 large diameter (42- and 60-inch) hollow steel pilings (see table 2.1.1-1). Installation of the pilings would result in a loss of 0.02 acre of shallow water habitat and 0.04 acre of deep-water habitat. This loss of habitat would be small and insignificant relative to available similar habitat in the lower Columbia River estuary. The pile-supported pier could result in small localized changes in current around the pilings; however, we expect no significant changes to current patterns or hydrology of the estuary (Coast and Harbor, 2009).

No grout or concrete would be injected around the piles during construction, nor otherwise exposed to waters of the estuary. Concrete would be poured into forms on the pier and access trestle, but BMPs would prevent release of concrete products to the water. These BMPs include watertight forms, a watertight "walkway" around each pour at least 3 feet wide so that misplaced concrete would be intercepted before entering the water, and a spill response plan. Oregon LNG's SWPPP (see appendix F1) includes a BMP for concrete curing.

Water-Based Construction Vessel Operations

Use of barges and other support vessels during terminal construction is not expected to increase shoreline erosion, benthic sediment disturbance, or prop channel bottom erosion in the terminal area as construction vessels would be slow moving and would not create substantial wakes. Some benthic sediment disturbance could occur when the barges are offloading at the terminal location or if jack-up barges are used; however, the use of barges would be temporary. In addition, vessel groundings are not likely due to the slow movement of the barges. We conclude that impacts associated with increased barge traffic on aquatic species would be temporary, and not significant.

Pile-driving Noise

Pile driving would be required to install piles for the pier, the access trestle, and breasting and mooring dolphins. This pile driving would create underwater noise, which could have adverse effects on fish and marine mammals (Hardyniec and Skeen, 2005; Vagle, 2003).

Effects on Fish

The intensity of underwater noise produced from pile driving typically depends on many factors, including, among other things, the type and size of the pile, the firmness of the substrate, the depth of water, and the type of hammer (Hanson et al., 2003). Pile driving with an impact hammer is the most sound-intense method. Vibratory hammers produce low-intensity sound waves compared to an impact hammer. Fish have demonstrated avoidance in response to a vibrating hammer (Knudsen et al., 1997), whereas pile driving hollow steel piles with an impact hammer has been shown to cause effects ranging from behavioral changes to fish mortality (Hanson et al., 2003). To the extent possible, Oregon LNG would initially install piles using barge-based vibratory hammers, which would result in reduced underwater and surface noise impacts. Final driving or "proofing" would be done with an impact hammer, the size of which would be determined at the time of construction.

The NMFS noise thresholds for injury to fishes (due to pile driving) are:

- peak pressure of 206 dB re: 1 µPa;
- 187 dB sound exposure level (SEL) (cumulative) for fish greater than or equal to 2 grams, the SEL is the total noise energy produced from a single noise event; and
- 183 dB SEL (cumulative) for fish less than 2 grams.

Current thresholds for disturbance to fish are represented as an impulse pressure, or root mean square (rms). The threshold for behavioral disturbance is 150 dB_{rms} re: 1 µPa (WSDOT, 2014). The areas around the piles that experience sound pressure levels exceeding the peak and SEL levels for injury are referred to as the "harm" zone, while those areas exceeding 150 dB_{rms} re: 1 µPa for disturbance are referred to as the "harassment" zone. These criteria should not be used to assess noise from vibratory pile driving because the thresholds for impact driving are likely to be much lower than for nonimpulsive, continuous sounds produced by vibratory drivers (Caltrans, 2009). Currently there are no formal fish criteria for vibratory pile driving.

Oregon LNG's technical memorandum entitled *Underwater Noise Propagation, Monitoring, and Mitigation* (CH2M HILL, 2009a), contains a discussion of the expected sound generated by pile driving for various pile sizes, SEL calculations, and potential mitigation measures. Oregon LNG's sound level predictions are based entirely on impact driving as a worst-case scenario.

The first row in table 4.1.5-4 presents the distance to the various NMFS noise thresholds for fish described above for anticipated pile strikes associated with impact driving of four or eight, 42-to-66-inch diameter piles per day without mitigation. The second row considers the application of a 20 dB sound reduction due to the use of bubble curtains and other noise attenuation devices (e.g., hammer cushion).

Table 4.1.5-4

Distances to Noise Impact Thresholds for Impact Pile Driving

	Distance to Noise Thresholds (feet) [a]					
			4 Piles per Day		8 Piles per Day	
Mitigation	**206 dB**	**150 dB_{rms}**	**187 dB SEL**	**183 dB SEL**	**187 dB SEL**	**183 dB SEL**
None	59	32,808	4,442	7,067	7,051	7,067
20 dB Mitigation	3	1,522	207	328	328	328

[a] Data based on 42- to 66-inch piles, but maximum proposed pile diameter is 60 inches.

Oregon LNG estimates that mitigation measures would reduce noise associated with pile driving by 20 dB. This amount of noise reduction is based on observations during construction of the Benicia Martinez Bridge in Contra Costa, California that found reductions of 17 to 34 dB were attained using both a confined bubble curtain contained within a larger pile surrounding the pile being driven (an "isolation casing"), and a "bubble tree" consisting of several separate bubble curtain sections which completely enclosed the piles and emitted bubbles through nine semicircular arcs on each section (Reyff, 2007). Noise attenuation methods are additive, and, therefore, a combination of methods (for example, bubble curtain plus hammer cushion) could reasonably result in a reduction goal of 20 dB.

With 20 dB of noise reduction, the peak sound pressure at a distance of 33 feet from piles in the 42- to 66-inch-diameter range would be 190 dB, the rms sound pressure would be 175 dB, and the cumulative SEL would be 165 dB. In calculating the distances to the harm and harassment thresholds, a number of conservative assumptions were made: 1) the number of strikes per day is higher than average based on WSDOT data (WSDOT, 2014); 2) although impact driving was assumed, in actual practice, piles would first be driven with a vibratory hammer, and an impact hammer would be used only to "proof" the piles or to drive piles where subsurface conditions preclude the use of a vibratory hammer; and 3) it is unlikely that more than four piles would be driven on any day.

Oregon LNG would use the in-water work period for pier construction recommended by the WDFW and ODFW that correlates to the period of the year with lowest salmonid abundance in the lower Columbia River to minimize the impact of pile driving and any other in-water work. Nonetheless, from November to February, some federally listed adult and juvenile salmonids are present in the estuary. These species, along with eulachon and green sturgeon and their designated critical habitat, are discussed further in section 4.1.8.1.

Other bony fish species are also present year-round in the lower Columbia River estuary and could potentially be affected by pile driving noise, but many of these species (such as sole and flounder) also lack a swim bladder. Fish that lack swim bladders, or ducted bladders, are potentially less sensitive to loud noises. The effects of loud sounds on fish are varied and range from acute and sometimes fatal effects (damage to auditory receptors and rupture of the swim bladder) (Hastings and Popper, 2009; Caltrans, 2004) to chronic effects such as behavioral changes and long-term stress (Hastings and Popper, 2009). Furthermore, because of their abundance, these species are unlikely to be affected on a population level. Assuming up to a 20 dB reduction, underwater noise would exceed thresholds of injury for fish out to 328 feet from the pile driving. This area would only represent a small fraction of the total width of the Columbia River at the terminal site (around 0.01 percent), but underwater noise could still interrupt migratory behaviors of fish because many fish species, including juvenile salmonids, use areas near the shoreline for migration. We conclude that noise reduction measures proposed by Oregon LNG would adequately minimize underwater noise from pile driving, and impacts on fish from pile driving would be temporary and localized.

Effects on Pinnipeds

Like fish, underwater noise has the potential to affect pinnipeds (i.e., seals and sea lions). For pinnipeds, NMFS suggests 160 dB_{rms} for the harassment threshold (level B harassment) and 190 dB_{rms} for the injury threshold (level A harassment) for impact pile driving and 120 dB_{rms} harassment threshold (level B) for vibratory pile driving. Potential underwater noise levels would likely exceed the harassment and injury threshold for pinnipeds.

Oregon LNG would conduct pile driving about 4 hours per day and Oregon LNG assumes that either four or eight piles would be driven per day. With a total of 152 piles in the current design, that would total 19 to 38 days of pile driving. For the purposes of modeling, Oregon LNG assumed that installation of piles could be accomplished over the course of one in-water work period and that the pile driving would be conducted evenly over the 4 months (November 1 through February 28). Assuming Oregon LNG's pile driving activities would occur 4 hours per day, if four piles are driven per day (38 days of driving), a potential noise exposure of approximately 152 hours would result. If Oregon LNG drives eight piles per day for 4 hours, the potential noise exposure would be 76 hours. Oregon LNG's in-water work period would coincide with the period of time that pinnipeds, including the Steller sea lions, use the South Jetty haulout (about 7 miles west of the terminal). The South Jetty haulout would be too far from the terminal to be directly affected by the pile-driving noise, but Steller sea lions that traveled upriver to the terminal could be affected.

Pile driving would also create loud airborne noises that could harass seals and sea lions near the terminal. According to NMFS, in-air noise greater than 100 dB_{rms} can cause behavioral disruption (e.g., flight response) to hauled-out pinnipeds (the thresholds for harbor seal is slightly lower at 90 dB_{rms}) (NMFS, 2015). Oregon LNG estimated that the maximum output from construction equipment noise at the terminal site (i.e., dredging, pile driving, general construction) would be less than 100 A-weighted decibels (dBA) at a distance of 50 feet from the source. However, WSDOT (2013) states that impact pile driving can produce in-air noise of 110 dBA at 50 feet, which would result in noises that exceed the in-air thresholds of disturbance for hauled out marine mammals (i.e., harbor seals) within 500 feet.

Pinnipeds, including California sea lion and harbor seals have been documented using various manmade objects as haulouts (e.g., navigation buoys, jetties, and docks) in the Columbia River, and near the terminal they are known to congregate around the South Jetty, Desdemona Sands, and Port of Astoria. However, airborne construction noise is not expected to extend into these areas, and therefore, harassment of marine mammals due to airborne noise is unlikely.

Pile-driving Mitigation Measures

Oregon LNG's noise mitigation strategy for pile driving would involve initial mitigation, noise monitoring during pile driving, and adaptive management to address any noise over the injury and disturbance thresholds. Oregon LNG would implement the following mitigation measures to address pile driving acoustic effects:

- observe the approved in-water work period for the Columbia River and possible curtailment in February to avoid the period when most salmonids are present;
- use vibratory hammers to the maximum extent possible;
- isolate shallow water piles completely within a dewatered cofferdam, when feasible;
- surround the pile being driven in water velocity of greater than 1.6 feet per second, by a confined bubble curtain (e.g., a bubble ring surrounded by fabric or metal sleeve) that

would distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column (NMFS, 2009a); and

- use noise-deadening hammer cushions.

Because no models exist that accurately incorporate the multiple variables that can affect sound propagation, Oregon LNG would monitor the actual pile driving noise during operations through the use of hydrophones. Oregon LNG would further minimize potential negative effects by adapting mitigation techniques based on measured sound pressure levels. Adaptive management strategies could include modification of bubble curtain design, change in hammer size and type, change in pile cap material, or other mitigation techniques as agreed upon during consultation with NMFS, should further noise attenuation methods be necessary. Oregon LNG would provide a written report on hydroacoustic monitoring to NMFS following completion of the pile driving.

Marine Mammal Monitoring

As described above, Oregon LNG proposes to adaptively manage pile driving to minimize noise by using some combination of hammer cushions (pile caps), stacked or confined bubble curtains, cofferdams, or other sound barriers. Even with mitigation, underwater noise likely would exceed the 190-dB pinniped injury threshold for individuals in very close proximity.

Oregon LNG outlined underwater noise monitoring protocols in CH2M HILL (2009a). Oregon LNG would monitor underwater noise using a hydrophone during pile driving, establish a seal and sea lion (i.e., pinniped) safety zone based on the threshold level for impact pile driving, monitor for the presence of pinnipeds, and cease pile driving if pinnipeds are visible within the zone where underwater noise exceeds the harassment threshold. The injury threshold for pinnipeds is 190 dB_{rms}. However, the NMFS has adopted a conservative interim threshold for disruption of behavioral patterns in pinnipeds of 160 dB_{rms} (level B harassment) for impact pile driving, and 120 dB_{rms} for continuous underwater sound (e.g., vibratory pile driving) (NMFS, 2009b). Vibratory pile driving would attenuate to ambient underwater conditions at 6.2 miles from the source; however, land masses and river bends are encountered well before this distance. The pinniped safety zone is defined as the distance to the threshold level from the impact driving.

Using a GPS unit**,** personnel in a boat would monitor the safety zone for the presence of pinnipeds. If pinnipeds are present, then trained marine mammal monitoring personnel would radio a "stop pile driving order" to construction workers. Pile driving would resume when no pinnipeds have been observed in the safety zone for a period of 5 minutes after they have surfaced. During pile driving, Oregon LNG would prepare daily monitoring reports send weekly summaries to the NMFS.

Given all of the mitigation methods Oregon LNG has proposed, we believe pile driving noise impacts on marine mammals would not be significant. In addition, Oregon LNG would apply to NMFS for an Incidental Harassment Authorization under the MMPA. The NMFS authorization, if granted, would prescribe permissible methods of taking, and requirements pertaining to the mitigation, monitoring, and reporting of such taking. The Incidental Harassment Authorization may include additional mitigation and monitoring measures to ensure that takings result in the least practicable adverse impact on affected marine mammal species or stocks.

Construction of Onshore Facilities

Construction of the onshore facilities has the potential to affect aquatic resources through withdrawal and discharge of water used for hydrostatic testing of the LNG storage tanks. There would

also be some losses of estuarine habitat and miscellaneous construction events that could impact aquatic resources such as hazardous materials releases, stormwater runoff, and construction lighting.

Hydrostatic Testing

Before LNG storage tanks are placed in operation, they would be hydrostatically tested using about 28 million gallons of water from either the Columbia River or the City of Warrenton, as described in section 2.1.4.1. A new intake would be constructed on the pier for withdrawal of water from the Columbia River. Hydrostatic test water withdrawn from the Columbia River would be screened to NMFS standards to minimize fish entrainment. Screening criteria include screen openings that do not exceed 0.07 inch in the narrow direction, and appropriate screen areas to allow for approach velocities that do not exceed 0.4 foot per second (fps). Water obtained from the City of Warrenton's POTW would be withdrawn through an existing intake, which is compliant with NMFS fish-screen criteria.

About half of the testing water would be reused for the cooling towers and half would be discharged to the City of Warrenton POTW (see section 4.1.3.2). Because all water would be treated in compliance with local, state, and federal criteria before discharge, we do not anticipate adverse effects on aquatic resources in the lower Columbia River estuary.

Loss of Estuarine Habitat

Oregon LNG modified the footprint of the shore-based facilities to avoid and minimize permanent impacts on important estuarine habitat. The proposed footprint would maintain existing intertidal mudflat habitat and minimize the loss of marsh habitats. Table 4.1.4-2 lists the amount of palustrine emergent marsh and estuarine emergent wetland habitat that would be lost to terminal construction. Both marsh and estuarine habitats contribute organic material to the estuarine food web through export of detrital material. Oregon LNG plans to compensate for these types of wetland habitat by creating new habitat at the Youngs River mitigation site as described in section 2.1.1.3. These measures would compensate for the unavoidable losses of marsh habitat, and comply with compensatory mitigation requirements of the USACE and the Oregon Department of State Lands. Because this mitigation is designed to be in compliance with the CWA, we conclude long-term detrimental effects on fishery resources from loss of estuarine marsh habitat would be adequately minimized.

Spills

Releases of diesel fuel, lubricants, hydraulic fluid, and other contaminants contained in LNG terminal construction equipment could potentially result in acute negative impacts on fish, invertebrates, and estuarine habitat. In addition, long-term effects could also result if a spill was not properly remediated. The chemicals released during spills could have a variety of effects on salmonids and other fish species including behavioral effects, changes in physiological processes, and changes in food resources. Some compounds are acutely toxic and could result in direct mortality or sublethal chronic consequences in high concentrations.

All over-water construction vessels would be fueled at existing commercial marine fuel docks. Such facilities have existing spill prevention systems in place that would avoid or immediately address any accidental spills. The only potential sources of contaminants at the pier, mooring dolphin, and access trestle during construction would be lubricating oils and fuel from the construction equipment itself. As described in section 4.1.3.1, Oregon LNG has developed an acceptable SPCC Plan (see appendix F1) that would minimize the potential for fish impacts related to spills. As presented in section 4.1.3.2, each LNG marine carrier would maintain a SOPEP as required by international convention, and all LNG marine carriers would comply with state spill prevention and contingency plans, including the applicable

requirements in Chapter 317-40 of the WAC – Bunkering Operations. Therefore, we believe spill risks would be adequately mitigated.

Surface Water Runoff

Surface water runoff during construction of onshore facilities could potentially cause detrimental effects on nearshore estuarine resources if not properly managed. To ensure proper controls are in place to prevent surface water contaminants and sediments from reaching the estuary, Oregon LNG would implements its SWPPP. BMPs included in the SWPPP include: diversion of runoff away from waterbodies, use of sediment fences, preservation of existing riparian vegetation to the extent practicable, and temporary and permanent seeding of areas where clearing is required. Therefore, we conclude that with measures in place to control runoff, impacts associated with surface water runoff would be minimized.

Construction Lighting

Construction would occur only during daylight hours; however, some lighting may be required early and late in the day or for specific tasks. If necessary, construction lighting would be directed at work areas to the degree possible, reducing the extent of impacts. Therefore, impacts on aquatic resources from construction lighting would be similar to impacts from operational lighting discussed below, although much less pronounced because of the anticipated short duration of lighting and the smaller number of lights operating at any one time.

Terminal Operations

Impacts on fish and other aquatic resources could occur from operation of the terminal facilities, including LNG marine carriers and maintenance dredging.

LNG Marine Carriers

The movement and operation of LNG marine carriers at the marine terminal would have the potential to affect aquatic resources in the lower Columbia River. The potential impacts include:

- bank erosion and increase suspended sediment levels;
- fish stranding;
- entrainment/impingement of aquatic species;
- cooling water discharges;
- exotic species introduction;
- vessel strikes; and
- potential fuel spills.

Bank Erosion and Fish Stranding

As discussed in section 4.1.1.1, we do not expect the LNG marine carriers to cause a measurable increase in bank erosion that could contribute to turbidity in the estuary. The wakes produced by deep-draft vessels transiting the lower Columbia River have been observed to cause occasional stranding of juvenile salmon (Hinton and Emmett, 1994; Pearson et al., 2006). Hinton and Emmett (1994) did not find stranding to be a significant cause of mortality to juvenile salmonids in the Columbia River; however, Pearson et al. (2006) observed a total of 126 vessel passages in the Columbia River, which resulted in 46 juvenile stranding events, and subyearling Chinook salmon accounted for 50 to 91 percent of the

stranded individuals. No strandings were observed as a result of vessels traveling at speeds under 9 knots. Fish stranding was localized in one or two spots at the three study sites, primarily areas with shallow sloping beaches.

Entrix (2008 as cited in Pearson 2008) studied beaches in the Columbia River to determine their degree of susceptibility to stranding. They examined transects at 200-meter intervals, from the mouth to RM 104. From the mouth to RM 13.0, Entrix (2008 as cited in Pearsons 2008) found no transects that met the first three screening criteria for stranding (channel confinement, distance from sailing line, and shielding features), and it was concluded that these areas were not susceptible to beach stranding. This finding is supported by the fact that the most downstream beach where salmon stranding has been observed is Tenasillahe Island at RM 38.3 (Entrix 2008 as cited in Pearsons 2008). When the screening criteria were combined, the farthest downstream locations identified as having more than minimal susceptibility to stranding were (1) at RM 22.0 on the Washington side, about 11 miles upstream of the terminal; and (2) at approximately RM 37.6 on the Oregon side (Entrix 2008 as cited in Pearsons 2008), about 26 miles upstream of the terminal.

Based on the results of the Entrix study (2008 as cited in Pearsons 2008), the low speeds of LNG marine carriers as they traverse the lower Columbia River estuary, and a lack of reported fish strandings in the vicinity of the project area, we conclude that fish stranding would be unlikely as a result of the proposed LNG marine carrier traffic. This is further supported by the fact that the terminal site would not contain broad, shallow beaches, and would not be within a confined portion of the lower Columbia River.

Entrainment/Impingement of Aquatic Species

As described in section 2.1.2.1 and table 4.1.3-4, export LNG marine carriers would take on cooling water while docked at the berth, and import LNG marine carriers (estimated two per year) would require both cooling water and ballast water. Vessels would take on water through openings, known as sea chests, on both sides of the hull. There is a potential that aquatic species could be entrained or impinged during cooling and ballast water intake through these submerged openings (e.g., sea chests). The potential for entrainment would be greater with ballast water withdrawal because of the larger volumes required, and the resultant higher intake velocities at the sea chests. The cooling water system operates independently of the ballast water system. However, the cooling water system could, and sometimes would, use the same sea chests as the ballast water system.

The number, size, and location of the sea chests used for ballast water withdrawal vary from ship to ship; however, most sea chests are equipped with a grate or trash rack consisting of 0.1- to 0.2-inch-wide bars spaced about 1 inch apart. These openings are therefore much larger than the screening criterion of 0.07 inch recommended by NMFS and ODFW for intakes where small fish are present. Most LNG marine carriers also have a filter inboard of the sea chest intake, consisting of a mesh with 0.2-inch openings. Because the typical intake screens size gaps and velocities would exceed ODFW and NMFS screening criteria, small fish could be entrained or impinged on the intake screen or filter if they swim in close proximity to the sea chest intakes during ballast and cooling water intake operations.

Susceptibility to Entrainment

The susceptibility of fish species to entrainment or impingement at ballast and cooling water intakes is dependent on a variety of factors. Variables that influence this susceptibility include the operational frequency and duration of intakes, velocities and volumes of water, migratory behaviors and seasonal patterns of specific species, and vertical and horizontal distributions of fish. Other important considerations include species-specific behavioral characteristics such as swim speed, avoidance or attraction, diurnal fluctuations, and lateral movements to streamflow.

Studies documenting entrainment of fish in ship ballast and cooling water are limited. Wonham et al. (2000) summarized the literature on this subject, which included documented fish species dispersals, introductions, and successful establishments via ballast water. They found 54 reports of 31 fish species collected from ballast tanks and 40 reports of 32 exotic species introductions attributable to ballast water. The authors found that gobies, herrings, and sticklebacks were the fish taxa most commonly found in ballast tanks, while gobies, blennies, and flatfishes dominated the successful introductions. No salmonids were found in ballast water. Wonham et al. (2000) speculated that the higher incidence of gobies and blennies in the ballast tanks was due to their affinity for small crevices and holes, which may lead them to actively seek out ballast intakes. The prevalence of sticklebacks was attributed to their ubiquity.

Wonham et al. (2000) reported that in most ballast water studies, few fish have been collected, but caution that these results likely under-represent the total numbers of fish in ballast tanks because of ineffective sampling methods. In a study of entrainment potential due to LNG ballast water intake operations on the east coast, Prakash et al. (2014) concluded that intake operations likely have very little effect on regional fish populations when considering the number of adults lost to the population (modeled based on the number of juveniles/larvae/eggs lost). The fish species considered in the study included sturgeon, shad, herring, anchovy, river herring, white perch, and striped bass.

Based on these and other studies, and the aquatic species that would potentially be present in the lower Columbia River estuary, it is possible that fish could be entrained and/or impinged by LNG marine carrier water intake operations. Entrainment of federally listed juvenile salmon and eulachon larvae is discussed in detail in section 4.1.8.1. Nonlisted fish species that could be susceptible to entrainment during water intake operations include Pacific lamprey, Pacific herring, American shad, northern anchovy, Pacific sardine, and several species of smelt, among others.

Like juvenile salmonids, Pacific lamprey abundance is highest from April through June. Very little is known about the distribution of lamprey within the estuary. Although the individuals present would be adults and large juveniles, previous analyses of swimming performance of the Pacific lamprey (Moursund et al., 2003; Mesa et al., 2003) indicate that the species is a relatively inefficient swimmer. It follows that lamprey near the sea chests during intake activities could be at risk of entrainment. However, a lack of data on lamprey population size, behavior, and distribution within the estuary makes assessing the risk of entrainment difficult.

The CREDDP study (Sherwood et al., 1984) documented the occurrence of several seasonally-common pelagic species in the lower Columbia River estuary including Pacific herring, American shad, northern anchovy, Pacific sardine, and several species of smelt. Although little information is available on the vertical distribution of the pelagic species, it is reasonable to assume that they are distributed throughout the water column, and juveniles could be susceptible to entrainment. Pacific herring 1 year and older were most abundant near the terminal location in spring, but some were present throughout most of the year. Pacific herring less than 1 year old were most abundant in summer. Because herring were found in previous ballast water sampling studies (Wonham et al., 2000), it is reasonable to assume that they could be entrained/impinged at the LNG marine carrier sea chests.

Northern anchovy less than 1 year of age were very abundant in the estuary during late summer and early fall, while adults can be found in the estuary during most of the year. Northern anchovy occur throughout the water column and are small enough to be entrained/impinged at the sea chests. American shad less than 1 year old were most abundant in fall, with none in spring or winter. American shad age 1 to 2 were most abundant in the vicinity of the terminal in winter and spring; adults (2 years and older) were not often abundant near the terminal except in the shipping channel in spring and summer. Adult American shad are strong swimmers and should be able to avoid entrainment. Surf smelt and longfin

smelt are present in the estuary throughout the year, with juveniles being most abundant in spring and early summer.

Early-stage larvae are surface oriented and would largely avoid entrainment but as larvae mature, they move to lower portions of the water column (California Department Fish and Game, 2001) and may become more susceptible to entrainment. Ichthyoplankton (fish larvae and eggs) could be entrained in the ballast and cooling water. Jones and Bottom (1984) and Misitano (1977) found that larval fish abundances in the lower Columbia River estuary were highest in winter and spring. Larval fish and fish eggs would only be susceptible to entrainment during part of the year, as the density of eggs and larvae decreases beginning in late spring until none are present from late summer through December (Jones and Bottom, 1984). Further, eggs that float would not likely be entrained by intakes below the surface.

Entrainment Mitigation

The typical solution for minimizing the impact of water withdrawals is to place screens across the openings. As discussed above, NMFS and ODFW have specific criteria for screen mesh openings and approach velocities. Both NMFS and ODFW have requested screening of the ballast and cooling water taken on by the LNG marine carriers associated with this project.

The Coast Guard has expressed concerns regarding any system for LNG vessels that requires a design and construction change, or equipment to be installed onto the LNG vessel, such as fish screens attached directly to the vessel or the installation of equipment and piping in the vessel to accommodate shore-side supplied screened water hook-ups (see appendix B1). The Coast Guard stated that the "use of any untested and internationally unrecognized water intake systems may have negative consequences for vessel safety and security, as well as adverse economic impacts." Adverse system impacts could include a reduction in cargo offload capacity, the potential for power loss to the vessel, potential impediments to a vessel's ability to perform an emergency disconnect or emergency offloads, and a reduction in water availability for the purposes of firefighting.

Extensive analysis by Oregon LNG, which has included close consultation with NMFS, ODFW, FWS, and other interested parties, has failed to identify a viable increased screening option of the sea chests. Furthermore, no available, or foreseeable, fish-screen technology would exclude ichthyoplankton.

Regardless, Oregon LNG has indicated it is committed to ongoing coordination with federal and state agencies to develop strategies to minimize potential effects of ballast and cooling water intakes on fish. Oregon LNG proposes to mitigate the impacts of entrainment through off-site habitat improvements as described below.

Cooling Water Discharges

The cooling water temperature at the discharge point from LNG marine carriers would be no more than about 11 to 16 °F warmer than at intake. Point source thermal discharges in Oregon must comply with four temperature standards (OAR-340-041-0053(2)(d)): impairment of active salmon spawning, acute impairment or instantaneous lethality, thermal shock, and migration blockage. In addition, temperature standards must be met within the mixing zone boundaries for each waterbody subject to the discharge (OAR-340-041-0053). These additional temperature standards apply in proximity to thermal point sources (including within mixing zone boundaries), and are described below.

- **Impairment of Active Salmon Spawning.** Prevented by limiting potential fish exposure to temperatures of 55.4 °F or less if salmon or steelhead are spawning near the location (not applicable to terminal site—no spawning areas).

- **Acute Impairment of Instantaneous Lethality.** Prevented by limiting potential fish exposure to temperatures of 89.6 °F or more to 2 seconds (not applicable to terminal site because no discharge temperatures would exceed 89.6 °F; however, recent instream summer temperatures near Astoria have approached 70 °F, and therefore the higher range of discharge temperatures could seasonally approach this number).
- **Thermal Shock.** Prevented or minimized by limiting potential fish exposure to temperatures of 77 °F or more to less than 5 percent of the cross-section of 100 percent of the 7-day, 10-year low flow ([7Q10]; the 7-day period with the lowest river flow with a recurrence interval of 10 years) of the waterbody (not applicable to terminal site since thermal discharge would not extend to 5 percent of cross-section of Columbia River).
- **Migration Blockage.** Unless the ambient temperature is 69.8 °F or greater, migration blockage is prevented or minimized by limiting potential fish exposure to temperatures of 69.8 °F or more to less than 25 percent of the cross-section of 100 percent of the 7Q10 low flow of the waterbody.

Of these, the 11 to 16 ºF temperature increase approaches the temperature thresholds for only migration blockage. As shown above, Oregon's mixing zone rule (OAR 340-041-0053) states that salmon migration blockage would be avoided/minimized if temperatures of 69.8 °F or more are limited to less than 25 percent of the cross-sectional area of the receiving body. Based on water temperature and diffusion modeling information provided by Oregon LNG (CH2M HILL, 2008) the thermal plume generated by the proposed project would be very limited in size, rapidly dissipate within the mixing zone (within a maximum of 2 minutes following discharge), and be completely diffused within a maximum of 67.9 feet of the LNG marine carrier discharge port and to a maximum depth of 19.7 feet. This results in a thermal plume occupying much less than 1 percent of the total cross-sectional area of the Columbia River. As a result, we conclude that the localized temperature increases caused by the proposed cooling water discharge would not negatively affect migrating or rearing salmonids and migration would not be blocked.

Ballast Water Discharge and Exotic Species Introduction

Unintentional introduction of exotic species is a concern in Pacific Northwest estuaries because invasive species can disturb ecosystems and impact native species. The project would increase ship traffic into the lower Columbia River estuary by two to four ships per week. When the terminal operates under import mode, LNG marine carriers would enter the estuary with a full load and not discharge ballast water into the estuary. When the terminal operates under export mode, the ships would undergo open-ocean ballast water exchange or ballast water treatment in accordance with OAR 340-143-0001, greatly reducing the likelihood of exotic species introductions via ballast water. Further, in recognition of the potential for introduction of nonnative organisms to the project area, discharge of ballast water will comply with 33 CFR Part 151 Subpart D, "Ballast Water Management for Control of Nonindigenous Species in Waters of the United States."

In the case of vessel fouling, long-distance voyages over wide latitudes and bioregions would comprise an effective mitigation to aquatic invasive species. In addition, the LNG marine carriers would move at sea speeds up to approximately 20 knots which would also preclude the survival of hydrodynamically-sensitive species. Davidson et al. (2006) concluded that ship hulls were transporting nonindigenous species to the lower Columbia River in large numbers, but that the environmental receptiveness of the Lower Columbia River, particularly the acute reduction in salinity and the limited habitat availability, likely was limiting many species from establishing viable populations. The ports of origin of the LNG marine carriers would depend on market forces and shipping costs, but most of the

shipments are expected to be bound for Asia. The low salinities (compared with seawater) of the berth location, likely precludes the ability of most exotic organisms attached to the hull or exterior superstructure of the tankers to survive as invasive species if released within the lower Columbia River estuary. Therefore, we conclude impacts from vessel fouling or ballast water discharge into the lower Columbia River estuary would not noticeably add to that currently experienced in the project area.

Vessel Strikes

There is potential, although limited, for a vessel strikes on a marine mammals, particularly whales, to occur over the life of the project. An analysis of potential, species-specific vessels strikes is presented in section 4.1.8.1.

Spills

Fuel (e.g., diesel) used for vessel propulsion or auxiliary/emergency generators on an LNG marine carrier could potentially spill or leak. However, fuel on each carrier is protected by the vessel's double hull. Furthermore, each LNG marine carrier would maintain a SOPEP and would also be required to comply with state spill prevention and contingency plans, including the applicable requirements in Chapter 317-40 of the WAC – Bunkering Operations.

In the highly unlikely event that LNG is spilled into the water from an accidental or intentional breach of an LNG marine carrier during transit, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Being less dense than water, LNG would float on the surface before vaporizing. Impacts on fish and fishery resources would be minor, localized, and short term.

Maintenance Dredging

Oregon LNG would conduct maintenance dredging every 3 years during the period from June 1 to September 30. Dredged materials would be disposed of at the same location identified for initial dredging. Impacts associated with maintenance dredging would be similar to those discussed previously for the initial construction dredging. Like initial dredging, maintenance dredging would remove immobile benthic organisms from the 109-acre dredge area. The effects of maintenance dredging would be similar to those for the initial dredging but smaller in scale because only one-fourth of the volume of material (about 300,000 cy) would need to be removed.

Terminal Facilities

Other LNG terminal facility operational impacts that could affect aquatic resources include:

- noise;
- artificial lighting from over-water and shore-side facilities;
- shading from over-water facilities;
- water withdrawals and discharges;
- potential spills of hazardous materials;
- habitat modification; and
- attraction of avian predators.

Noise

Potential sources of operational noise include increased ship and tug traffic in the lower Columbia River estuary marine transit area, and acoustic impacts from maintenance dredging and equipment

operation at the terminal. LNG marine carrier and tug operations along the vessel transit route would generate underwater sound pressure levels that could elicit responses in marine organisms. These responses would likely be limited to avoidance of the noise source, or temporary disruption of foraging activities. Sound pressure levels are generally in the range of 112 to 160 dB (re: 1 µPa); intensities that may influence organism behaviors or perceptions but are not great enough to cause physiological damage (Richardson et al., 1995).

In summary, although large vessel traffic through the lower Columbia River estuary would increase with the project, fish in the terminal area are currently subjected to some disturbance from on-going ship traffic through the navigation channel. LNG marine carriers would generate underwater noise that would contribute to the noise associated with existing shipping traffic but noise levels are not expected to reach levels that could harm fish. Therefore, we conclude that terminal operations would not likely produce underwater sound pressures that result in physiological damage to aquatic species.

Lighting

Localized changes in light can, among other things, disorient fish, delay migration and predator avoidance responses, and attract potential predators (Simenstad et al., 1999; Tabor et al., 2004). While Oregon LNG would require some lighting at all times on the pier and access trestle, more intense light would be required during unloading operations, a maximum of 2 days per week. Oregon LNG would use the minimum amount of light necessary to complete operation tasks and meet requirements for safety and security. All lighting would be directed to work areas in order to minimize stray light.

Lighting would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting. Oregon LNG would minimize the potential for lighting effects on fish resources by using: (1) directional lighting facing onshore to the extent possible; (2) screens or lighting hoods; (3) motion-activated lighting; and (4) full-cutoff light fixtures, which have no direct uplight, help eliminate glare, and are more efficient by directing all lighting down to the intended area only. Oregon LNG would also plant vegetation along the shoreline to screen open-water areas from operating lights. With implementation of these proposed measures, we conclude that lighting impacts on aquatic resources would be minimal and limited to the immediate proximity of the terminal.

Shading

Shading from over-water structures reduces the amount of light available to phytoplankton and aquatic plants. However, there is no submerged aquatic vegetation in the terminal location and primary productivity in the water column is low. Shade can also hide predators, thereby potentially increasing predation on small fish (Tabor et al., 2004).

The over-water structures associated with the terminal would consist of a trestle, loading/unloading platform, four breasting dolphins, six mooring dolphins, interconnecting walkways, and associated piping and equipment. Structures oriented north–south cast less significant shadows than similar structures oriented east–west. The longest portion of the terminal marine facilities would be the roughly north–south-oriented access trestle (2,128 feet long and 28 feet wide or 59,584 ft^2), which would support an 8-foot-wide road that would be constructed with grated metal decking, thus reducing shading. The unloading platform would be oriented roughly east–west with 4,380 ft^2 of open-grid steel deck and 5,670 ft^2 of solid surface. The pilings and breasting/mooring dolphins would also cast shadows but are significantly smaller, with the largest mooring dolphins being 816 ft^2.

The grated metal decking over much of the docking platform and trestle would allow light transmission. The platform would be offshore in deepwater (i.e., greater than 20 feet MLLW) and would

not shade shallow water habitat. Shading of shallow water habitats by the trestle is expected to be minimal because of the narrow north–south axis and its height above the water (the elevation of the base of the trestle slopes towards the terminal and is between 20.2 and 25.5 feet [NAVD 88]).

The pier and access trestle would result in some minor shading of water column phytoplankton, causing a subsequent decrease in phytoplankton (and resultant detritus) production. However, we conclude this decrease would not have a significant biological consequence.

Water Withdrawals and Discharges

As described in section 2.1.1.1, the terminal fire protection system would use both domestic water from the City of Warrenton and river water from the Skipanon River through a screened intake. Water for the deluge system would be fed from dedicated pumps taking suction from an intake on the Skipanon River. The intake structure would be designed using NMFS screening criteria to keep salmonid fry from entering the intake. Testing of the fire suppression system would be a nonconsumptive use of water, as all water would be returned to the system following completion of the tests. The intake structure would also serve as the water outlet following testing. Oregon LNG would discharge into the intake structure so that the intake screen serves to distribute flow into the river. The discharge rate would be controlled so the velocity of water flowing through the screen is less than 0.4 feet per second, which would prevent fish impingement, as well as scouring of substrates as the test water is returned to the river.

We do not anticipate that testing would result in more than minor changes in water temperature because the water would be re-circulated through the piping for 30 minutes weekly and for 2 hours once per year. Therefore, effects on fish would be minimal.

As described in section 2.1.1.1, during operation, stormwater that falls onto impervious surfaces at the terminal would be conveyed to the stormwater treatment system and would either be used as makeup water for the cooling tower or discharged to the City of Warrenton POTW, and into the Columbia River. Because of the size of the lower Columbia River estuary as a receiving body, the treatment of the water, and discharge water diffusion technology, we do not anticipate that discharges of stormwater would affect aquatic resources in the lower Columbia River estuary.

Spills

Before beginning operations, Oregon LNG would prepare spill plan for operation of the terminal that would meet state and federal agency requirements. Implementation of this plan would reduce the potential for spills of fuels and hazardous materials at the terminal. In the event of a release, the plan would provide measures for containment and cleanup, minimizing potential impacts on aquatic resources.

The potential for LNG spills at the terminal would be greatly reduced by numerous design and security measures, including multi-walled tanks, secondary containment of piping and onshore tanks, and leak detection equipment. If a spill were to occur and reach the river, the LNG would float on the surface before vaporizing, and the impacts on fish and fishery resources would be minor, localized, and short term.

Habitat Modification and Aquatic Species Production

The shoreside component of the terminal would result in the loss of emergent plant production on about 12.1 acres of tidal marsh, including 12.0 acres of high marsh, and 0.1 acres of low marsh. However, the absence of tidal channels in existing high marsh habitat currently prevents fish from accessing the high marsh and limits the availability of terrestrial invertebrates to the fish and estuary. Therefore, the loss of 12.0 acres of high marsh habitat would have little impact on benthic

macroinvertebrates or other fish food organisms. The loss of low marsh habitat would result in the loss of a small amount of rearing habitat for small fish, and the loss of both low and high marsh habitats would result in a reduction in the contribution of organic material (i.e., detritus) to the lower Columbia River estuary.

Section 4.1.4.1 describes Oregon LNG's efforts to avoid and minimize impacts on wetlands in the terminal area. Unavoidable permanent wetland impacts would affect fish habitat. Oregon LNG would provide compensation for impacts on tidal marsh by restoring a tidal marsh area on the Youngs River, as detailed in section 4.1.4.3. Therefore, with the implementation of mitigation, we anticipate that long-term detrimental effects on fishery resources would be minimized.

Attraction of Avian Predators

The pilings, pier, trestle structures, and other structures at the terminal could potentially provide roosting areas for avian predators, such as cormorants. The tops of the pilings would be capped with cones designed to prevent roosting. In the event that predatory birds begin using the platform, terminal, or access trestle, Oregon LNG would implement an adaptive management plan in consultation with local ODFW biologists to prevent roosting. Potential exclusion methods would vary, depending on the bird species involved and the specific roosting locations. Before exclusion methods are implemented, Oregon LNG would submit any management plan to the FWS for comment.

In the unlikely event of nesting on facility structures, nests would be removed immediately upon discovery. If a nest becomes established and it is not discovered until young birds are present, the disposition of the nest would be handled in accordance with the provisions of the MBTA. We conclude that these measures would minimize the likelihood of attracting avian predators and limit their increased impact on fisheries in the terminal area.

Pipeline Construction and Operation

The effects on fish and aquatic habitat from pipeline construction and operation are primarily related to waterbody crossings and associated construction activities necessary to install the pipeline under waterbodies and through adjacent riparian corridors. Therefore, the pipeline route was selected, in part, to minimize the number of crossings of waterbodies that support fish and other important aquatic resources. Where stream crossings were unavoidable, the pipeline crossing was oriented as close to perpendicular to the axis of the waterbody channel as feasible. Oregon LNG organized numerous meetings and site visits with resource agency personnel (including NMFS, FWS, ODFW, ODF, and Native American tribes) to gather input during the pipeline route selection process. At the request of agencies, Oregon LNG changed a number of the crossings originally planned for the flume crossing technique to the HDD crossing method during the site selection process.

The pipeline would cross 186 waterbodies in both Oregon and Washington, including crossings of the same waterbody at multiple locations. Oregon LNG would cross all waterbodies that are flowing at the time of construction using either the flume or HDD method. Intermittent or ephemeral streams that do not support fish and are dry at the time of crossing would be crossed using conventional upland construction techniques. As described in detail in section 2.1.4.2, the flume technique uses upstream and downstream dams to isolate the crossing area, and a flume (pipe or trough) is used to bypass the flowing water around the work site. A pump would be used in most cases to dry the work area between the dams following work area isolation. HDD has the lowest potential for negative effect because this technique would not involve actions within the waterbody channel and near-channel riparian zone; however, HDD has its own limitations and risks. For example, drilling fluid used during HDD can escape through fractured bedrock and sands and enter waterbodies and wetlands. Drilling fluid typically consists of a

mixture of bentonite, water, and soil cuttings but can still negatively affect water quality by increasing turbidity. The risk of an inadvertent release of drilling fluid depends on subsurface conditions. Additionally, HDD is not feasible under certain geologic or topographic conditions and requires a relative large workspace.

A list of proposed waterbody crossings and proposed crossing methods, including in-water work periods, is presented in appendix G1. Crossings of streams that contain habitat for federally listed fishes are discussed in section 4.1.8.1. Not all of the waterbodies support fish. Impacts associated with pipeline construction would depend on the crossing method used, the timing and duration of in-water construction, and other factors such as post-construction stabilization of streambanks and restoration of riparian vegetation.

To minimize impacts on fish, Oregon LNG would cross waterbodies that support fish in Oregon during in-water work windows designated by the ODFW, and for those in Washington during in-water work windows approved by the WDFW. Oregon LNG would adhere to the recommended work windows unless an extension of those work periods is requested and granted. In-water work periods are variable, depending on the region and the waterbody; start dates can begin as early as June 1 and end dates are as late as October 15 (see appendix G1). As stated previously, the Columbia River (Oregon and Washington) window is November 1 through February 28. Oregon LNG anticipates requesting a modification for the crossing of the Columbia River at Deer Island because the HDD would not involve in-water work.

Waterbody crossings methods outlined in its Procedures would limit water quality impacts during construction. Oregon LNG would cross intermittent or ephemeral streams that do not support fish and dry at the time of crossing using conventional upland construction techniques. Oregon LNG would cross other waterbodies using the most appropriate dry crossing techniques determined at the time of construction and in consultation with the appropriate regulatory agencies. Construction activities would be scheduled so that the pipeline trench is excavated immediately prior to pipe-laying. In accordance with its Procedures, Oregon LNG would limit the duration of construction in the streambed to 24 hours across minor waterbodies (10 feet wide or less) and 48 hours across intermediate waterbodies (between 10 and 100 feet wide). All activities associated with the stream crossing (including initial setup, stringing of the pipe, flume installation and break-down, and regrading of the banks) could take 3 to 4 days. Oregon LNG would stockpile excavated spoils at least 25 feet from the edge of the waterbody, install erosion control devices, and stabilize disturbed soils within 50 feet of the top of streambanks after disturbance.

Salmon Anchor Habitat Basins

The pipeline route crosses one designated SAH Basin—Upper Rock Creek. Oregon LNG would conduct clearing related to pipeline construction on state forest land in the Upper Rock Creek Basin consistent with the SAH strategy. The strategy aims to lower short-term risk to salmonids in SAHs while landscape strategies foster the development of properly functioning aquatic systems and suitable habitat forest-wide. Primary forest operations on state forest land in SAHs are subject to limitations on management activity levels and timber harvest, set forth in annual operations plans of the state forests.

Direct Mortality

The potential for direct mortality of nongame fish, coldwater residents (e.g., cutthroat trout), and anadromous migrants present during construction would be reduced by Oregon LNG's use of dry crossing methods and fish salvage. Oregon LNG would remove fish from in-water work areas prior to excavation using seining and/or electrofishing. Oregon LNG would obtain all appropriate fish handling

permits from ODFW, WDFW, and NMFS prior to commencing fish salvage, and would relocate all collected fish to an appropriate area within the same waterbody. Fish salvage methods are described in appendix F5.

Pipeline installation would result in the loss or displacement of benthic invertebrates within the waterbody crossing construction zones (i.e., typically 75 feet wide). However, invertebrates would recolonize the disturbed area after construction. Organisms such as mayflies, caddisflies, and midge larvae that drift with the stream current would more rapidly recolonize disturbed areas.

Sedimentation and Turbidity

Increased sedimentation from trenching and backfilling at the waterbody crossing locations, continuing erosion from waterbody crossing bank cuts, and runoff from cleared rights-of-way in vegetated riparian areas could impact fish and aquatic resources within the pipeline project area. Increased sediment load can cause siltation of gravel streambeds (thereby decreasing their suitability as spawning habitat), suffocation of eggs in the substrate, filling of pool habitat, and a reduction in benthic macroinvertebrates. Additionally, suspended sediments can reduce feeding efficiency, clog gill rakers, and erode gill filaments (Kerr, 1995).

Reid and Anderson (2000) found that isolated water crossings can be effective at reducing the risk of sediment-related adverse effects on downstream fish and fish habitat. Proper construction and implementation of Oregon LNG's Plan and Procedures would limit sedimentation increases at dry waterbody crossings to the short periods of time when isolation dams would be installed and removed. This would minimize turbidity to a relatively short pulse of sediment associated with the reestablishment of streamflow over the disturbed sediments.

Ongoing streambank erosion following completion of construction would be a concern where bank-cuts pass through softer (nonbedrock) substrates. Streambank erosion would be limited by minimizing clearing of riparian vegetation, grubbing only over the trench line, leaving root stock in place for erosion control and rapid post-construction vegetative regeneration, in addition to seeding and mulching, planting native vegetation (where necessary), and in some cases using biodegradable erosion control fabrics. Measures contained in Oregon LNG's Plan and Procedures require it to monitor and report on areas disturbed by construction to ensure that bank stabilization methods are effective in abating increased sedimentation. Restoration of waterbody crossings is also addressed in Oregon LNG's Conceptual Mitigation Plan (see appendix F3).

Oregon LNG would use the HDD crossing method on large streams and rivers and on smaller streams where particularly sensitive fish habitat is at risk. While the HDD crossing method would avoid direct impacts on the waterbody channel, this method has the potential for inadvertent releases of drilling fluid into the waterbody (see section 2.1.4.2). Drilling fluid primarily consists of water and bentonite, a naturally occurring clay material. Bentonite, as with any fine particulate material, could interfere with oxygen exchange by the gills of aquatic organisms. Additional potential effects related to the release of bentonite into a waterbody would be the same as described above for increased sedimentation.

Oregon LNG has developed acceptable site-specific crossing plans for HDD waterbody crossings (see appendix G3) and an acceptable contingency plan (see appendix F1) in the event of an inadvertent release. HDD entry and exit pits would be a minimum of 75 feet from sensitive waterbodies, which would minimize the potential for an inadvertent release into a waterbody, as the greatest potential is near the entry and exit locations. Therefore, we conclude that the likelihood of impacts on aquatic resources due to inadvertent releases is low.

Fish Passage

Oregon LNG would avoid impediments to fish passagethrough pipeline burial and the use of HDD crossing methods. Most waterbody crossings would be completed within 24 to 48 hours and crossed using flume or open cut methods, thereby minimizing fish passage delay. HDD crossings would not hinder fish passage as in-water work is not required for this method. Oregon LNG would not cross streams known to support anadromous fish during periods of adult upstream migration; downstream juvenile salmonid migrations would be available via bypass flume or culvert. If construction across a waterbody would require more than 3 days, then Oregon LNG would:

- install upstream passage in conformance with ODFW, WDFW, and NMFS fish passage regulations;
- complete the crossing if it is determined that extending the in-water work to construct an upstream-passage facility would be biologically counter-productive; and
- consult with the ODFW, WDFW, and NMFS to determine other measures on a case-by-case basis.

During construction, regardless of duration, Oregon LNG would maintain adequate flow rates to protect aquatic life and avoid disruption of downstream uses. Oregon LNG would monitor the area within 1,000 feet downstream of each crossing for distressed fish and other aquatic biota. Pipeline construction would take place within in-water work windows (except for tidal sloughs), which would avoid sensitive life history periods for fish. In addition, Oregon LNG would cross many waterbodies using the HDD method.

Over time, vertical and lateral scouring of waterbody channels could potentially result in exposure of the pipeline and possibly create fish passage barriers. Oregon LNG completed a scour analysis to determine scour potential for waterbodies that support sensitive fish species. Based on the results of the analysis, Oregon LNG designed pipeline crossings so that the potential for scour would be minimized.

At all waterbody crossings, Oregon LNG would bury the top of pipeline a minimum depth of 3 feet below the streambed. At waterbodies that Oregon LNG characterized with a moderate to high scour potential, the pipeline would be buried deeper than 3 feet to prevent pipe exposure due to scour. Appendix of F of Oregon LNG's Conceptual Mitigation Plan contains a table of waterbodies classified as having moderate to high scour potential (see appendix F3). Oregon LNG would also monitor crossings over the life of the project and address channel subsidence, bank erosion, channel scour, or other negative long-term effects of pipeline construction using case-specific responses in coordination with the appropriate resource agencies (e.g., NMFS, ODFW, and FWS).

Prior to construction, Oregon LNG would prepare a Fish Passage Plan to meet ORS 615-412 and OAR 509.580. This plan would address temporary (construction-related), post-construction, and permanent (operation-related) fish passage issues at specific waterbody crossings along the pipeline route. Through implementation of these conservation measures and maintenance activities required by PHMSA, Oregon LNG would minimize the likelihood of pipeline exposure due to long-term scour and channel migration. Furthermore the condition of the pipeline would be monitored regularly during operation in accordance with PHMSA requirements. Therefore, we conclude that there is low potential for the development of fish passage barriers due to pipeline exposure.

Riparian Vegetation

Riparian areas currently support upland conifer or deciduous forest, agricultural crops, orchards, pastures, or tree plantations. Oregon Forest Practices Act rules determine allowable activities and riparian vegetation to be retained within forested riparian areas. Riparian management area widths vary from 50 to 100 feet for fish-bearing waterbodies, and from 10 to 70 feet for nonfish-bearing waterbodies. In addition, provisions are made for retaining snags, downed wood, dead trees, hardwoods (where appropriate), all trees leaning over the channel, and all live trees within 20 feet of waterbodies (except some small nonfish-bearing waterbodies). Also, all understory vegetation within 10 feet of the ordinary high water (OHW) elevation must be retained.

Pipeline construction requires vegetation clearing within the 100-foot-wide construction right-of-way. For perennial streams, this amounts to about 1.8 acres (100 feet wide by 800 feet long); for intermittent/ephemeral streams, it amounts to about 0.9 acre (100 feet wide by 400 feet long). The area of potential effect for any given stream crossing could be slighter more where ATWS are present and slightly less where the construction corridor is narrowed to 75 feet wide through a portion of the riparian buffer. In addition, streams crossed by the HDD method would have fewer riparian effects because clearing would not occur between the drill entry and exit.

Oregon LNG has finalized its proposed pipeline route to avoid and minimize impacts on areas containing mature riparian vegetation function along important fisheries, as practical. Oregon LNG would retain important specimen trees, significant wildlife snags, and nest trees in riparian areas, where possible and safe to do so; salvage natural habitat features, such as logs greater than 12 inches in diameter, downed large wood, and rocks; and control noxious weeds. The actual area of disturbance would depend on preconstruction vegetation conditions and the effective riparian area providing functions to support adjacent aquatic organisms and stream habitat. Riparian habitats crossed by the pipeline are listed in appendix G5.

After pipeline construction, Oregon LNG would revegetate the right-of-way to preconstruction riparian conditions. Plantings would consist of a mixture of native tree, shrub, and grass/forb/legume species. Revegetation and restoration of the riparian zone would reduce the potential for bank erosion, and would restore the nutrient-filtering function of the riparian zone. At forested riparian areas, a 10-foot-wide zone centered over the pipeline may be mowed every 1 to 3 years, and trees exceeding 15 feet in height may be removed from a 30-foot-wide corridor centered over the pipe for aerial inspection surveys and maintenance. As a result, about 70 percent of the entire 100-foot-wide corridor would be rehabilitated to native tall-growing trees where vegetation clearing would occur, 20 percent would be converted to native small trees (less than 15 feet tall) or shrub habitat, and 10 percent would be converted to herbaceous cover or small shrubs. For streams that contain federally listed or EFH species, Oregon LNG would not limit tree size except in the 10-foot-wide herbaceous center strip.

Water Temperature

Removal of riparian vegetation could reduce waterbody shading and result in increased water temperatures. Higher water temperatures and increased light exposure could increase production of instream microorganisms, algae, fungi, and macroinvertebrates; thereby increasing the food base for salmonids and boosting salmonid production. However, many waterbodies in western Oregon, including the Columbia River, already are considered temperature-limited for coldwater fish species. Therefore, any increase in temperature is considered a negative impact. Oregon LNG would cross all of the waterbodies listed (CWA 303(d)) as temperature sensitive using HDD, thereby avoiding loss of streamside vegetation. At flume and open-cut crossings, the removal of riparian vegetation would be minimized to the extent practicable, as described under *Riparian Vegetation*, above.

Oregon LNG used the USGS Stream Segment Temperature Model to compare nonvegetated and vegetated riparian scenarios and estimate temperature increases at waterbodies where riparian vegetation would be cleared for pipeline construction (CH2M HILL, 2009b). Modeling results predicted that the mean temperature rises would range from a minimum of 0.01 °F in a 2-foot-wide stream during high flow to a maximum of 1.5 °F in a 30-foot-wide stream during low flow, but in most cases clearing of the full 100-foot-wide right-of-way could result in temperature increases around 0.1 °F. We conclude that it is unlikely that the resultant increase in incident solar radiation would be sufficient to cause biologically significant increases in downstream water temperatures. Currently, it is common for gaps to exist in the riparian canopy cover that would be comparable in size to the proposed construction right-of-way. Temperatures would be expected to equilibrate to ambient conditions within 500 to 1,000 feet downstream, as has been shown in effects of vegetation removal studies (Zwieniecki and Newton, 1999). Over time, as riparian trees grow and mature, the impacts on streamside shade would be reduced and preconstruction conditions would return. Instream temperature changes are anticipated to be minimal.

Large Woody Debris

LWD is important as a cover for fish and habitat for macroinvertebrates. The proposed pipeline construction would result in the long-term and permanent clearing of woody riparian vegetation and short-term localized shifting of LWD in the waterbody channel to allow equipment access for installation of cofferdams and trench construction.

Possible effects of LWD loss on fish habitats and species depend on local species presence, the amount of existing LWD in aquatic and riparian areas, the ability of adjacent riparian habitats to compensate for reduced recruitment in the pipeline corridor, the rate at which temporarily affected riparian habitat can regain LWD delivery potential, and LWD replenishment and enhancement through mitigation actions.

To compensate for the disruption of LWD recruitment potential and shifting of instream LWD, Oregon LNG has agreed to replace LWD removed during construction and restore the woody riparian corridor, to replenish source areas for LWD recruitment. At waterbody crossings where LWD is lacking, Oregon LNG has agreed to install LWD at certain waterbody crossings determined by consultation with ODFW and DSL to improve habitat quality. In areas where Oregon LNG would remove unmerchantable trees or downed LWD greater than 12 inches in diameter at breast height (dbh), it would salvage some of the material for retention on wood-deficient soil surfaces, consistent with wildfire protection regulations, or in waterbody channels in accordance with ODF and ODFW wood placement guidelines. In addition, Oregon LNG would stockpile cleared, unmerchantable LWD for redistribution to the site as part of post-construction rehabilitation, particularly the portion of the construction corridor outside the 50-foot, permanent right-of-way.

Site-specific placement of LWD for mitigation should be determined with agency input and concurrence at each of the open-cut waterbody crossings as determined by agency input. Therefore, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, a plan for placement of LWD or other waterbody habitat improvement features. The LWD plan should be developed in consultation with the ODFW, WDFW, FWS, and NMFS and include, at a minimum, details of when, where, and what structures (e.g., LWD) would be placed instream, and describe the process for making those decisions.**

Oregon LNG has prepared a conceptual mitigation plan that includes post-construction monitoring. As part of this plan, post-construction monitoring of LWD placement would be conducted twice during the first year following construction at approximately 6-month intervals and annually thereafter for a total of 5 years, or until successful reclamation is complete, whichever is longer. Oregon LNG has committed to finalizing this plan prior to construction, and the plan would require agency approval prior to implementation.

Landslides and Mass Failures

The pipeline would cross a variety of terrain types, some of which have steep slopes that could be susceptible to landslides. Forest clearing and construction (especially in steep areas) could have the potential to increase the frequency and size of mass failures (landslides or mud slides) (Swanson et al., 1987). Mass failures adjacent to waterbodies could result in debris flows, which can move large amounts of sediment into waterbodies. Bare ground resulting from mass failures favors fast-growing, early-successional vegetation, such as red alder, rather than longer-lived conifer species that contribute to functional LWD recruitment over the long term (Knutson and Naef, 1997).

To address comments by the State of Oregon, ODF, and WA Ecology, Oregon LNG assessed the potential for landslides and debris flows to affect fish-bearing waterbodies crossed by the pipeline by open-cut methods (see appendix G6). Four waterbodies (Cedar Creek, Clatskanie River, Milton Creek and the Tributary of Merrill Creek) were rated high for landslide risk, and the North Fork of Wolf Creek was rated very high. At all of these waterbody crossings, Oregon LNG would include specific measures to minimize the effect of the pipeline construction and operation on landslide hazards, as well as measures to protect the pipeline from exposure to landslide effects should they occur. These engineering precautions would reduce the potential for mass failures, and are described in section 4.1.1.2. By identifying potential landslide hazards in advance and developing appropriate engineering solutions to minimize the risk of landslides as sensitive sites, Oregon LNG has minimized risk to aquatic resources from the effects of potential landslides at the open-cut or flumed waterbody crossings.

Water Withdrawals and Discharges

Hydrostatic testing of the pipeline and HDD drilling techniques may require withdrawal of water from selected streams and rivers. Water withdrawals and discharges can have a direct impact on fisheries resources including entrainment of fish and impacts on surface water quality. As described in section 2.1.4.2, Oregon LNG proposes to obtain about 3.0 million gallons of water for the hydrostatic tests from the City of Woodland or from the Columbia River at RM 11.5 and MP 82.0. The construction schedule proposes that most hydrostatic testing withdrawals take place from October to December. Obtaining water would require the issuance of Limited Water Use Licenses from OWRD. As part of the Limited Water Use License process, OWRD will review existing storage, water use allocations, and in-stream flow allocations for this river to determine the availability of water during the time proposed for withdrawal.

For HDD and hydrostatic test water withdrawals, Oregon LNG would use NMFS-compliant screens on intakes. The amount of water required for HDD drilling operations would be small relative to the available sources, and we do not anticipate adverse impacts on aquatic resources. Oregon LNG would minimize effects on aquatic resources by applying the measures indicated in its Procedures. In addition, Oregon LNG would implement the measures below.

- All withdrawals and discharges to water sources would comply with appropriate agency requirements that consider the protection of fishery resources on a case-by-case basis.

- Withdrawals and discharges would comply with appropriate permits and instream water rights.
- Adequate flow rates would be maintained during withdrawals to protect aquatic life and provide for waterbody uses and downstream withdrawals of water by existing users.
- Discharge pipes would be anchored for safety and the overall rate of discharge would be controlled to prevent flooding and erosion.
- Test water would be discharged to straw bale dewatering structures to dissipate energy, reduce velocities, and spread water flow to avoid erosion and promote ground penetration. Turbidity levels would be maintained in accordance with those outlined in the NPDES permit issued by ODEQ or the 1200-C construction permit issued by Clean Water Services.
- Test water would be discharged only in uplands across well-vegetated areas and transfer of water between basins would not occur.
- No biocides or other additives would be used.

Infiltration of the water in upland areas and prohibition of water transfer between basins should effectively preclude the cross-watershed transfer of any exotic aquatic species or pathogens that may be present in the water. Prior to discharge of hydrostatic test water into waterbodies, Oregon LNG would obtain an NPDES Wastewater Discharge permit from ODEQ.

Oregon LNG would further avoid cross contamination of waterbodies from dirty construction equipment through implementation of an equipment decontamination plan, which would be developed and submitted to the ODFW before construction begins. The plan would address large equipment (such as excavators, earthmovers, and trucks), as well as small hand tools. Oregon LNG has not yet finalized specific risk minimization and equipment decontamination procedures but indicated that they would likely include the following measures.

- Keep vehicular traffic to the absolute minimum necessary.
- Before equipment remobilizes moving to a new crossing location, remove contaminants and loose debris (e.g., caked mud and dust) from equipment and tools using scrapers or brushes. Remove solids from equipment and tools to the extent feasible and spread on-site.
- Immerse hand tools in a warm soap-and-water solution and/or a solvent rinse using alcohol (methanol or isopropanol).
- Decontaminate equipment by steam cleaning, pressure washing, or washing in soapy water (e.g., Alconox or other phosphate-free detergent), followed by a clean water rinse.
- Decontaminate in designated decontamination areas with the following features, or with alternative features that provide an equivalent level of protection:
  - puncture-resistant geomembrane/plastic sheeting robust enough to resist damage from vehicle traffic;
  - adequate size to accommodate the largest anticipated equipment, plus workspace for decontamination technician(s);
  - adequate water from a stationary tank, water truck, or municipal/private supply;

  - bermed sides or sloped topography permitting the complete collection of spent wash water;
  - sides or curtains to contain splash or overspray; and
  - a tank or tank truck for storing spent wash water.
- Haul spent wash water off site and dispose of in a POTW, unless proper discharge permits are obtained for on-site disposal.

Because the final equipment decontamination procedures have not yet been determined, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, its final equipment decontamination plan. The plan should be developed in coordination with ODFW and NMFS and identify wash station locations.**

We conclude that implementation of Oregon LNG's agency-approved equipment decontamination plan and proposed management of hydrostatic test water discharges would adequately prevent the spread of pathogens and nonnative species between waterbodies.

Noise

Construction equipment, including earthmovers, loaders, dump trucks, and other heavy equipment, along with HDD operations, would produce noise during waterbody crossings. However, machinery would not be used in active flow. Crossings would be conducted using dry-crossing methods, thereby minimizing equipment noise and associated impacts on aquatic biota by limiting in-water exposure of construction equipment.

Blasting

Oregon LNG would trench bedrock with jackhammers and does not anticipate the need for blasting during pipeline construction. However, in the event blasting becomes necessary, potential impacts on fishery resources could include short-term impact of increased sedimentation and turbidity within the water column; and injury or death of fish caused by acoustic shock or damage to internal organs. Should blasting be required, Oregon LNG would implement the following measures to minimize the effects of blasting on fishery resources:

- develop and file a blasting plan (including site-specific details and measures to remove fish from the blast area) for review and approval by the Director of OEP before blasting activities begin;
- obtain appropriate blasting permits from ODFW and adhere to all permit stipulations;
- consult with NMFS and FWS regarding potential effects and mitigation measures with respect to fish and wildlife species; and
- use appropriate BMPs as necessary to minimize effects on fish (e.g., suitable blasting time windows, fish removal, and sediment curtains).

Spills

Releases of diesel fuel, lubricants, hydraulic fluid, and other contaminants contained in construction equipment could potentially result in acute negative impacts on fish, invertebrates, and instream habitat. To protect aquatic resources, ATWS would be set back at least 150 feet from

waterbodies and wetlands. In addition, Oregon LNG's overnight parking of vehicles, storage of fuels and other hazardous materials, and refueling activities would take place no closer than 150 feet from a waterbody or a wetland, unless full containment of potential contaminants is provided. Under certain clearly defined conditions; and subject to ODFW, FWS, NMFS and FERC approval; ATWS may be placed closer than 150 feet to waterbodies or wetlands. Oregon LNG would implement its SPCC Plan if any spills of fuels or hazardous materials occur.

Cumulative Effects of Multiple Stream Crossings

Although the effects of individual pipeline crossings may be small, if multiple crossings occur on the same streams or on different rivers and streams but in close proximity, the overall effect could be greater than the sum of the individual effects. For example, the pipeline would cross the Lewis and Clark River three times within 3.5 river miles but the cumulative impact of these multiple stream crossings would likely be avoided as Oregon LNG proposes to use HDD at these crossings. The same waterbody would not be crossed more than once using open-cut crossing methods. HDD would be used in the few places where the pipeline would cross the same waterbody multiple times (e.g., Lewis and Clark River, Nehalem River). The pipeline would cross 164 waterbodies using open-cut crossing methods. Within individual watersheds, the pipeline would cross 64 waterbodies in the Lower Columbia watershed, 75 waterbodies in the Nehalem watershed, 18 in the Lower Columbia-Clatskanie, and 7 in the Lower Willamette watershed. These crossing areas are sufficiently far apart as to have little to no potential additive effects, and little potential for multiple project-related exposure to the same individual fish, for example.

Oregon LNG would remove vegetation only within the construction corridor. Considering the entire amount of riparian clearing within a drainage basin, the project would result in the clearing of a maximum of 0.09 percent of the entire riparian length in any of the river basins crossed. These estimates assume that all existing areas have fully functional riparian zones, which is not the case.

To minimize the potential for cumulative effects from multiple stream crossings, Oregon LNG would minimize all maintenance mowing and vegetation removal to the amount necessary to satisfy pipeline inspection and maintenance requirements, as described below.

Based on the conservation measures discussed above, we conclude that the cumulative temperature effects from stream clearing would be small and biologically insignificant, particularly considering that disturbed riparian habitats would be revegetated after pipeline installation.

Disturbance Due to Pipeline Operation and Maintenance Activities

Maintenance of the pipeline would include periodic vegetation mowing, as necessary and in accordance with Oregon LNG's Procedures to allow for visual pipeline inspections. At stream crossings, the mowed area would be no wider than 10 feet. This corridor of permanent maintenance would experience a permanent change in condition; however, disturbance to aquatic resources due to periodic mowing would be unlikely, as mowing would not exacerbate the initial effects of vegetation removal from the riparian corridor (e.g., loss of shade, etc.).

After construction, typical restrictions would contain a 10-foot-wide mow strip centered over the pipeline, and a 20-foot-wide split zone where trees exceeding 15 feet in height may be cut. The remainder of the 75- to 100-foot-wide construction right-of-way would revert to vegetation cover preferences or requirements of the landowner. For waterbodies that contain federally listed or EFH species, Oregon LNG would adopt the following revegetation scenario:

- Riparian vegetation (trees and shrubs) would be restored continuously for a distance of 25 feet perpendicular to the top of the bank, except for a 10-foot-wide herbaceous strip immediately above the pipeline itself. Except for this 10-foot- wide strip centered over the pipeline, trees would be allowed to grow to their full potential height within the 50-foot permanent right-of-way.
- The 25-foot minimum width of continuous riparian cover (perpendicular to the waterbody) would occur regardless of the preconstruction condition of the riparian corridor.
- Where there is preconstruction continuous riparian cover greater than 25 feet perpendicular from the top of the bank, the riparian restoration would extend out to match the riparian width of existing conditions up to the width from the top of the bank required by the Forest Practices Act.
- Trees adjacent to the 10-foot-wide herbaceous strip may be limbed to a height of 10 feet on the interior (direction of pipeline) side of the tree to permit passage of personnel for purposes of inspecting the pipeline.

For waterbodies that do not contain federally listed species, critical habitat, or EFH, Oregon LNG would restore riparian tree cover to within 15 feet on either side of the pipeline centerline. The 10-foot-wide "mow strip" centered over the pipeline would be maintained in a herbaceous condition to facilitate pipeline inspection. In the remainder of the 30-foot-wide zone, trees with roots that could compromise the integrity of the pipeline coating would be removed.

Crossing unbridged waterbodies would not be required for maintenance activities. Oregon LNG would not construct any new permanent bridges or culverts along the pipeline route at waterbody crossings. Equipment such as "brush-hogs" that may be required for controlling vegetation would access the pipeline on the existing access roads. If necessary, workers would clear vegetation on foot.

In the event that pipeline repairs are needed at waterbody crossings, the repair access approach would be the same as that described for the original construction. Pipeline installed using HDD methods would not be removed under any circumstances. If a pipeline at an HDD crossing were to fail, a new pipeline would be installed using HDD methods, rather than attempting a repair.

Oregon LNG would not apply herbicide unless absolutely necessary; and, if necessary, would not apply herbicide within 100 feet of a wetland or waterbody unless approved by appropriate federal and state agencies. In the event that herbicide application proves necessary, Oregon LNG would develop specific usage guidelines prior to its use.

Compensatory Mitigation

Oregon LNG has modified project design, construction, and operation plans to avoid or minimize impacts on aquatic resources. These efforts would be ongoing during construction in order to capitalize on avoidance and minimization opportunities that cannot be predicted. However, both direct and indirect impacts on aquatic resources would result from construction and operation of the proposed project.

Following construction of the LNG terminal and associated pipeline, Oregon LNG would restore the temporarily disturbed habitat and ecosystem function in-kind. Oregon LNG would mitigate permanent impacts on aquatic resources by restoring habitat with similar ecological function in areas substantially larger than that lost to permanent impacts.

At this time the proposed compensatory mitigation is conceptual, based on input from the FWS and NMFS and other state agencies through the Mitigation Subgroup process. However, Oregon LNG has indicated it is committed to implementing the minimum elements of compensatory mitigation measures described below once the project is authorized.

Youngs Bay Estuarine Enhancement

For impacts associated with the terminal construction and operation, Oregon LNG would enhance approximately 140 acres of diked pasture land on the Youngs River near the mouth of Youngs Bay where historical tidal floodplain would be reconnected to the estuary. The riverside parcel is currently used for grazing and protected from flooding by dikes. Oregon LNG would modify these dikes to create estuarine wetland habitat and provide access for listed salmonids and other aquatic species. Channel depths and cross sections would be created and match typical tidal surge channels found in mature tidal marshes in Youngs Bay. After native plants have recolonized the property, the marsh is expected to provide productive new rearing habitat for juvenile salmon and other aquatic species that use Youngs Bay, including prey items for green sturgeon.

Improving and protecting access to the low-velocity habitat within the dikes mimics the once abundant pocket estuaries, embayments and tidal channels in the estuary. Bank topping events can be simulated in dike breaching projects by creating areas of topographic diversity that would provide an array of habitats, such as floodplain and wetland areas that can be flooded during high flow/high tide events. This increased floodplain availability would also improve habitat quality for subyearling salmon immediately, though most benefits would be realized after construction and as such are described below under indirect effects as off-channel habitats mature and microhabitats and complexity evolves.

Oregon LNG would construct the Youngs Bay estuarine mitigation site at the same time as terminal construction, which would take place over a period of four years. Construction and installation of the mitigation site would likely take 2 to 3 years and would be completed by the end of third year of terminal construction. Following completion of construction, Oregon LNG would monitor the site to ensure it is functioning as intended. Oregon LNG would use the guidelines and principles in *Protocols for Monitoring Habitat Restoration Projects in the Lower Columbia River and Estuary* (Roegner et al., 2008a) as the foundation for monitoring the estuarine mitigation site.

Although Oregon LNG would identify specific construction methods for habitat enhancement at Youngs Bay at a later date, potential effects would include those associated with standard in-water methods. Oregon LNG would conduct all in-water work during the estuarine work window of November 1 through February 28. While this timing would minimize exposure of salmonids to in-water work, many other fish and other aquatic species that are present in the in-water work areas could be harmed or killed during mitigation construction activities. In most cases, fish would be temporarily displaced by in-water activities. Potential effects would include:

- increased noise and visual disturbance;
- temporary increases in turbidity;
- accidental spills or introduction of hazardous materials; and

- fish exclusion.

These effects would be similar, though lesser in extent and duration, to those associated with in-water work for terminal and pipeline construction.

Fish Barrier Removal

Oregon LNG would mitigate permanent effects on aquatic resources by restoring habitat with similar ecological function compared to that displaced by the project. Therefore, Oregon LNG would remove eight fish barriers outside of the project right-of-way to mitigate for effects associated with pipeline construction. Oregon LNG would select existing fish passage barriers to remove based on input from its Adaptive Management Team consisting of representatives from the USFWS, NMFS, ODF, ODFW, and WDFW. The goal would be to remove barriers that would restore access to at least 1 mile of productive rearing and spawning habitat for the ESUs/DPSs affected by construction of the project. Oregon LNG would provide assurance to the resource agencies that it has acquired legal rights to remove or replace the barriers and that at least a 1-mile reach above each barrier would be protected from future degradation. Oregon LNG would base site selection on the following criteria: downstream location and presence of targeted salmonid ESU/DPU; length of waterbody where benefit would occur; site identified as high priority by ODFW, ODOT, or local watershed council; preliminary engineering review; support from the landowner and local watershed council, irrigation district, or soil conservation district; and cost and cost-benefit review. Oregon LNG would provide a narrative and data sheet demonstrating net enhancement opportunity for each candidate culvert to its Adaptive Management Team for their approval prior to site selection.

Although Oregon LNG has not yet developed specific construction methods for each barrier removal project, anticipated effects on aquatic species that may be present in the in-water construction area would be similar to those effects described above for dike modification (increased noise, turbidity, introduction of hazardous materials, harassment associated with fish exclusion and salvage). Oregon LNG would minimize or avoid negative effects on aquatic species resulting from the construction of crossing upgrades by completing work during agency recommended in-water work windows and implementation of the measures described in its Conceptual Mitigation Plan (see appendix F3) and applicable permit approvals.

Oregon LNG would include final plans for the fish barrier removal projects in it final Mitigation Plan. We have included a recommendation above that Oregon LNG file its final Mitigation Plan prior to beginning construction.

Other Compensatory Mitigation

Oregon LNG would modify the Carmichael property mitigation site to provide additional mitigation for impacts on fish from pipeline activities. The Carmichael property site is adjacent to the Nehalem River, 1.7 river miles upstream of the HDD crossing at MP 33.5 and contains a relict oxbow channel that is currently overgrown with reed canary grass (see figure 2.1.1-6). During high water events the channel floods, allowing access to coho salmon, which become trapped after the water recedes. As part of this mitigation effort, Oregon LNG would remove the reed canary grass, enhance the current off-channel habitat, plant a mix of native vegetation, and deepen the connection with the Nehalem River to allow coho to exit the channel under all flow conditions.

To mitigate, in part, for the long-term loss of LWD recruitment potential at pipeline crossings, Oregon LNG would purchase conservation easements on riparian conifer stands to prevent selective cutting of mature trees within 100 feet of the stream edge. Oregon LNG would select locations within the

range of salmonids that are affected by clearing activities, and would purchase easements at a 1 to 1 ratio. Based on the number of streams crossed with existing riparian vegetation, it is estimated that about 3 miles of riparian habitat would be protected by Oregon LNG in the Coast Range. Final mitigation amounts would be based on the habitat effects determined during final engineering.

4.1.5.3 Essential Fish Habitat

The MSA was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. On the basis of federal responsibilities in considering the Oregon LNG Project, FERC is required by the MSA to evaluate project-related effects on habitat of commercially managed fish populations. For the purposes of the MSA, EFH has been defined as: "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). NMFS has further added the following interpretations to clarify this definition:

- "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate;
- "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities;
- "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and
- "spawning, breeding, feeding, or growth to maturity" covers the full lifecycle of a species (50 CFR 600.10).

Section 302 of the MSA established regional fishery management councils that develop management plans for each fishery requiring conservation and management. Section 303(a) (7) of the MSA requires that these fishery management plans (FMPs) describe and identify EFH. The proposed project would be constructed and operated within the region of the Pacific Fishery Management Council (PFMC). The PFMC has developed four FMPs for species in Oregon/Washington marine, estuarine and freshwater areas: Pacific Groundfish, Coastal Pelagic Species, Salmon, and Highly Migratory Species.

Federal agencies that authorize, fund, or undertake activities that may adversely impact EFH must consult with NMFS. For the Oregon LNG Project, that consultation will be initiated as along with the ESA Section 7 consultation. A summary of impacts on EFH, however, is provided below.

Terminal

EFH is identified as everywhere that species managed by the PFMC occur. The EFH boundaries are generally defined as all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths along the coasts of Washington, Oregon, and California seaward to the boundary of the EEZ (64 FR 49092).

Identification of EFH in Terminal Area

In the proposed LNG terminal location, EFH includes habitat for 12 species of groundfish, 5 species of coastal pelagic species, and 2 species of salmon. The LNG waterway also contains habitat for 13 highly migratory species.

Groundfish. The West Coast Groundfish FMP manages 83 species over a large and ecologically diverse area. Of these, spiny dogfish, big skate, Pacific hake (whiting), black rockfish, kelp greenling, lingcod, cabezon, Pacific sanddab, butter sole, English sole, starry flounder, and sand sole are known to occur within the Columbia River estuary.

Coastal Pelagic Species. The coastal pelagic fishery includes four finfish species: Pacific sardine, Pacific mackerel, northern anchovy, and jack mackerel, and one invertebrate: the California market squid. The geographic boundary of EFH for coastal pelagic species is defined as above the thermocline, where sea surface temperatures range from 50 °F to 78.8 °F (PFMC, 1998). This EFH definition includes the terminal portion of the project area.

Pacific mackerel, jack mackerel, and California market squid have not been identified historically in the lower Columbia River estuary. Northern anchovy and Pacific sardine are the only coastal pelagic species commonly found in the lower Columbia River estuary and, thus, the only coastal pelagic species to have designated EFH within the proposed terminal area. Because of the freshwater conditions at the disposal areas, coastal pelagic species are not expected to be present.

Pacific Coast Salmon. The terminal portion of the project area contains EFH for Pacific coast salmon, including coho and Chinook salmon. Pacific coast salmon EFH includes those waters and substrate necessary for salmon to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. The nonfederally listed Pacific Coast salmon (Chinook and coho) in the lower Columbia River estuary include mid-Columbia River spring, Deschutes River summer/fall, upper Columbia River summer/fall, and some naturalized hatchery-origin Chinook and coho that do not belong to defined ESUs (for instance, coho in the Upper Willamette Basin). EFH for the Pacific coast salmon fishery also includes all waterbodies, lakes, ponds, wetlands, and other currently viable waterbodies and most habitat historically accessible to salmon. Excluded are areas upstream of certain impassable man-made barriers (e.g., dams), and longstanding, naturally impassable barriers (e.g., waterfalls in existence for several hundred years) (PFMC, 2000). Freshwater EFH for Pacific coast salmon consists of four major components: spawning and incubation habitats; juvenile rearing habitat; juvenile migration corridors; and adult migration corridors and holding habitat. Important features of habitat for spawning, rearing, and migration include: substrate composition; water quality, waterbody characteristics; food availability; cover; habitat area and complexity; access; and passage.

Highly Migratory Species. The EFH for highly migratory species is defined by the species' temperature and geographic range during all life stages in the past, present, and where they could occur in the future. EFH has been designated for individual species because of their highly variable life histories. In general, species are found in temperate waters with varying distributions and abundance based on oceanic environmental conditions, including water temperature, current patterns, and the availability of prey (PFMC, 2011). The highly migratory species FMP includes five species of tuna (north Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin), five species of shark (common thresher, pelagic thresher, bigeye thresher, shortfin mako, and blue), two billfish/swordfish (striped marlin and Pacific swordfish), and dorado (also known as dolphinfish and mahi-mahi). Five additional species (great white shark, megamouth shark, basking shark, Pacific halibut, and Pacific salmon) are included in the highly migratory species FMP for monitoring. Highly migratory species are pelagic and generally occur in the open ocean. Although they may spend part of their life cycle in nearshore waters, these species are not associated with estuaries (PFMC, 2011).

Impacts from Terminal Construction and Operation

The PFMC (2000) identified potential sources of impacts on salmon EFH from nonfishing related activities. These include habitat modification or loss by actions that involve dredging, placement of fill,

removal of shoreline vegetation, water discharges and withdrawals that locally affect temperature, loss of prey due to dredging, and the construction of docks and piers. In addition, construction adjacent to EFH could increase run-off of sediment, excess nutrients, chemicals, and petroleum products, all of which can adversely affect EFH. LNG marine carrier operations (125 annually, escorted by at least two tugs) could generate elevated underwater noise. As discussed in section 4.1.1.1, we do not expect the LNG marine carriers to cause a measurable increase in bank erosion and subsequent turbidity loading that would adversely affect EFH in the estuary. Potential adverse impacts on groundfish, coastal pelagic species, salmon, and highly migratory species are listed in table 4.1.5-5 and discussed below.

Table 4.1.5-5

Potential Impacts on Essential Fish Habitat from Terminal Construction and Operation

EFH	Description of EFH	Project Action with Potential to Affect EFH	Determination of Effect
Groundfish	Aquatic habitat from the extent of saltwater intrusion in river mouths to the boundary of the EEZ.	• Accidental spill or leak of hazardous materials. • Dredging of the berth and maneuvering area. • Removal of riparian vegetation. • Shoreline development. • Pile driving. • Water withdrawals and discharges.	Project may adversely affect EFH for one groundfish species.
Coastal Pelagic Species	All marine and estuarine waters from the coast to the limits of the EEZ and above the thermocline where sea surface temperatures range between 50 °F and 79 °F.	• Accidental spill or leak of hazardous materials. • Open ocean exchanges of ballast water.	Project may adversely affect EFH for northern anchovy and Pacific sardine.
Pacific Coast Salmon	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon.	• Accidental spill or leak of hazardous materials. • Dredging of the berth and maneuvering area, and loss of prey species. • Removal of riparian vegetation. • Shoreline development and potential shoreline erosion due to vessel wakes. • Pile driving. • Water withdrawals and discharges. • Lighting.	Project may adversely affect EFH for Pacific Coast salmon.
Highly Migratory Species	All marine waters from the coast to the limits of the EEZ.	Accidental spill or leak of hazardous materials.	Project would not adversely affect EFH for highly migratory species.

EFH present along the waterway but outside of the terminal area would not be adversely affected by the project, due to the highly unlikely potential for accidental spills or introduction of hazardous materials associated with LNG marine traffic. If a spill were to occur, the vessel would abide by its SOPEP to minimize the likelihood of adverse effects on EFH. Construction and operation of the LNG terminal has the potential to impact one species of groundfish (starry flounder) and two species of Pacific coast salmon (Chinook and coho). EFH for juvenile and adult Chinook and coho salmon occur at the proposed terminal site. Such EFH is primarily restricted to migratory habitat, as no spawning habitat is present at the terminal and juvenile rearing habitat is limited.

Of the 83 species managed by the groundfish FMP, 12 groundfish species have been designated as having EFH in estuaries for at least one of their life stages, and/or have been recorded in the lower Columbia River estuary (Bottom et al., 1984; Sytsma et al., 2004). These include: spiny dogfish, big

skate, lingcod, cabezon, kelp greenling, Pacific whiting, black rockfish, butter sole, English sole, Pacific sanddab, sand sole, and starry flounder. These 12 groundfish species are all carnivorous and feed primarily on fish and benthic organisms. Sampling (2002 and 2003) in shallow-water habitats in the lower Columbia River estuary (at RM 8.0, which is downstream and therefore more conducive to West Coast groundfish) collected only English sole, sand sole, and starry flounder (Roegner et al., 2008,). Of these, starry flounder has been documented in freshwater habitat, and it is by far the most common species in the estuary. For these reasons, it is likely to be the only groundfish species present at the proposed terminal construction site. All 12 groundfish species could potentially be present along the estuarine marine vessel route, but adverse effects on EFH along the route are unlikely. Potential impacts on aquatic resources (which include EFH) from dredging of the ship berth and maneuvering area, removal of riparian vegetation, shoreline development, pile driving, and water withdrawals and discharges may adversely affect Pacific coast salmon EFH for Chinook and coho salmon as well groundfish EFH for adult starry flounder. Construction adjacent to EFH could also result in increased stormwater runoff and/or an inadvertent spill of hazardous materials, either of which could result in adverse effects on EFH. A detailed discussion of measures that would be implemented to avoid or minimize impacts on aquatic resources (which include EFH) is presented in sections 4.1.5.2 and 4.1.8.1.

Dredged Material Disposal Site

Identification of EFH at Disposal Site

The proposed EPA Deepwater Site would contain habitat for all coastal pelagic species. Pacific mackerel, jack mackerel, and California market squid would likely be prevalent at the Deepwater Site, which is fully marine. As a result of its marine nature, the Deepwater Site includes habitat for more West Coast groundfish species than does the estuary. In fact, in an EFH consultation on the Deepwater Site, NMFS determined that it includes habitats that have been designated as EFH for various life-history stages of 50 species of groundfish (NMFS, 2003).

EFH for Pacific salmon (including pink, Chinook, and coho salmon) extends from the nearshore and tidal submerged environments within state waters out to the full extent of the EEZ. However, the proposed disposal site contains EFH primarily for coho and Chinook salmon, and not pink salmon. Although pink salmon occasionally enter the Columbia River and spawn in tributaries including the Cowlitz River, they tend to spawn in tributaries near the estuary, since juveniles do not rear in freshwater. Primary spawning populations occur from the Puyallup River in Washington northward to Alaska (Columbia Basin Bulletin, 2011). Pink salmon populations regularly occur in marine waters as far south as northwest Washington in streams that feed into Puget Sound and in the Olympic Peninsula, and do not occur off the coast of the Columbia River estuary with great regularity.

The PFMC and NMFS developed a Highly Migratory Species EFH FMP that authorizes the PFMC to actively manage the following species off the west coast of the United States:

- tunas: north Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin;
- sharks: common thresher, pelagic thresher, bigeye thresher, shortfin mako, blue;
- billfish/swordfish: striped marlin, Pacific swordfish; and
- other: dorado (also known as dolphinfish and mahi-mahi).

Under the FMP, the PFMC also monitors other species for informational purposes including great white sharks, megamouth sharks, and basking sharks. EFH for highly migratory species is present in the Deepwater Site dredge disposal area.

Impacts from Use of Disposal Sites

NMFS (2005, 2012) has fully evaluated the effects on EFH due to the disposal of dredged material at the existing disposal location. NMFS identified the following potential negative effects for the Deepwater Site:

- alteration of bottom topography;
- elimination of benthic invertebrate populations that provide food or structural habitat for managed fish species;
- alteration of sediment structure/composition;
- disruption of physical processes in the water column;
- dispersal of sediments outside of the designated site;
- temporary increases in turbidity during and immediately following disposal; and
- temporary reduction of EFH from disturbance during disposal events.

NMFS concluded that the adverse effects on groundfish EFH would be significant in the immediate location of the site, but that the Deepwater Site, which encompasses 10.5 square nautical miles, is small relative to the total habitat area available to the species involved, most of which occupy ranges that extend along large portions of the West Coast of North America. The overall effects on the affected groundfish species from adverse effects on EFH at the Deepwater Site are not likely to be evident on a population scale (NMFS, 2005a). In addition, NMFS (2012) found that dredge disposal at the permitted site would have negligible effect on the salmon or EFH.

NMFS has previously found that disposal at the Deepwater Site would adversely affect EFH designated for the various life-history stages of Pacific salmon, groundfish species, and highly migratory species (NMFS, 2005a; 2012). The effects of Oregon LNG's proposed disposal of dredged material at this existing, approved site would be consistent with potential effects that were consulted on previously.

Regarding highly migratory species, the disposal of material from the turning basin would most likely have a temporary effect on water quality as the sediment settles. Settling sediment could also limit visibility, which is important to those highly migratory species that are visual hunters. These changes may cause migratory routes to be slightly deflected around the disposal barges and it may disperse their prey. However, given the flushing nature of the waters at the Deepwater Site and the large scale of the overall habitat relative to the size of the disposal area, these effects would be temporary and have only a negligible impact on the EFH or any particular species of the highly migratory species group.

Pipeline and Associated Facilities

Identification of EFH in Pipeline Area

For the purposes of this analysis, all fish-bearing waterbodies that would be crossed by the proposed pipeline route are assumed to provide EFH for Pacific Coast Salmon (i.e., Chinook or coho salmon). Waterbody crossings, including salmonid presence, are provided in table 4.1.5-3. In freshwater, EFH for Chinook and coho salmon include habitats for spawning, rearing, and migration corridors (PFMC, 2000). In addition, because of their tolerance for low-salinity water, starry flounder are the only West Coast groundfish species expected to occur in the pipeline project area. Within the pipeline project area, starry flounder would be restricted to the tidally influenced portions of the Lewis and Clark River and its tributaries, and the Skipanon River. No EFH for coastal pelagics or highly migratory fish is present in the pipeline project area.

Impacts from Pipeline Construction and Operation

With the exception of several slough crossings for which Oregon LNG would request in-water work timing modifications (generally between MPs 0.0 and 5.6), Oregon LNG would conduct all waterbody crossings that involve open trenching during established in-water work windows. The Columbia River (both Oregon and Washington) published in-water work window is November 1 through February 28. Oregon LNG would request an in-water work timing modification for the pipeline crossing of the Columbia River at Deer Island because the HDD crossing method would not involve in-water work.

Construction of the pipeline could adversely affect designated EFH through removal of terrestrial and riparian vegetation, LWD and other instream habitat, sedimentation and passage delay during in-water pipeline construction, accidental spills and leaks of hazardous materials, inadvertent releases of drilling fluid during HDD crossings, water appropriation for HDDs and hydrostatic testing, and increased stormwater runoff. Potential impacts on aquatic resources (which include EFH) from pipeline construction as well as measures that Oregon LNG would implement to avoid or minimize impacts on aquatic resources are detailed above in section 4.1.5.2.

The determinations of effect on EFH resulting from the proposed pipeline are summarized in table 4.1.5-6. In-water work and disturbance to the adjacent riparian corridors due to pipeline construction could result in an adverse effect on Pacific Coast Salmon EFH. As described in section 4.1.5.2, Oregon LNG has proposed to mitigate for impacts on aquatic resources and fish habitats. As discussed in section 4.1.4.3, Oregon LNG's Wetland Mitigation Plan (see appendix F4) describes compensatory mitigation locations for permanent impacts from the terminal and pipeline construction. Starry flounder are expected to occur in the tidally influenced portions of the Youngs Bay tributaries and the Lewis and Clark River and its tributaries. These include only one flume crossing: Barrett Slough. Effects on starry flounder would be restricted to short-term pulses of turbidity from pipeline construction. Based on this information, we would anticipate that adverse effects on EFH for starry flounder from pipeline activities would be minor and temporary in nature.

Table 4.1.5-6

Potential Impacts on EFH from Oregon LNG Pipeline Construction

EFH	Description of EFH	Project Action with Potential Impacts on EFH	Determination of Effect
Groundfish (starry flounder)	Aquatic habitat from the extent of saltwater intrusion in river mouths to the boundary of the EEZ.	• Accidental spill or leak of hazardous materials. • Flume pipeline construction at Barrett Slough. • Crossings of Lewis and Clark River via HDD. Though inadvertent releases of drilling muds are possible using HDD, they are unlikely.	Project may adversely affect EFH for starry flounder.
Pacific Coast Salmon (Chinook and coho)	All streams, lakes, ponds, wetlands, and other waterbodies currently and historically accessible to salmon along pipeline route.	• Accidental spill or leak of hazardous materials. • Pipeline construction at waterbody crossings – (e.g., temporary loss of habitat, degradation of affected waters through increased turbidity). • Water withdrawals.	Project may adversely affect Pacific Coast salmon EFH (Chinook and coho salmon).

4.1.6 Vegetation

Most of the project would occur in the ecologically diverse Coast Range ecoregion. The low mountains of the Coast Range ecoregion are covered by highly productive, rain-drenched evergreen forests. Sitka spruce (*Picea sitchensis*) forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and seral Douglas-fir (*Pseudotsuga menziesii*) blanketed inland areas. Today, Douglas-fir plantations are prevalent on an intensively logged and managed landscape.

Within the Coast Range ecoregion, the project would traverse four Level IV ecoregion subdivisions: Coastal Lowlands, Coastal Uplands, Volcanics, and Willapa Hills. The terminal would be in the Coastal Lowlands subdivision. The majority of the pipeline route would traverse the Volcanics and Willapa Hills subdivisions.

The Coastal Lowlands contain beaches, dunes, and marine terraces below 400 feet elevation. Wet forests, lakes, estuarine marshes, and tannic streams are characteristic features of the landscape. Wetlands have been widely drained and converted to dairy pastures. Vegetation consists of spruce-cedar-hemlock forest/Sitka spruce, western hemlock, Douglas-fir canopy, with salal (*Gaultheria shallon*), sword fern, vine maple (*Acer circinatum*), and Oregon grape (*Berberis aquifolium*) in the shrub layer. Riparian areas contain red alder (*Alnus rubra*), western red cedar, and bigleaf maple (*Acer macrophyllum*) with salmonberry understory. Estuaries and coastal wetlands consist of Baltic rush (*Juncus balticus*), Lyngby's sedge, tufted hairgrass (*Deschampsia cespitosa*), Pacific silverleaf, and seaside arrowgrass (*Triglochin maritima*) with shore pine (*Pinus contorta*), sweet gale (*Myrica gale*), and Hooker's willow (*Salix hookeriana*). Stabilized dunes support shore pine over salal, rhododendron (*Rhododendron macrophyllum*), and evergreen blackberry (*Rubus lacinatus*), with dune wildrye (*Elymus mollis*), Chilean strawberry (*Fragaria chiloensis*), and dune bentgrass (*Agrostis pallens*).

The Coastal Uplands includes headlands and low mountains surrounding the Coastal Lowlands. The climate of this ecoregion is marine, influenced with an extended winter rainy season and minimal seasonal temperature extremes. Abundant fog during the summer dry season provides moisture for vegetation. Vegetation consists of spruce-cedar-hemlock forest/Douglas-fir, and/or western hemlock canopy, with salal, sword fern, vine maple, Oregon grape, rhododendron, and evergreen huckleberry (*Vaccinium ovatum*) shrub layer. Wetter slopes and riparian areas contain red alder, bigleaf maple, and western red cedar, with salmonberry and currant **(***Ribes* spp.) understory.

The Willapa Hills sub-ecoregion has a more rolling topography and a lower drainage density than other upland areas in the Coast Range. Industrial timberland has nearly replaced the historical forests of the Willapa Hills. In undisturbed areas, vegetation consists of hemlock–Douglas-fir forest/Douglas-fir and/or western hemlock canopy, with sword fern, vine maple, salal, Oregon grape, and rhododendron shrub layer. Wetter slopes and riparian areas contain red alder, western red cedar, and bigleaf maple in the canopy, with salmonberry and Oregon oxalis (*Oxalis oregana*) beneath.

The Volcanics sub-ecoregion is characterized by steeply sloping, high elevation mountains of the Coast Range underlain by fractured basaltic rocks. Vegetation consists of hemlock–Douglas-fir forest/Douglas-fir and/or western hemlock canopy, with salal, sword fern, vine maple, Oregon grape, and rhododendron shrub layer. Wetter slopes and riparian areas contain western red cedar, bigleaf maple, and red alder canopy, with salmonberry and oxalis understory. Grassy coastal headlands and mountaintop balds consist of Roemer's fescue, thin bentgrass, California oatgrass, and diverse forbs.

The portion of the pipeline east of MP 80.0 would be within the Willamette Valley ecoregion and cross the Portland/Vancouver Basin sub-ecoregion. The Portland/Vancouver Basin ecoregion is dominated by urban and suburban development, pastures, cropland, and tree farms. Vegetation in area includes urban and suburban native and exotic vegetation, pasture grasses, crops. Potential natural vegetation includes prairies, Oregon white oak (*Quercus garryana*), Douglas-fir, Oregon ash (*Fraxinus latifolia*), alder, and western red cedar.

The approximate milepost ranges where the ecoregions are crossed by project facilities are listed in table 4.1.6-1.

Table 4.1.6-1

Ecoregions Crossed by the Oregon LNG Project

	Mileposts	
Ecoregion	**Begin**	**End**
Terminal		
Coastal Lowlands	NA	NA
Pipeline		
Coastal Lowlands	0.0	6.3
Coastal Uplands	6.3	21.9
Willapa Hills	21.9	38.0
	46.3	65.2
	72.0	75.1
	78.0	79.2
Volcanics	38.0	46.3
	65.2	72.0
	75.1	78.0
	79.2	80.0
Portland/Vancouver Basin	80.0	86.8

The terrestrial (upland) vegetation types that would be affected by the project facilities are broadly categorized into the following vegetation types: upland coniferous forests and deciduous forests, upland grasslands, agricultural (e.g., row crops, pastures, orchards, and tree farms), and developed (e.g., buildings, managed landscapes, and roadways). The vegetation impacts are discussed by facility type in the following subsections. These broadly based vegetation types are also described in more detail as they relate to wildlife habitats and their respective vegetative resources in section 4.1.7 and additional habitat descriptions are provided in appendix F3. An analysis of wetland vegetation affected by the project is provided in section 4.1.4.

We received comments regarding impacts on forested vegetation (new and old growth forest) and riparian vegetation, the introduction and/or spread of noxious and invasive weed species, and wind erosion impacts resulting from loss of vegetation. Comments also noted concerns regarding restoration efforts, governance on private forested land (Oregon FPA), reforestation and construction methods (i.e., fire suppression) on private and state forested lands, and potential changes in local micro-climates resulting from the loss of vegetation. The ODF expressed concerns that areas of disturbance associated with pipeline construction on state forest land would be prone to noxious weed invasions.

4.1.6.1 Terminal

Existing Environment

The past use of the East Skipanon Peninsula as a dredged material disposal area has limited the vegetation currently present at the terminal location to early successional deciduous and coniferous forest (0 to 20 years) mixed with abundant Himalayan blackberry, Scot's broom, and other noxious weeds. The entry road area is currently about 98 percent early successional deciduous forest, which is typified by scrub-shrub and early successional trees.

Impacts and Mitigation

Construction of the terminal facilities, including the access road, would permanently affect 23.2 acres of upland vegetation. Table 4.1.6-2 lists the upland forested vegetation that would be lost due to construction of the terminal. Impacts on wetland vegetation are discussed in section 4.1.4. About 2.5 acres of additional temporary impacts would occur on upland vegetation during construction of the terminal facilities.

Table 4.1.6-2

Upland Vegetation Affected by Construction and Operation of the Terminal

Facility	Upland Coniferous Forest (acres)		Upland Deciduous Forest (acres)		Disturbed Land/ Road (acres)	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Access Road	0.2	<0.1	3.0	0.8	0.5	0.5
Terminal Site	3.5	<0.1	16.0	1.1	0.0	0.0
Total	3.7	<0.1	19.0	1.9	0.5	0.5

Oregon LNG would limit the size of temporary and permanent construction areas and utilize unvegetated areas to the extent possible. The permanent loss of upland vegetation habitats would represent a minor impact because of the generally disturbed nature of the terminal site.

During initial site clearing at the terminal, Oregon LNG would flag and remove noxious or invasive weed species to support successful revegetation with native plant communities. Noxious weeds and invasive nonnative vegetation that would significantly affect the planted vegetation would be removed by hand, ensuring that native vegetation would not be disturbed. Removal would occur during the spring, before the invasive species goes to seed or develops a substantial root mass. Oregon LNG would bag invasive species in plastic and dispose of them off site at a permitted landfill.

Following construction activities, Oregon LNG would plant nondeveloped areas around the terminal site with wetland seed mix and landscaped buffer. The wetland seed mix would be planted adjacent to existing nondisturbed wetland areas. Oregon LNG would install a 50-foot-wide landscaped buffer strip to create a visual barrier along the southern property line of the terminal in upland habitat. The landscaped buffer would be planted with a mixture of native trees (Sitka spruce and shore pine), shrubs (Hooker's willow, salal, evergreen huckleberry, and red alder), and grasses (American dune grass, red fescue, seashore lupine, and coast strawberry). A slow release or organic fertilizer may be applied to stimulate plant growth as a one-time event at the time of the planting or in the spring following a dormant season installation. Fertilizer would be placed either in planting holes or around the base of individual shrubs and trees. The one-time and localized used of fertilizer would be filtered by vegetation, thus minimizing the risk of excess nutrients entering ground or surface water.

Herbicides may be spot applied to the buffer strip no more than one time per year for a period of 1 to 3 years after installation to reduce competition from noxious weeds. Oregon LNG would monitor the success of revegetation at the terminal for at least the first two growing seasons according to its Plan. Oregon LNG would implement a Noxious Weed Control Plan, which is described further under *Impacts and Mitigation* for the pipeline.

4.1.6.2 Pipeline and Associated Facilities

Existing Environment

Upland vegetative communities present along the pipeline route include coniferous forest, deciduous forest, riparian habitat, agricultural communities, and developed areas. Coniferous forests and agricultural communities are the most common vegetative communities along the pipeline alignment. The majority of coniferous forests are composed primarily of trees between 20 and 60 years old that have been planted for commercial timber on state and private lands. These stands are predominantly uniform in structure and age. Herbaceous agricultural fields and pastures are found scattered along the pipeline route and are closely associated with roads, residential developments, and sometimes industrial developments.

Noxious weeds and invasive plant species are nonnative, undesirable native, or introduced species that exclude and out-compete desirable native species; thereby decreasing overall species diversity. Noxious weeds often invade and persist in areas after recent ground disturbance and establishment of noxious weeds can hinder restoration. Exotic/nuisance species can reduce crop yields, destroy native plant and animal habitat, damage recreational opportunities, clog waterways, lower land values, and poison livestock.

In Oregon, prioritization and implementation of weed control strategies is the responsibility of the ODA's Noxious Weed Control Program. The program sets policy for coordinating noxious weed prevention and control efforts within both public and private sectors. The program has developed a list that classifies noxious weeds in three major categories, according to the seriousness of the threat they pose to the state or a region of the state (ODA, 2014). "A" designated weeds are subject to eradication or intensive control when and where found; "B" designated weeds are subject to intensive control at the state, county, or regional level on a case-by-case basis. "T" designated weeds are priority noxious weeds designated for statewide management planning and are selected from either the "A" or "B" list.

In Washington, prioritization and implementation of weed control strategies is the responsibility of the individual jurisdictions. In Cowlitz County, the Cowlitz County Noxious Weed Board adopts a County Noxious Weed List each year (Cowlitz County, 2014). This list categorized weeds into three major classes – A, B, and C – according to the seriousness of the threat they pose to the county.

- Class A weeds are nonnative species with a limited distribution in Cowlitz County. Preventing infestations and eradicating existing infestations in the highest priority. Eradication of all Class A weeds is required by law.
- Class B weeds are nonnative species presently limited to portions of the state. Class B species are designated for control in regions where they are not yet widespread. Preventing infestations is a high priority. In regions where a Class B species is already abundant, control is decided at the county level, with containment as the primary goal.

- Class C weeds are nonnative weeds found in Washington. Many of these species are widespread in the state. Long-term programs of suppression and control are a local option, depending on local threats and the feasibility of control in local areas.

Species of noxious weeds and invasive plants identified by Oregon LNG during field surveys of the proposed pipeline route are listed in table 4.1.6-3.

Table 4.1.6-3

Noxious Weeds and Invasive Plant Species Along the Proposed Oregon LNG Pipeline Route

Common Name	Scientific Name	ODA Weed Designation	Cowlitz County Weed Designation
Himalayan blackberry	*Rubus discolor*	B	C
Scot's broom	*Cytisus scoparius*	B	B
English ivy	*Hedera helix*	B	C
English hawthorn	*Crataegus monogyna*	NL	NL
Oxeye daisy	*Leucanthemum vulgare*	NL	NL
Yellow flag iris	*Iris pseudacorus*	B	C
Creeping buttercup	*Ranunculus repens*	NL	NL
Queen Anne's lace	*Daucus carota*	NL	NL
Teasel	*Dipsicus fullonum*	NL	C
Reed canarygrass	*Phalaris arundinacea*	NL	NL
Creeping bentgrass	*Agrostis stolonifera*	NL	NL
Kentucky bluegrass	*Poa pratensis*	NL	NL
Velvetgrass	*Holcus lanatus*	NL	NL
Red fescue	*Festuca rubra*	NL	NL
Orchard grass	*Dactylis glomerata*	NL	NL
Ryegrass	*Lollium spp*	NL	NL
Cat's ear	*Hypochaeris radicata*	NL	NL

NL=Not listed.

Impacts and Mitigation

Construction of the pipeline would involve clearing and grubbing the construction work area and permanent conversion of vegetation types within a portion of the pipeline corridor. Table 4.1.6-4 summarizes the associated permanent and temporary impacts on upland vegetation. Impacts on wetland vegetation are discussed in section 4.1.4.

Table 4.1.6-4

Upland Vegetation Types Affected by the Oregon LNG Pipeline

	Coniferous Forest (acres)		Deciduous Forest (acres)		Agriculture/Pasture/ Orchard/Nursery (acres)		Disturbed Land/Road (acres)	
Facility	Permanent [b]	Temporary [c]	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Pipeline [a]	362.4	452.8	31.4	37.1	23.1	28.2	14.0	18.5
Compressor Station	14.7	10.1	0.0	0.0	0.0	0.0	0.0	0.0
Total	391.8	473.0	31.4	37.1	23.1	28.2	14.0	18.5

[a] Includes ATWS, meter stations, mainline valves, and pig launchers/receivers. Excludes areas between HDD entry and exit point.
[b] Temporary impacts include the construction right-of-way and ATWS, excluding permanent right-of-way.
[c] Permanent impacts for the pipeline include areas within the permanent right-of-way.

Construction of the pipeline and compressor station would disturb about 985 acres of forest and agricultural upland vegetation. More than half of this upland area would be returned to preconstruction conditions after construction but about 423 acres of forest habitat within the permanently maintained operational right-of-way and would be permanently converted to an herbaceous community. The pipeline would also cross 32.5 acres of disturbed land associated with existing developments or roads. These areas are expected to be unvegetated, landscaped, or other maintained herbaceous vegetation. Oregon LNG would avoid permanent impacts on about 46 acres of vegetation by using the HDD method to install the pipeline underneath older coniferous and deciduous forest, riparian habitat, and some roads. None of the coniferous or deciduous forest delineated within the construction or operational rights-of-way is considered old growth forest. The ages of stands within the pipeline corridor range from 0 to 60 years.

The primary impact from the pipeline and associated aboveground facilities on vegetative communities would be the cutting, clearing, and/or removal of existing vegetation within the construction work areas. The magnitude of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction, and the frequency of vegetation maintenance conducted during operation of the project.

Secondary effects associated with disturbances to upland vegetation would include increased soil erosion, increased potential for the introduction and establishment of invasive weedy species, and a local reduction in available wildlife habitat (see section 4.1.7). Short-term effects would occur in the agricultural areas (e.g., pastures and row crops), which would typically regenerate quickly after cleanup and reseeding of the right-of-way. However, agricultural land associated with orchards, vineyards, tree plantations, and plant nurseries would take longer to reestablish. Impacts on these perennial crops would be long term because of the time needed to establish the crops and, in some cases (i.e., orchards and tree plantations), the impacts would be permanent if the crop is of the type (e.g., woody) that would not be permitted within the maintained portion of the permanent right-of-way.

Compatible crops in the permanent right-of-way include nursery stock, orchard and Christmas trees, field and specialty crops, landscape and native vegetation up to 20 feet tall. Deep rooted woody vegetation would be excluded directly over the pipeline and within 5 feet of centerline. Orchard trees would be excluded at least 15 feet from the pipeline, but canopy cover can overlap the pipeline. Vegetation would be replanted within the temporary construction right-of-way immediately after construction as part of site-specific plans and agreements with landowners, except for large trees and shrubs, which, due to availability, may not be replaceable with specimens of comparable size. All other temporarily impacted areas would be restored to preconstruction condition and/or as specified by the landowner to minimize the potential for erosion following removal of vegetation. Additional information about impacts and potential mitigation measures for residential areas, including landscaping, is presented in section 4.1.9.2.

Long-term impacts on forested habitats (i.e., coniferous, deciduous, and riparian forests and corresponding scrub-shrub) would occur because of the time required to restore the woody vegetation to its preconstruction condition. Permanent impacts on woody species would occur where vegetation is maintained within the permanent right-of-way because the species would not be allowed to regenerate the woody canopy present before construction due to periodic right-of-way maintenance activities.

Within the maintained portion of the permanent right-of-way and the compressor station, about 423 acres of forest would be permanently converted to an herbaceous state and would be reseeded only with conservation grasses, legumes, native herbaceous species, or other standard erosion control/cover species. The areas outside the maintained portion of the permanent pipeline right-of-way, would be

restored through plantings directed by site-specific restoration and revegetation plans and by natural recolonization of the area, but each would require many years to reestablish its woody canopy.

At waterbody crossings that would not be crossed using the HDD method, riparian vegetation clearing typically would be 100 feet wide for equipment access and construction. Generally, spoil stockpiling, pipe stringing, pipe bending, and welding would occur at least 50 feet from the edge of waterbodies, except where the adjacent upland consists of actively cultivated or rotated cropland or other disturbed land. Occasionally, a wider riparian clearing width may be required to cross waterbodies in steep terrain to account for larger trench backslopes, to perform temporary grading, and to install structures for equipment access. However, clearing for steep terrain crossings would be limited to the minimum width necessary to safely complete the crossing. Existing LWD would be salvaged for reinstallation where possible, and a sufficient quantity of large conifer trees would be stockpiled for post-construction aquatic habitat enhancement.

Vegetation maintenance activities would include a combination of machine mowing using a brush hog or similar mower to maintain low vegetative cover, and manual methods typically involving hand-cutting with chainsaws. If necessary, tall-growing woody vegetation would be removed through mechanical or manual removal methods within 15 feet on either side of the pipeline in the permanent right-of-way for a total 30-foot wide corridor. Additionally, a 10-foot-wide strip centered on the pipeline would be mowed every 1 to 3 years to facilitate pipeline inspection. Vegetation maintenance would also be conducted in accordance with the provisions of Oregon LNG's Plan and Procedures.

Oregon LNG would implement its Plan and Procedures to avoid and minimize impacts on vegetation types, and to repair, rehabilitate, or restore unavoidably affected habitats. The type and amount of mitigation for unavoidable upland impacts in Oregon would be consistent with the FWS Mitigation Policy (FWS, 1981) and guided by the ODFW Habitat Mitigation Policy, which allows the federal and state agencies to require upland mitigation for large scale energy and water projects. The mitigation policies provide goals and guidelines for mitigating upland habitat impacts. Specific mitigation proposals for upland vegetation (habitat) replacement or substitution arising from the FWS and ODFW Habitat Mitigation Policy (which define the upland vegetation types) would be limited to the permanent impact areas. Further information on this policy is provided in section 4.1.7.3.

Oregon LNG would reduce the amount of vegetation clearing required by limiting the width of the pipeline construction right-of-way to 100 feet. This is narrower than the 110-foot width recommended for 36-inch-diameter pipelines by the Interstate Natural Gas Association of America (INGAA) Foundation (Gulf Interstate Engineering, 1999). To minimize disturbance to soils and vegetation, Oregon LNG would limit vehicle use to the cleared construction right-of-way or existing access roads as much as possible.

Construction, operation, and maintenance activities have potential to spread noxious weeds. Prior to construction, Oregon LNG would consult with staff from ODA Noxious Weed Control Program and the Cowlitz County Noxious Weed Control Board to develop a Noxious Weed Control Plan to guide weed control activities during construction and operations. The plan would include provisions for monitoring noxious weeds at the pipeline and terminal. Specific weed control actions would be defined through easement agreements with landowners. Methodologies for managing noxious weeds in Oregon would be consistent with ODA policies. Specific measures to control the spread of noxious species on state forest during construction and operation would be defined in ODF easement agreements and would be consistent with the Oregon Forest Practices Act.

Mowing or grubbing would be the preferred method to minimize the spread of noxious weeds in riparian areas and wetlands. Herbicides would be applied if necessary to control noxious weeds but

would not be used within 100 feet of waterbodies or wetlands unless approved by appropriate state and federal agencies. Only EPA-approved herbicides would be applied. Herbicide application would be conducted according to the methods outlined on the label and in accordance with federal and state regulations. Additional measures would include the application of weed-free straw to exposed soils to prevent erosion. Construction equipment would be washed before it enters construction areas to avoid biological contamination from other sites.

Prior to vegetation clearing operations, Oregon LNG would identify individual trees in the temporary workspaces that are significant for their habitat attributes, and would attempt to save them. These individual trees would be removed only if attempts to work around them during construction are unsuccessful. In certain areas and special cases where the removal of individual trees would cause a significant upland vegetative impact, Oregon LNG would consider utilizing stovepipe and/or drag section installation techniques for short lengths of pipeline to minimize clearing of trees and limit impacts on large trees that are of high value to wildlife species.

During construction, woody vegetation that has been cleared from the construction workspace would typically be stored on the edge of the construction right-of-way until restoration commences. Woody slash and debris would generally be ground up and spread onto the right-of-way as mulch. Merchantable trees would be cut and stacked in designated areas outside of riparian and floodplain corridors for commercial sale (see *Forest Practices* below for more detail on merchantable timber). No trees, slash, or woody vegetation would be burned during construction of this project.

Oregon LNG would revegetate immediately after construction has been completed in accordance with its Plan and Procedures; USDA NRCS's *Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000); site-specific restoration plans developed in conjunction with federal, state, and local agencies; and specific requests received from landowners prior to construction. For example, the ODFW recommends a rapid-germinating forage seeding mix for permanent erosion control seeding to enhance nutritional benefits to a variety of wildlife species.

Cleared upland forested communities in the pipeline right-of-way would be replanted in-kind with trees, except for the area within 15 feet of the centerline of the pipeline which would be planted with a native grass/forb/legume seed mix and maintained in a herbaceous state to facilitate maintenance and inspection. Trees greater than 20 feet tall, or deep-rooted shrubs that could damage the pipeline's protective coating, obscure periodic surveillance, or interfere with potential repairs, would not be allowed to grow within 15 feet of centerline of the pipeline. Nearly complete canopy coverage over the pipeline would be expected to develop in most areas within about 20 years. The construction right-of-way would be restored to natural landscape conditions, except for limited permanent aboveground facilities (e.g., the meter stations and compressor station). Topsoil would be left in a roughened and uncompacted condition to promote revegetation and infiltration of water.

Near waterbodies, Oregon LNG would stabilize disturbed streambanks and replant the construction right-of-way. Plantings would consist of a mixture of native tree, shrub, and grass/forb/legume species. At a minimum, a 25-foot-wide riparian strip on each side of the waterbody would be permanently revegetated with native trees across the entire construction right-of-way, except for a 10-foot-wide herbaceous corridor to facilitate periodic pipeline inspections. Native tree and shrub species would be established outside the 10-foot-wide herbaceous corridor. Restored riparian vegetation would be protected from removal during maintenance operations, except that trees within 15 feet of the pipeline that are greater than 15 feet in height may be cut and removed from the permanent right-of-way. Figure 4.1.6-1 depicts vegetation restoration in riparian areas.

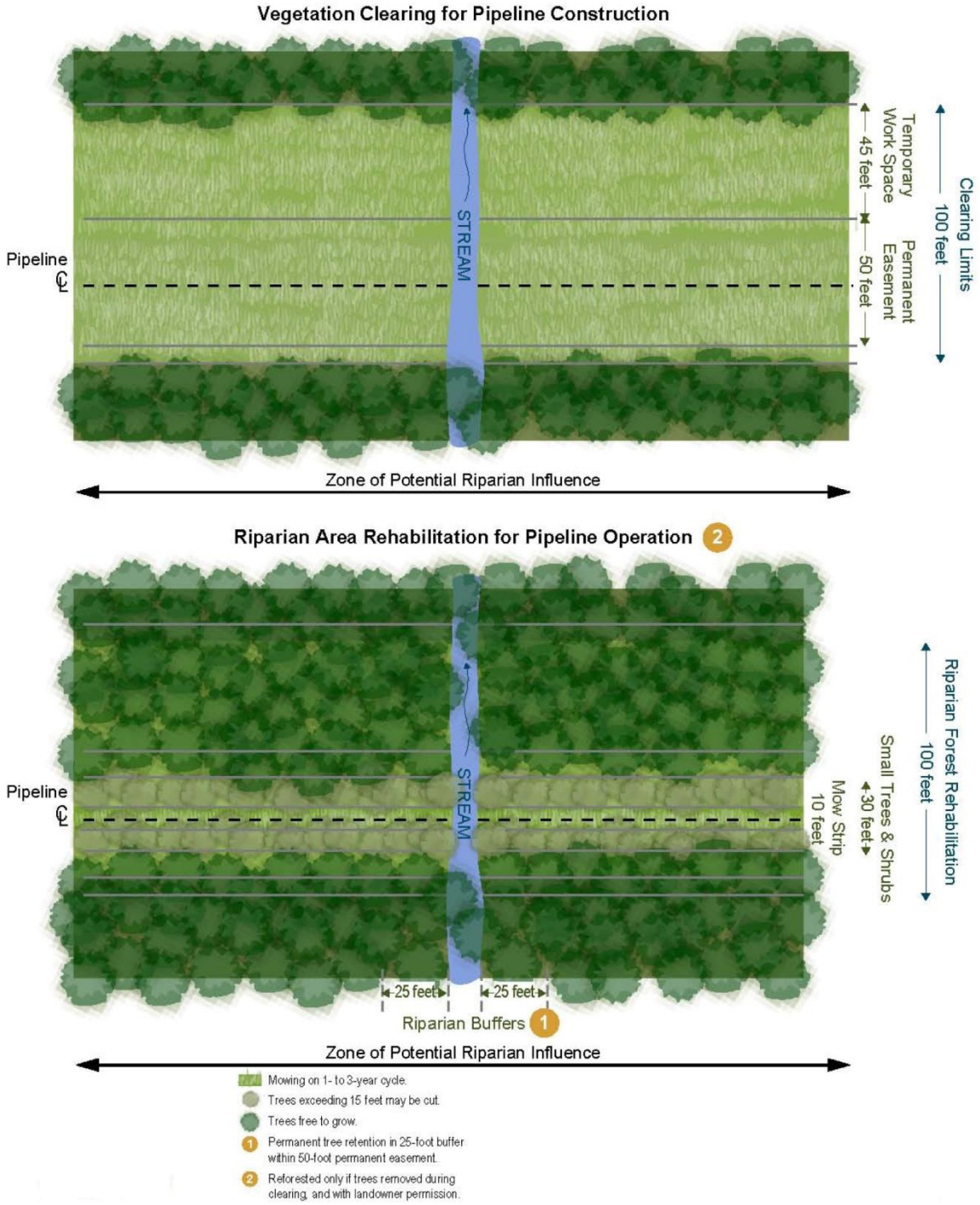


Figure 4.1.6-1: Riparian Vegetation Restoration

Oregon LNG would use the NRCS *Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000) to develop site specific vegetation plans. Revegetation in forested habitats would also consider guidance in Oregon State University's College of Forestry *Guide to Reforestation in Oregon* (Rose and Haase, 2006). Criteria for developing these plans are discussed in the Conceptual Mitigation Plan (see appendix F3). We have received scoping comments from ODFW concerning the specific seeding mixture Oregon LNG would use in riparian areas. However, Oregon LNG has not committed to a specific seeding and planting mix. Therefore, **we recommend that**:

- **Prior to pipeline construction, Oregon LNG should file its Riparian Restoration and Monitoring Plan with the Secretary for review and written approval by the Director of OEP. The plan should include a seed and planting mixture for the restoration of riparian areas that is based on regional habitat differences, and include documentation of Oregon LNG's consultation and approval of the plan by the NRCS, ODFW, and other applicable agencies.**

The revegetation of the construction area would be considered successful when, based on visual observation, the density or cover of well established, herbaceous, nonnuisance vegetation in the construction area is similar to the density or cover of herbaceous vegetation in adjacent areas not disturbed by construction. If the herbaceous vegetative cover or density in the construction area is not similar to that in adjacent areas not disturbed by construction, or if there are excessive noxious weeds after the first or second growing season, an agronomist would determine the need for additional restoration measures. Oregon LNG would implement additional restoration or mitigation measures, as necessary.

Establishment of noxious weeds along the pipeline would be most likely to occur during the first 3 years after construction. Therefore, Oregon LNG would inspect the pipeline right-of-way annually for the presence of noxious weeds during the first 3 years after construction or until native vegetation has become established. Surveys would be performed in the late spring or early summer (May to early July time frame). Thereafter, vegetation maintenance would occur once every 3 years between mid-July and October, or would be scheduled to minimize potential conflicts with breeding and nesting seasons of listed animal species.

We conclude that the project could be constructed and operated in a manner that minimizes impacts on vegetation with implementation of Oregon LNG's Plan and Procedures, Noxious Weed Control Plan, site specific vegetation plans, and our recommendations.

Forest Practices

Vegetation clearing for the project on state and private forest lands may generate merchantable forest products. Merchantable timber is wood harvested for a landowner, operator, or timber owner who receives payment from a purchaser. The sale of timber would be negotiated between Oregon LNG and the property owner prior to clearing. The commercial harvest of timber for the project would comply with the FPA and ODF administrative rules (Chapter 629). These rules establish BMPs for timber harvesting and road construction that protect natural resources and public safety. Oregon LNG would notify the State Forester of timber harvesting operations for the project on state forest land. Logging contracts from the clearing of the pipeline corridor in state and private forest lands would be administrated by ODF.

Along the Oregon portion of the pipeline about 855 acres of merchantable timber would be removed during construction. Removal of merchantable timber would be most concentrated in Columbia County between MPs 58.8 and MP 60.9. The Washington portion of the pipeline would not cross areas

with merchantable timber. No old growth timber would be harvested as part of the project because old growth habitat would be avoided. Average stands along the route are 20 to 60 years of age and managed as part of 60- to 80-year timber harvest cycles.

Oregon LNG's timber harvesting techniques near waterbodies, wetlands, and wildlife areas (including sensitive bird habitat) would follow the FPA and ODF administrative rules. Tree clearing would not occur outside the approved construction right-of-way and ATWS locations. Forest-clearing equipment would access the construction right-of-way via the construction right-of-way and existing and new access roads. Equipment would access the construction right-of-way via the predetermined existing access roads stationed about every mile along the pipeline route. Upon entering the construction right-of-way, forest-clearing equipment would traverse the right-of-way primarily with off road vehicles operating from temporary haul routes in the future permanent pipeline right-of-way. Vehicles would not cross waterbodies for the purpose of clearing vegetation in the permanent rights-of-way. Further, Oregon LNG would not construct any new permanent bridges or culverts at waterbody crossings for timber harvest.

Pipeline construction activities would be subject to state wildfire prevention and suppression requirements. These requirements include the need to obtain certain permits, provide fire prevention equipment on machinery, limit or stop work during periods of elevated fire danger, provide firefighting tools, provide water supplies and pumping equipment, provide fire watch personnel, suppress wildfires originating from construction activity, dispose of debris in a specified manner, and the need to accept liability for the State's cost of suppressing wildfires originating from construction activity. Following construction of the pipeline, operation and maintenance activities would be subject to many of these same requirements. Oregon LNG would comply with the following BMPs to prevent wildfire along the corridor:

- tree tops and limbs may be lopped and scattered, or chopped and crushed in place by a bulldozer equipped with a brush blade;
- nonmerchantable trees would be distributed in areas where downed woody debris is lacking and left for wildlife, consistent with wildfire protection regulations; and
- if on-site slash disposal would create a wildfire hazard greater than exists in the natural forest, off-site disposal would be performed at a commercially operated disposal location. If there is uncertainty about the natural wildfire hazard, the ODF forest practices forester would be consulted.

Oregon LNG received scoping comments from the public about potential damage to the pipeline from naturally occurring forest fires. Oregon LNG would follow DOT guidelines for pipeline safety and bury the pipeline a minimum of 36 inches below ground. In addition, Oregon LNG would maintain a corridor along the pipeline that limits the type and size of vegetation that is present directly over the pipeline. Because of these precautions, along with the insulating capacity (poor heat conductivity) of soil, we conclude that the risk of pipe rupture due to a forest fire burning over the pipeline is low.

To minimize conflicts with planned operations on state forests, Oregon LNG would conduct preconstruction coordination with ODF on construction phasing to avoid or minimize conflict with forest management activities described in ODF's Annual Operations Plans.

Northwest Oregon State Forests Management Plan

The pipeline would cross portions of the Tillamook and Clatsop State Forests, which are managed under the Northwest Oregon State Forests Management Plan (ODF, 2010). The plan describes the concepts and strategies for integrated forest management on state forest land. For example, the

construction right-of-way would cross state forest designated by ODF for aquatic and riparian habitat, recreation, visual, transmission, and wildlife habitat.

Oregon LNG would minimize permanent and temporary loss of forest productivity on state forest lands by collocating the pipeline with existing rights-of-way of the West Oregon Electric Cooperative transmission line and Highway 26 through southeast Clatsop County. Vegetation clearing on state forest lands could cause long-term impacts on forest productivity where timber clearing is needed. Oregon LNG would revegetate disturbed areas with tree species consistent with the Northwest Oregon State Forests Management Plan.

To address the concern about removal of riparian trees on state forest land, Oregon LNG would implement its Plans and Procedures for waterbody crossings, remove trees only as necessary, and perform riparian revegetation and rehabilitation with native tree species where possible. To comply with the state's wildfire prevention and suppression requirements, Oregon LNG would perform pipeline construction, operation, and maintenance activities that are consistent with wildfire prevention and suppression requirements of ORS Chapter 477 and the associated administrative rules. Therefore, we conclude that Oregon LNG pipeline route selection, implementation of its Plan and Procedures, and its proposed post construction restoration would minimize disturbance to state forest lands.

Washington Forest Practices Act

The Washington Forest Practices Act governs all forest practices on nonfederal lands that are conducted within Washington, although not all forest practices are regulated by the state. A forest practice permit is required from the state or county jurisdiction whenever more than 5,000 board feet of merchantable timber is harvested from an area or property. Forest practices permits are designed to protect public resources while assuring that the state of Washington continues to be a productive timber growing area. No forest land would be crossed by the pipeline in Washington; therefore, the project would not be subject to the Washington Forest Practices Act.

4.1.7 Terrestrial Wildlife

The project would affect a variety of wildlife species and associated habitats. Impacts on terrestrial species would mostly occur as a result of disturbance to their habitat. Species listed as representative of a particular habitat may readily utilize other adjacent habitats; thus, these habitats exhibit a large degree of overlap with regard to wildlife communities, as many animal species utilize or require varying habitats throughout their life cycles.

The project area contains habitats suitable for most native species found in the Coast Range and Willamette Valley ecoregions (Thorson et al., 2003; Brown, 1985; Csuti et al., 2001). One estimate lists approximately 270 species, of which 63 are mammals, 147 birds, 32 amphibians and reptiles, and 28 fishes (ODF, 2010). Representative wildlife species in the vicinity of the project vary by ecoregion, habitat type, and time of year. While many of the species are full-time residents, others are seasonal or migratory. Typical wildlife species that occur within the general vegetative communities identified in the project area are listed in table 4.1.7-1.

Table 4.1.7-1

Wildlife Species Occurring Within the Vegetative Communities in the Vicinity of the Project

Vegetative Community	Typical Wildlife Species
Forested [a]	**Amphibians:** northwestern salamander, western red-backed salamander, roughskinned newt, western toad, Pacific tree frog, red-legged frog, bullfrog. [b] **Reptiles:** rubber boa, common garter snake, northwestern garter snake. **Mammals**: beaver, big brown bat, black bear, black-tailed deer, bobcat, bushy-tailed woodrat, California myotis, cougar, coyote, deer mouse, Douglas squirrel, elk, forest deer mouse, hoary bat, little brown myotis, long-eared myotis, long-legged myotis, mink, mountain beaver, porcupine, nutria [b] raccoon, red fox, Roosevelt elk, silver-haired bat, striped skunk, Townsend's chipmunk, vagrant shrew, California myotis, western gray squirrel, Yuma myotis. **Birds:** American kestrel , American robin, bald eagle, barred owl, belted kingfisher, Bewick's wren, blue grouse, black-capped chickadee, darkeyed junco, downy woodpecker, great blue heron, great-horned owl, hairy woodpecker, northern flicker, olivesided flycatcher, osprey, peregrine falcon, red-breasted nuthatch, red-tailed hawk, ruby-crowned kinglet, ruffed grouse, rufous hummingbird, song sparrow, spotted towhee, Steller's jay, Swainson's thrush, varied thrush, willow flycatcher, winter wren, and yellow-rumped warbler, American kestrel, Bewick's wren.
Wetlands [c]	**Amphibians:** northwestern salamander, western toad, Pacific tree frog, red-legged frog, bullfrog, [b] Oregon spotted frog. **Reptiles:** western painted turtle, northwestern pond turtle, common garter snake. **Mammals**: beaver, big brown bat, black bear, California myotis, coyote, hoary bat, little brown myotis, long-eared myotis, long-legged myotis, mink, muskrat, northern river otter, nutria, [b] raccoon, striped skunk, silver-haired bat, Townsend's big-eared bat, vagrant shrew, Yuma myotis. **Birds:** American coot, belted kingfisher, Bewick's wren, black-bellied plover, black-capped chickadee, Canada goose, cinnamon teal, cliff swallow, common snipe, dunlin, great blue heron, greater yellowlegs, mallard, marsh wren, northern harrier, northern pintail, northern shoveler, peregrine falcon, pied-billed grebe, purple finch, redwinged blackbird, short-billed dowitchers, song sparrow, sora, tree swallow, violet-green swallow, Virginia rail, western sandpiper.
Streams and Ponds	**Amphibians:** long-toed salamander, northwestern salamander, Pacific giant salamander, western toad, Pacific tree frog, red-legged frog, bullfrog [b], Oregon spotted frog, tailed frog. **Reptiles:** western painted turtle, northwestern pond turtle, common garter snake, rubber boa. **Mammals**: beaver, big brown bat, black bear, California myotis, coyote, hoary bat, little brown myotis, long-eared myotis, mink, muskrat, nutria, [b] raccoon, silver-haired bat, Townsend's big-eared bat, Yuma myotis. **Birds:** Bewick's wren, black swift, black-capped chickadee, black-throated gray warbler, common yellowthroat, olive-sided flycatcher, peregrine falcon, rufous hummingbird, song sparrow, spotted towhee, yellow warbler, American dipper, band-tailed pigeon, barn swallow, belted kingfisher, Bullock's oriole, common merganser, great blue heron, green heron, hooded merganser, mallard, mourning dove, red-eyed vireo, ruffed grouse, spotted sandpiper, warbling vireo, wouldow/alder flycatcher, Wilson's warbler, wood duck, yellow-breasted chat.
Agriculture (e.g., Pasture, Orchard, Tree Farm)	**Amphibians:** Tree frog, rough-skinned newt. **Reptiles:** common garter snake, northwestern garter snake. **Mammals**: beaver, big brown bat, black-tailed deer, black rat, California myotis, coast mole, coyote, creeping vole, deer mouse, fox squirrel, hoary bat, house mouse, little brown myotis, long-eared myotis, long-legged myotis, long-tailed vole, muskrat, shrew-mole, silver-haired bat, snowshoe hare, striped skunk, Townsend's big-eared bat, Townsend's mole, Townsend's vole, Trowbridge's shrew, vagrant shrew, Yuma myotis. **Birds:** American bittern, American crow, Canada goose, common yellowthroat, barn swallow, Brewer's blackbird, common snipe, house finch, house sparrow, killdeer, mourning dove, northern harrier, red-tailed hawk, ring-necked pheasant, rock dove, [b] Savannah sparrow, song sparrow, spotted towhee, western meadowlark.
Developed (e.g., buildings, roads)	**Reptiles:** common garter snake, northwestern garter snake. **Mammals:** black-tailed deer, deer mouse, raccoon, California ground squirrel. **Birds:** American crow, house sparrow, [b] killdeer, mourning dove, rock dove, [b] song sparrow, spotted towhee**.**

[a] Forested communities include coniferous, deciduous, and scrub-shrub upland vegetation communities.

[b] Nonnative species or invasive species.

[c] Wetland communities include palustrine scrub-shrub, forested and aquatic bed wetlands, estuarine intertidal emergent wetland, high and low marsh, intertidal unvegetated

Oregon LNG coordinated with the ODFW and FWS to develop wildlife habitat definitions consistent with existing plans and designations to provide comprehensive multispecies characterizations, facilitate impact analysis, and frame potential mitigation actions. In particular, the habitat descriptions of vegetation cover types for the project area were developed consistent with the *Oregon Conservation Strategy* and the *Oregon Nearshore Strategy* (ODFW, 2006a and 2006b), *Natural Vegetation of Oregon and Washington* (Franklin and Dyrness, 1988; Thorson et al., 2003), and *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil, 2001).

Wildlife habitats in the project area are qualitatively classified in Oregon in accordance with the ODFW Habitat Mitigation Policy (OAR 635-415-0000 to 635-415-0025). ODFW defines six categories of wildlife habitat. Each category comes with a recommended set of goals for habitat mitigation. Wildlife habitats in the project area are based on the dominant vegetative cover, presence of wetland characteristics, and other qualities, such as level of disturbance and presence of unique or rare features.

In addition, riparian habitat and wetland buffer habitat subcategories were also identified within the primary habitats as they provide additional function and value to primary habitats because of their association with water. Each of the primary habitats were categorized using the ODFW's system, which qualitatively ranks the relative habitat functions and values based on the vegetation composition and qualitative characteristics into one of six categories and includes a recommended set of goals for habitat mitigation. The ODFW defines the categories as shown in table 4.1.7-2.

Table 4.1.7-2

ODFW Habitat Mitigation Goals and Implementation Standards

Habitat Category	Habitat Description	Mitigation Goal	Implementation Standard
1	Irreplaceable, essential and limited habitat	No loss of either habitat quantity or quality.	Avoidance. No impact.
2	Essential and limited habitat	No net loss of either habitat quantity or quality, and to provide a net benefit of habitat quantity or quality.	Avoidance of impacts through alternatives to the development action; or mitigation of unavoidable impacts through reliable in-kind, in-proximity habitat mitigation to achieve no net loss of either pre-development habitat quantity or quality. In addition, a net benefit of habitat quantity or quality must be provided. If this cannot be achieved, the ODFW shall recommend against or shall not authorize the development action.
3	Essential habitat or important and limited habitat	No net loss of either habitat quantity or quality.	Avoidance of impacts through alternatives to the development action; or mitigation of unavoidable impacts through reliable in-kind, in-proximity habitat mitigation to achieve no net loss in either pre-development habitat quantity or quality. If this cannot be achieved, ODFW shall recommend against or shall not authorize the development action.
4	Important habitat	No net loss in either existing habitat quantity or quality.	Avoidance of impacts through alternatives to the development action; or mitigation of unavoidable impacts through reliable in-kind or out-of-kind, in-proximity or off-proximity habitat mitigation to achieve no net loss in either pre-development habitat quantity or quality. If this cannot be achieved, ODFW shall recommend against or shall not authorize the development action.
5	Habitat having a high potential to become either essential or important habitat	If impacts are unavoidable, is to provide a net benefit in habitat quantity or quality.	Recommends or requires avoidance of impacts through alternatives to the development action; or mitigation of unavoidable impacts through actions that contribute to essential or important habitat. If this cannot be achieved, ODFW shall recommend against or shall not authorize the development action.
6	Low habitat value and low restoration potential	Minimize impacts.	Minimize direct habitat loss and avoid impacts on off-site habitat.

A total of 12 different primary terrestrial habitats are present including coniferous forest, deciduous forest, upland grassland, palustrine emergent wetland, palustrine scrub-shrub wetland, palustrine forest wetland, estuarine inter-tidal and estuarine emergent wetland, stream, agriculture (e.g., pasture, orchard, tree farm), developed (e.g., building, roads), and rare plant habitats.[2]

4.1.7.1 Terminal

Existing Environment

Habitats at the terminal include developed/buildings/roads; upland coniferous and deciduous forest; palustrine emergent scrub-shrub, and forested wetlands; and estuarine (including mudflats and low and high marsh) and stream habitats. Much of the vegetation and wildlife habitat at the northern end of the East Bank Skipanon Peninsula was created during the last 100 years from the deposition of sandy dredge spoil. Historically, the Skipanon River flowed into the Columbia River through a braided marsh (Thomas, 1983).

The most prevalent wildlife habitats at the terminal site are forest and palustrine wetland habitats; however, the forested habitat is very early successional in nature and has a large invasive plant species presence. In general, the forested and scrub-shrub habitats provide good vertical structure and support diverse faunal assemblages. Wetland habitats support high vegetation species diversity and provide foraging and dispersal habitat for a wide variety of wildlife species. A portion of the forest and wetland habitats at the site would also be considered riparian habitat of the Columbia and Skipanon River. Much of the habitat includes large areas of invasive plant cover, combined with immature marsh habitats because of ongoing dredge spoil placement at the terminal site, the overall quality and condition of wildlife habitat is poor. Though heavily impacted and in poor condition the wildlife habitats at the terminal provide nesting, cover, dispersal, migration, and/or foraging habitat for various wildlife species.

No Category 1, irreplaceable habitat, is present at the terminal location. Estuarine habitats, including shallow subtidal and mudflat habitats and palustrine habitats (i.e., emergent and scrub-shrub, and forested), are rated at Category 2 because they are important and essential habitat for salmonids and certain terrestrial species (including wading birds and other waterfowl). Most of the terminal would be within Category 4 and 5 habitats, which are low quality habitat in the ODFW rating system.

Oregon LNG conducted wildlife surveys in 2005 and 2007 to assess habitat value and wildlife use at the Skipanon Peninsula (CH2M HILL, Inc., 2005; CH2M HILL, Inc., 2007). Bald eagles were observed during site visits; however, the East Bank Skipanon Peninsula does not contain important habitat structure for eagles. The trees on the peninsula are too small to support eagle nesting, roosting, or perching. Eagles forage along the Columbia River and Youngs Bay in the vicinity of the terminal. The nearest bald eagle nest is about 1 mile from the terminal, west of the Skipanon River (Isaacs and Anthony, 2011; also confirmed in data provided by Oregon Natural Heritage Information Center [ORNHIC]).

Oregon LNG surveyed existing pilings in the Skipanon Channel, Columbia River, and Youngs Bay for purple martins and signs of nesting activity. Purple martins were observed using these pilings for roosting in 2005. No purple martins or signs of nesting activity were observed during the 2007 surveys. It is unlikely that the habitat at the East Bank Skipanon Peninsula would support more than one or two breeding pairs.

[2] See appendix 3F of Oregon LNG's Resource Report 3 filed in June 2013 for maps depicting habitat types, available on FERC's eLibrary at www.ferc.gov/docs-filing/elibrary in Docket No. CP09-6 et al. under Accession No. 20130607-5081.

Migratory waterfowl commonly frequent the terminal area for foraging and nesting. Many species of ducks, wading birds, and shorebirds were observed in the mudflat and shallow sub-tidal habitats surrounding the terminal. The few songbirds that were observed were primarily associated with scrub-shrub habitat in the vegetated uplands. Sighting and signs of mammals were few. The few species of songbirds observed is a strong indicator of overall poor quality of the wildlife habitat in the wetland and upland habitats due to the presences of invasive plant species and overall low complexity of the habitat.

Overall, habitat diversity, structure, and features are low; invasive plant species cover is high and most of the East Bank Skipanon Peninsula is highly disturbed by human recreational use. Consequently, the diversity and density of birds in the uplands and marsh habitats are low. Birds present at these habitats are common and adapt to low levels of disturbance.

Impacts and Mitigation

The impact of the terminal facilities on terrestrial wildlife species and their habitats would vary depending on the requirements of each species and the existing habitat present within the project area. Table 4.1.7-3 lists the impacts of the terminal on terrestrial wildlife habitats by acreage.

Table 4.1.7-3

Terminal Wildlife Habitat Impacts

Habitat Type	Habitat Category	Total Acres (Temporary and Permanent)
BP	5	8.7
CF	3	2.9
DF	4	22.9
ES	2	27.6
PEM	2	1.0
PSS	2	3.7
PSS	3	0.5
Total		**67.3**

BP = developed/buildings/roads; CF = upland coniferous forest; DF = upland deciduous forest; ES = estuarine and estuarine emergent wetland; PEM = palustrine emergent wetland; PSS = palustrine scrub-shrub wetland

Direct impacts on a wildlife species or its habitat from construction of the project would include the displacement (associated with noise and lighting or loss of habitat/food) of wildlife species within the project area and possibly direct mortality of some individuals. Indirect impacts include those effects caused by the project action that would occur later in time but are still reasonably certain to occur, such as fragmentation due to fencing.

Construction

Construction of the terminal would involve the clearing of the construction work area, earthwork, and permanent conversion of portions of the site into industrial uses. The primary impact of construction on terrestrial wildlife resources would be the temporary alteration and permanent loss of habitats. To avoid construction-related impacts, Oregon LNG has restricted the size of temporary and permanent construction areas to the minimum necessary. Oregon LNG would follow its Plan and Procedures to minimize impacts on habitats. Terrestrial wildlife habitats in temporary workspaces would be restored to their preconstruction habitat conditions. Most of the terminal would be aboveground and permanently replace existing terrestrial wildlife habitat.

Construction of the terminal would have relatively little impact on wildlife individuals. Some species, such as small rodents, snakes, and insects, may be affected by the construction due to habitat alteration and may suffer mortalities from direct contact with construction equipment. More commonly, wildlife would be displaced to adjacent habitat areas.

Waterfowl and shorebirds may be affected by loss of migration, foraging, or nesting habitat to the extent that it is regionally limited. However, impacts on mudflats and sub-tidal habitat would be primarily from the construction of the elevated pier and dock. At times, waterfowl and shorebirds may be temporarily displaced during construction or by sudden noises during construction. Surveys conducted by Oregon LNG did not identify nesting habitat for waterfowl or shorebirds within the footprint of the terminal. Thus, effects on waterfowl and shorebird habitat would be limited to the footprint of the pilings, which would be relatively small.

Estuarine habitat on the East Bank Skipanon Peninsula is not directly connected to the estuary through channels that are typically associated with this type of habitat. The lack of connectivity reduces the importance of the estuarine habitat. However, water shrews have been observed in the estuarine habitat, particularly the high marsh area of the habitat and raptors such as northern harriers hunt over the high marsh habitat. Impacts on estuarine habitat would likely have a minor effect on raptors that forage in the area.

Earthwork involving fill and excavation may generate windblown dust from unstabilized surface soils. Soil and vegetation disturbances from excavation and vehicle traffic can provide an avenue for the establishment and expansion of noxious weeds, which could reduce wildlife habitat. Oregon LNG would implement dust suppression measures (see section 4.1.12.1) and a Noxious Weed Management Plan (see section 4.1.6.2) to minimize impacts on wildlife habitat.

Noise

Noise during the construction phase can be generated by site clearing/excavation, concrete pouring, steel erection, pile driving, mechanical, and cleanup activities. For the majority of species, information is unavailable regarding the thresholds at which animals respond to noise, with bald eagle being one of the exceptions (Steidl and Anthony, 1996). However, wildlife responds to human activity through three adaptation mechanisms: avoidance, habituation, or attraction (Knight and Temple, 1995).

Avoidance of the area may result in: (1) no measurable effect, (2) reduced fitness, potentially decreasing overwinter survival, or (3) decreased reproduction. Sporadic noise associated with heavy equipment and construction probably would cause many species to abandon areas directly adjacent to construction, alter use patterns to access habitat when construction would not be occurring, or cause increased energy expenditure.

Abrupt, very loud noise probably would result in "startle" response by all individuals within some distance from the source. These events may cause temporary cessation of feeding and perhaps movement away from the disturbance. For nesting birds, "startle" response may cause them to abandon their nest momentarily, which would lead to increased nest and nestling predation (Bowles, 1995). However, most nest abandonments last for less than 5 minutes (Knight and Temple, 1995). If species adapt by shifting their normal range to avoid disturbance or by occupying unoccupied habitat, the total amount of available habitat for the species would be decreased, unless other individuals of that species are more tolerant of disturbance and occupy the abandoned habitat. If individuals of a species are displaced and do not find unoccupied habitat, that population would suffer from reduced reproduction and, eventually, from decreased population size.

High levels of continuous noise may adversely affect foraging, social interaction, and rearing of young (Knight and Temple, 1995). They may reduce reproductive success of individuals, particularly birds, potentially resulting in abandonment of otherwise functional nesting habitat or increased predation (Knight and Temple, 1995). Over time, some species or individuals may adapt to the continuous noise either through changes in temporal allocation of resources or by reoccupying some portions of their habitat as they become accustomed to the disturbance (Peeke and Herz, 1973; Borg, 1981). Reproduction should rebound over the long-term as the animals become habituated (Knight et al., 1987).

The response of birds and other terrestrial mammals exposed to the same disturbance repeatedly with no accompanying harassment declines rapidly over time (Krausman et al., 1986). Most nesting birds appear to become at least partially habituated if direct harassment does not occur. After habituation, birds generally show minimal increased nesting failure because of disturbance (Knight et al., 1987; Black et al., 1984). This would not mean that wildlife would continue to use the area as they did before the noise, but that their avoidance distance is expected to decline as they habituate to the disturbance.

The distance at which the disturbance effect would abate is dependent on the tolerance levels of the species and individuals within species. Noise during terminal construction would be limited to daylight hours and abate to background levels within 1,000 feet of the source. Noise would be generated from limited points at the facility at any period of time. We expect impacts on wildlife associated with construction noise to be minor.

Lighting

The specific impacts of artificial lighting on individual organisms, populations, or communities are difficult to predict. To minimize the positive and negative impacts of lighting on wildlife, the FWS has developed *Service Interim Guidelines for Recommendations on Communications Tower Siting, Construction, Operation, and Decommissioning* (FWS, 2000a). These guidelines, which Oregon LNG has agreed to implement, can be applied to facilities other than communication towers and include recommendations to reduce the number and intensity of security lights to the minimum required and to use down-shielding lights. To avoid and minimize construction lighting effects, lights would be shielded and directed as needed to illuminate the work areas and meet safety requirements, but to avoid extending off site unnecessarily. Researchers speculate that in rural locations, down-shielding would have an even greater effect than in urban areas because there is less illumination from other lit structures (Reed et al., 1985). While potential project impacts from artificial lighting cannot be completely eliminated, implementation of the FWS guidelines related to facility lighting would minimize the potential for terminal lighting to adversely affect wildlife in the project area.

Operations

Noise

Activities that would generate noise at the terminal during typical operations include ship mooring and unloading and the operation of various equipment described in section 4.1.12.2. The noise limit at the terminal would comply with FERC's day-night sound level (L_{dn}) of 55 dBA. The human ear is less sensitive to higher and lower frequencies than to mid-range frequencies. Therefore, sound level meters used to measure environmental noise generally incorporate a filtering system that discriminates against higher and lower frequencies in a manner similar to the human ear to produce noise measurements that approximate the normal human perception of noise. Measurements made using this filtering system are termed "A-weighted decibels," abbreviated as dBA.

Typical operational noise would be relatively continuous during operating hours. Noise during plant operation would abate to background levels within 500 feet of the source. Over time, some species

or individuals would habituate to disturbance and the use of the habitat surrounding the terminal would increase, but it may be less than preconstruction levels. Animals are more likely to habituate to operational noise than to construction noise, and we conclude impacts would be minimal. Additional discussion of noise impacts is provided in section 4.1.12.2.

Lighting

Operation of the terminal would create increases in light and traffic in the immediate vicinity. Portions of the terminal would be illuminated for night activity and safety. During operation, security/safety lights and early morning and late evening vehicle arrival would illuminate the developed portion of the terminal and result in light intrusion into adjacent areas. Security/safety lighting would be used year-round. Traffic flow is expected to be low frequency, with low speeds and flow limited to paved access roads. Generally, the effects of light and traffic on wildlife are less than the effects of noise disturbances, but wildlife appear to react more to disturbances they can see and hear than to activities they can only hear (Knight and Temple, 1995; Stalmaster and Newman, 1978). The effects on wildlife are similar to those described for noise (that is, flight, nest abandonment, or possibly defense), although the penetration of the effect into adjacent habitat may be less if intervening vegetation or structures block site distances. Regardless of the reaction, increased energy expenditure may occur, foraging success may decrease, and reproductive failure may increase.

One of the most pervasive effects of night lighting is on behaviors controlling orientation (Wada et al., 1987; Witherington, 1997; and Evans and Ogden, 1996). Sometimes, artificial lighting may disorient organisms used to navigating in dark environments. For example, songbirds can confuse lights on buildings and communication towers for stars that provide navigational cues during migration. This disorientation can lead to birds striking buildings and towers or colliding with one another, especially under overcast or foggy weather conditions (Evans and Ogden, 1996; Evans and Rosenberg, 1999). Conversely, increased illumination may extend diurnal or crepuscular behaviors into the nighttime by improving an animal's ability to orient itself (Longcore and Rich, 2004). This can be beneficial to some individual animals by allowing them to extend the length of activities such as foraging or mating.

Behavioral changes associated with increased lighting can affect activity levels, foraging behavior, habitat use, and mating (Wolfe and Summerlin, 1989; Yurk and Trites, 2000; Bird et al., 2004). In a study conducted by Buchanan (1993), the ability of frogs to detect and consume prey was significantly reduced under increased lighting. Many frogs exhibit a narrow range of environmental illumination in which they are active; within this range, frogs exhibit certain behaviors (such as calling, breeding, and foraging) only at very specific light levels. Bird et al., (2004) found that mice used fewer patches of food and ate less in areas with artificial lighting, indicating that the perceived risk of predation increases with increased lighting (Lima and Dill, 1990). Alternatively, certain species of bats are attracted to and congregate around lit areas, presumably to feed on insects also attracted by the light (Blake et al., 1994). Although outdoor lighting has been shown to affect flight, navigation, vision, migration, dispersal, oviposition, mating, feeding, and has lead to increased predation in some moth species, many moth species appear unaffected by outdoor lighting (Frank, 1988). Large mammals, such as deer, strongly avoid lit areas, which can alter their movement patterns and potentially increase habitat fragmentation (Longcore and Rich, 2004).

Most of the artificial lighting at the terminal would be in the plant process area, including atop the storage tanks and along the length of the marine dock unloading area. Other areas that would be illuminated include the facility perimeter, the parking area, and the roadway leading into the terminal. The Oregon LNG storage tanks would be about 183 feet above ground level. The Oregon LNG storage tanks would have a dual aviation lighting system with flashing red obstruction lights for nighttime use

and medium-intensity flashing white obstruction lights for daytime and twilight use. No communications towers are planned for the project.

Oregon LNG would use directional lighting on travel lanes and stairways, and tanks would not be spotlighted to minimize side lighting. In all cases, for the various types of lighting throughout the terminal, the lights would be positioned in a manner so as not to be obtrusive to the natural environment surrounding the facility. Oregon LNG would implement additional measures to minimize impacts from terminal lighting on wildlife, especially due to the frequent use of the Columbia River in the terminal area by shorebirds, waterfowl, and other water birds migrating along the Pacific Flyway and the potential presence of sensitive wildlife species. These measures include:

- install and use only the minimum required light for safe and efficient operation of the facility, as described in *Interim Guidance on the Siting, Construction, Operation and Decommissioning of Telecommunications Towers* (FWS, 2000a);
- use "full cut-off" or "fully shielded" lighting for all outdoor lighting, where practicable. Full cut-off lighting uses a flat glass lens, eliminates or minimizes direct glare, and projects no upward throw of light;
- use automatic photoelectric control switches for dusk to dawn control; and
- report any bird collisions with terminal storage tanks or other lighted structures that kills a migratory bird to Oregon LNG's designated environmental compliance officer within 24 hours of such an incident. The environmental compliance officer would be responsible for reporting the incident to the FWS.

Fire

Systems for fire prevention, detection, and control would be installed at the terminal to control the risk of habitat damage from fire. These systems are described in section 2.1.1.1.

Fencing

For security purposes, Oregon LNG would install 8-foot-high woven wire fencing topped with barbed wire around the perimeter of the LNG terminal. The fencing could potentially change local wildlife movement patterns. At this height, the fence would effectively preclude most if not all wildlife from jumping over the fence (Montana State University (MSU) Extension Service, 2000), thus minimizing or eliminating the risk of wildlife being trapped within the terminal site. To minimize impacts from fencing Oregon LNG would establish and maintain a natural grade and native vegetative community along the shoreline between the berm and the MLLW elevation. This would allow passage for mammals and other terrestrial wildlife around the perimeter of the fenced terminal. In addition, the majority of the fenced area would be graveled and developed for industrial use, and thus would not provide suitable habitat for foraging, breeding, dispersal, or other wildlife movements. Therefore, wildlife in the area would be expected to use other, more suitable areas of habitat for dispersal or other movements. As such, significant impacts on wildlife as a result of terminal fencing are not anticipated.

Habitat alteration and fragmentation (directly caused by the fencing) are believed to facilitate invasion and population increases by some generalist species (Joslin and Youmans, 1999). Species commonly implicated include American crow and other corvids, coyote, raccoon, European starling, and English house sparrow. The addition of regular human presence may result in an increase in local generalist predators/competitors that would result in increased predation/competition. However, we expect post-construction disturbance effects on wildlife to be minimal after habituation and also localized at the terminal.

The project site is surrounded by habitat areas that provide similar and ample habitats for wildlife displaced during operation of the terminal. These undeveloped lands would prevent the project from having significant impacts on the region's wildlife. Many species would continue to use the remaining habitat areas of the terminal site during and after construction.

4.1.7.2 Pipeline Facilities

Existing Environment

Wildlife habitats in the area of the pipeline route include upland coniferous forest, upland deciduous forest, riparian habitat, palustrine scrub-shrub wetland, palustrine forested wetland, palustrine emergent wetland, stream, agriculture/pasture/orchard/tree farm, and developed/buildings/roads. The vast majority of terrestrial wildlife habitats that would be crossed in the Coast Range are characterized as industrial forests. Some stands of trees proposed for crossing would likely be logged prior to construction, and recent clear-cuts and younger stands would age. Forest habitats provide the greatest vertical structure and support diverse faunal assemblages. Wetland habitats support diverse floral species and provide foraging and dispersal habitat for a wide variety of wildlife species. A portion of the forest and wetland habitats would also be considered riparian habitat. Similar to the other forest habitats, riparian forest provides significant vertical structure, and generally supports the most diverse faunal assemblages of the affected habitats. Although agricultural habitats support several cover types, they often have low diversity within each cover type.

Impacts and Mitigation

The highest quality habitat that would be crossed by the pipeline is wetlands. Impacts on wetlands are further discussed in section 4.1.4. Discrete patches of Category 2 conifer forest were avoided by route selection. Most of the conifer forest in the Coast Range that would be affected is in younger age classes in second-growth forest. Most habitat (80 percent) that would be crossed by pipeline is Category 4 and 5 habitat, consisting primarily of private ownerships dominated by commercial forest and agricultural land use.

Oregon LNG would use specialized construction methods to avoid Category 1 habitats such as waterbodies with listed species and patches of large trees with suitable nest sites for marbled murrelets, eagles, northern spotted owls, and other raptors. Protected species are further discussed in section 4.1.8. In addition, the project would avoid areas of mature oak woodland with a native grassland component and true wet prairie with native vegetation species, both of which are Category 1.

The impact of the pipeline facilities on terrestrial wildlife species and their habitats would vary depending on the timing of construction and types of construction techniques used, as well as on the requirements of each species and the habitat present at the various project components. Table 4.1.7-4 provides a summary of habitat impacts for the pipeline facilities in Oregon. Another 52.1 acres of terrestrial wildlife habitat would be permanently impacted in Washington; this habitat was not categorized.

Table 4.1.7-4

Oregon LNG Pipeline Wildlife Habitat Impacts for Oregon [a]

Habitat Type [b]	Habitat Category	Total Acres (Temporary and Permanent)
AW	5	34.5
BP	3	0.3
BP	4	13.0
BP	5	14.6
BP	6	2.1
CF	3	159.2
CF	4	583.2
CF	5	97.6
DF	3	52.5
DF	4	5.8
DF	5	5.9
DF	6	1.2
E2USN	2	5.1
NO	3	1.0
NO	4	1.0
NO	5	13.9
PEM	3	26.6
PEM/PFO	2	0.1
PFO	3	12.5
PSS	3	11.1
PSS/PFO	2	6.4
ST	2	1.0
ST	3	3.9
Total Oregon		**1,052.5**

[a] A total of 52.1 acres of impact occur in Washington. Impacts in Washington were not categorized.

[b] AW = agriculture wetland; BP = developed/buildings/roads; CF = upland coniferous forest; DF = upland deciduous forest; E2USN = estuarine intertidal unconsolidated shore regularly flooded wetland; NO = agriculture/pasture/orchard/tree farm; PEM = palustrine emergent wetland; PSS = palustrine scrub-shrub wetland; PFO= palustrine forested wetland; ST= stream

Construction

Direct impacts on wildlife during construction could include the displacement of wildlife within the project area and direct mortality of some individuals. Individuals of some wildlife species may be directly impacted by construction of the project if they are killed by vehicles traveling to and from construction sites. Species most susceptible to vehicle-related mortality include those that are inconspicuous (e.g., salamanders, frogs, snakes, small mammals), those with limited mobility (e.g., amphibians), burrowing species (e.g., mice and voles, weasels, beaver, frogs and toads, snakes, subterranean mollusks), and wildlife with behavioral activity patterns making them vulnerable, such as deer that are more active at dusk and dawn, and wildlife that may scavenge roadside carrion (Leedy, 1975; Bennett, 1991; Forman and Alexander, 1998; Trombulak and Frissel, 2000).

Other species are likely to be displaced from habitats that are cleared of vegetation (e.g., passerine birds, and tree-dependent/cavity-dependent birds and mammals such as woodpeckers and bats) and from areas adjacent to construction sites (waterfowl, raptors and medium-sized mammals). Land clearing for the pipeline right-of-way may result in habitat discontinuity or fragmentation of

surrounding areas. Clearing of forested habitats associated with pipeline construction would increase the amount of edge habitat in the area.

Displacement from adjacent habitats would most likely be a temporary effect during construction and wildlife would be expected to return after restoration of the right-of-way is complete. However, if adjacent habitats are at carrying capacity for the species, displaced individuals could be adversely affected by competition for resources, increased susceptibility to predation, or disease that may be facilitated by crowding. Construction activities may decrease individuals' reproductive success by increasing nest abandonment or interfering with breeding behaviors and success. These impacts may negatively affect population growth through diminished rates of survivorship and fecundity. Populations may also be negatively affected if individuals move from habitats affected by project-related disturbances.

As the pipeline is being installed, the open trench may pose a risk to wildlife movement. In locations with evidence of high wildlife activity (i.e., visual observations, tracks), Oregon LNG would implement measures to reduce impacts such as minimizing the length of open trench and duration of opening, and providing temporary crossings to allow movement of amphibians and mammals.

Prior to vegetation clearing, Oregon LNG would identify individual trees in the construction right-of-way that are significant for their habitat attributes, and would avoid them where practicable. In limited and special cases where the removal of individual trees would cause a significant habitat impact, Oregon LNG would consider utilizing stovepipe and/or drag section installation techniques for short lengths of pipeline to minimize clearing of trees.

The timing of land clearing and other construction activities would be scheduled to reduce potential impacts on nesting migratory birds (see section 4.1.7.5). If vegetation clearing cannot be avoided during the breeding season, Oregon LNG would monitor nest(s) during construction for signs of disturbance and if nest disturbance is detected then construction would be halted at that location until such time as the nest has fledged or failed (due to natural causes). No harvest of trees in riparian areas would occur until native and migratory bird species have completed nesting activities.Temporary and long-term impacts could occur on amphibians and reptiles associated with waterbodies and the riparian areas. Removal of riparian vegetation along waterbody edges that are crossed by the pipeline could increase sediment transport into the waterbody and/or increase water temperatures. Changes in hydrology could also occur within wetlands and waterbodies used for breeding, limiting dispersal or reducing breeding habitat (ODFW, 2006a).

Oregon LNG planned the pipeline route and is proposing use of the HDD construction method to avoid riparian zone effects in many areas. Where possible, Oregon LNG would avoid removing important specimen trees, significant wildlife snags, and nest trees in riparian areas. Oregon LNG would also avoid removing natural habitat features,such as logs greater than 12 inches in diameter, downed large wood, and rocks. Effects on the riparian zone would be minimized by reducing the amount of clearing as much as possible, and by revegetating the cleared riparian areas as rapidly as possible following construction.

Oregon LNG's proposed pipeline route and HDD crossings were planned to avoid riparian zone effects as much as possible. Oregon LNG would implement the following measures to minimize construction impacts on riparian habitats:

- revegetate with conservation grasses and legumes or native plant species using NMFS recommended native species mixes;

- establish native tree and shrub species outside the 10-foot-wide maintenance right-of-way centered over the pipeline;
- retain important specimen trees, significant wildlife snags, and nest trees, where possible;
- retain natural habitat features—such as logs greater than 12 inches in diameter, downed large wood, and rocks;
- reduce the amount of clearing as much as possible; and
- revegetate the cleared riparian areas as rapidly as possible following construction.

Because much of the area affected by pipeline construction would be restored to preconstruction habitat types, impacts on wildlife species would generally be short term. However, long-term impacts on terrestrial wildlife could occur in forested areas due to the time required to restore the forested habitat to its preconstruction condition.

Construction of ancillary facilities (i.e., metering and regulating facilities, pigging facilities, and compression station) would have minor temporary, short- and long-term impacts on wildlife habitat, causing localized impacts on wildlife populations. During construction, the clearing and grading of the aboveground facilities may result in mortality to less mobile forms of wildlife, such as small rodents and reptiles (Larsen, 1997). The meter stations and compressor station would be permanent structures that would result in a permanent loss of vegetative cover and provide minimal habitat for wildlife; however, they are minor in terms of the entire pipeline right-of-way (less than 2 percent of permanent pipeline impacts).

Noise and visual disturbance from pipeline construction would cause some wildlife to reduce their use of habitat during construction. Construction noise would be generated by site clearing, trench excavation, pipe-laying, HDD, and cleanup activities. Noise from heavy equipment may invoke a startle response from wildlife, or cause short-term modifications of behaviors, as described for terminal construction. The distance at which the disturbance effect would abate is dependent on the tolerance levels of the species and individuals within species.

Oregon LNG would schedule construction to avoid or minimize harm to reproductive activities. Also, noise during construction would be limited to daylight hours, except at HDD locations where round-the-clock activities may be necessary, and would abate to background levels within approximately 1,000 feet of the source. Noise would be generated from limited points along the pipeline at any particular period of time. The impacts would extend a shorter distance where topographic screening occurs.

Operations

As described in section 4.1.6, revegetation would occur immediately after construction in accordance with Oregon LNG's Plan and Procedures; the *Oregon & Washington Guide for Conservation Seedlings and Plantings* (NRCS, 2000); restoration plans developed with federal, state, and local agencies; and requests by landowners. Oregon LNG would use the ODFW recommended rapid germinating forage seeding mix for permanent erosion control seeding to enhance nutritional benefits to a variety of wildlife species. The remaining permanent right-of-way and temporary workspaces would be restored to reestablish preconstruction habitat conditions.

During pipeline operation, indirect impacts on wildlife populations could result through habitat alteration (cleared and maintained habitats). Direct mortality of species could also occur during right-of-

way maintenance operations, such as mowing. Direct impacts could result from operational noise at the compressor station.

Long-term habitat impacts could result from a permanent shift of the vegetation structure, primarily where trees would be prevented from occupying the permanent pipeline right-of-way. Creation of a permanent pipeline right-of-way would permanently convert many habitats to early seral vegetation stages. The trees removed by clearing would be replaced by nonwoody vegetation, shrubs and small trees, which may provide seeds and foliage as food for terrestrial mammals and birds, as well as habitat for ground-nesting birds and mammals. Where preconstruction conditions were similar, the effects on habitat support functions would be minimal. On the other hand, where the construction impacts change species composition or habitat structure to an important degree, wildlife that are closely associated with the changed conditions may respond by shifting activity to habitats that provide better support.

Impacts on scrub-shrub habitat due to construction of the pipeline would be of shorter duration than the impacts on forest lands, but regeneration of these areas would still take up to 3 years. Although the structural component of scrub-shrub habitats would recover slowly, successful restoration of nonwoody vegetation may improve the value of forage for some wildlife within a relatively short time.

Forest fragmentation caused by the new right-of-way can have negative effects on forest dwelling species, causing individuals to crowd into remaining patches of habitat. This can lead to increased competition for nesting habitat, breeding habitat, and food resources (Piatt et al., 2006). In extreme situations, the habitat breaks would inhibit movement by certain wildlife species across the right-of-way; however, most of the pipeline right-of-way would be pervious to wildlife movement after restoration. The loss of forest habitat, expansion of existing corridors, and the creation of open early successional and induced edge habitats could decrease the quality of habitat for forest interior wildlife species in a corridor much wider than the actual cleared right-of-way. The distance an edge effect extends into a woodland is variable, but most studies point to at least 300 feet (Rodewald, 2001; Ontario Ministry of Natural Resources, 2000; Robbins, 1988; Rosenberg et al., 1999).

Along much of the right-of-way, the pipeline would not be noticed by wildlife. Approximately 11 percent of forested areas crossed by the pipeline are considered Category 5 habitat, which generally corresponds to clearcuts and early seral stage forests that do not provide suitable habitat for interior forest species. At other locations, the behavior of some wildlife species may be modified when the habitat breaks are encountered, such as deer or raptors that may forage in the permanent right-of-way while using surrounding forest for cover or roosting. The pipeline right-of-way may also allow fringe forest species to move into the area, and edges may result in increased songbird nest predation and parasitism (Harris, 1984; Yahner, 1998; Temple and Cary, 1988). Consequently, some studies have shown a positive correlation between nest success rates and greater distances from the forest edge (Piatt et al., 2006). Because of the similar and ample habitat in the vicinity of the project; however, we do not expect the conversion of forested habitats to herbaceous/grassland habitats to have an adverse impact on wildlife populations.

Pipeline rights-of-way can play a useful role in linking fragmented habitats and providing essential wildlife travel and dispersal routes (Hay, 1994). The principal impact of forest fragmentation on wildlife using the pipeline right-of-way would be to favor species using edge habitat or more open areas (Pearce and Moran, 1994). Edge habitats have higher penetrations of light and wind. Also, winter snow cover may increase under reduced tree cover, but wildlife use is maintained where some vegetation shows through the snow (BPA, 2000). On the other hand, increased herbaceous plant growth near edges can be beneficial to foraging species, if noxious weeds are controlled (Roberts and Arner, 1984). The magnitudes of shift in habitat function and quality depend on the landscape context and within the

shifting mosaic of landscape conditions and patch sizes along the right-of-way; the project would generate relatively low vegetation contrast with the surrounding matrix.

Compatibility with surrounding habitats would be promoted to the extent that the right-of-way would be covered by diverse communities of shrubs and herbs. Selective tree removal that maintains shrub-scrub cover in the right-of-way softens the edge through forest habitat (Adams and Leedy, 1994). The pipeline right-of-way would intersect numerous riparian corridors, where a permanent break in tree canopy would occur at waterbodies crossed using trenching methods; however, the relatively short length of canopy disruption (i.e., 10 to 30 feet) is unlikely to prevent movement along watercourses because sight distance is relatively short. Through developed and agricultural areas, the right-of-way habitat may be improved. At most areas following construction, wildlife would be expected to return and resume normal activities consistent with the availability of post-construction habitats.

The primary source of operational noise from the pipeline is the compressor station. The compressor station would be between Highway 30 on the west and a slough on the east at MP 80.9 of the pipeline corridor. Due to its location next to a major highway and industrial district, existing ambient noise levels are relatively high and it is likely that any wildlife using this area are habituated to the elevated noise levels. Ambient and operational noise for the compressor station is analyzed and described in section 4.1.12.2. At the proposed compressor station site, ambient noise was measured as 65 dBA L_{dn} and operational noise from the compressor station is estimated to peak at 90 to 105 dBA at 1 to 3 feet from the compressor; however, noise is expected to attenuate to 58 dBA Ldn at 0.4 mile, an increase of only 3 dBA Ldn over the baseline condition.

The compressor station would incorporate a number of noise-reducing features as described in section 4.2.12.2. These features would minimize the potential for noise to impact wildlife. Impacts on wildlife from operation of the compressor station would likely be limited to avoidance of the areas closest to the station. Previously habituated species already using the surrounding areas would be unlikely to be impacted by operation.

4.1.7.3 Habitat Mitigation Policy

The FWS and ODFW have developed mitigation policies that allow for compensation for temporary or permanent impacts on wetlands and upland vegetation, as well as wildlife and salmonid habitats that would not otherwise be mitigated through other state and federal laws. In Oregon, the FWS defers to the six wildlife habitat resource categories used by the ODFW (see table 4.1.7-1). The State of Washington does not have an equivalent policy.

The ODFW developed the Habitat Mitigation Policy (OAR 415-635-0010) to provide "consistent goals and standards to mitigate impacts on fish and wildlife habitat caused by land and water development actions" (ODFW, 2006c). The purpose of these rules is to further the Wildlife Policy (ORS 496.012) and the Food Fish Management Policy (ORS 506.109) of the State of Oregon through the application of consistent goals and standards to mitigate impacts on fish and wildlife habitat caused by land and water development actions. The policy provides goals and standards for general application to individual development actions, and for the development of more detailed policies for specific classes of development actions or habitat types. The mitigation policies provide goals and guidelines for mitigating habitat impacts. The preferred form of mitigation is avoidance and minimization of fish and wildlife losses. Mitigation goals are listed in table 4.1.7-2.

Oregon LNG met with the ODFW, FWS, and other resource agencies to refine the habitat categories in the project area to facilitate Oregon LNG's compliance with habitat mitigation policy by

coordinating with resource agencies regarding the expected habitat impacts from the project prior to construction. The interagency process provided a project-specific impact analysis and mitigation planning that incorporated the general ODFW Mitigation Policy with project specific habitat elements.

Category 1 – Habitats. Potentially adverse impacts on Category 1 habitats would be avoided. If construction is scheduled to include the raptor nesting season, a biologist would visit known or suspected raptor nest sites to confirm exact locations before project implementation. If the nest is active that year, construction within one-quarter mile of the nest site would be avoided during the critical breeding and nesting season for the species. Designated critical habitat would be avoided to the maximum extent practicable.

Oregon LNG would use HDD methods to avoid impacts at Category 1 streams and riparian habitats. The drilling operation at each waterbody crossing would be engineered to minimize the potential for inadvertent releases by specifying bentonite slurry mixtures to reflect the subsurface geology determined by investigation, and each drilling operation would be carefully monitored to further reduce the potential for water quality impacts. As an additional precaution, drilling under Category 1 streams would occur during the applicable ODFW-recommended in-water work period, unless otherwise approved by the ODFW.

Category 2 – 6 Habitats. The specific mitigation measures Oregon LNG would implement to avoid, minimize, and mitigate for the habitat categories (i.e., Categories 2 through 6) that would be affected by the pipeline facilities are summarized in table 4.1.7-5.

Table 4.1.7-5

Avoidance, Minimization, and Mitigation Measures for Affected Habitat Categories

	Habitat Category where Measures would be Implemented				
Avoidance, Minimization, and Mitigation Measures to be Implemented	**2**	**3**	**4**	**5**	**6**
Routing the pipeline through managed landscapes under active land use and habitat manipulation	X	X	X		
Routing the pipeline through existing developed lands, and right-of-way used for transportation, transmission, or other utilities. Maximizing construction activities in previously cleared or developed areas.					X
Avoiding interior forest habitats and their potential fragmentation	X	X	X	X	
Avoiding removal of vegetation, especially riparian trees and significant wildlife tree types (snag, nest, etc.), wherever possible	X	X	X	X	
Avoiding removal of vegetation where present and if possible					X
Narrowing the pipeline construction right-of-way width from 110 feet (recommended by the INGAA Foundation for 36-inch-diameter pipelines) to 100 feet.	X	X	X	X	X
Constricting the construction right-of-way width from 100 feet to 75 feet when entering wetlands	X	X	X	X	
Retaining specimen trees, where possible	X	X			
Maximizing construction activities along existing right-of-way and access roads	X	X	X	X	
Using construction BMPs to prevent soil erosion and to control sediment delivered to waterbodies	X	X	X	X	
Minimizing obstructions to wildlife movement	X	X	X	X	
Minimizing grading and benching within the pipeline right-of-way	X	X	X	X	
Avoiding in-stream construction during the critical life phases of sensitive fish species	X	X	X	X	
If possible, avoiding construction during breeding seasons and critical rearing times at sites where sensitive species are known to occur	X	X	X	X	

Table 4.1.7-5

Avoidance, Minimization, and Mitigation Measures for Affected Habitat Categories

Avoidance, Minimization, and Mitigation Measures to be Implemented	Habitat Category where Measures would be Implemented				
	2	**3**	**4**	**5**	**6**
Isolating work areas from actively flowing waterbodies	X	X	X	X	
Restoring disturbed riparian areas with native species and retaining natural riparian habitat features such as logs greater than 12 inches in diameter, downed large woody material, snags, and rocks	X	X	X	X	
Restoring streambeds and streambanks affected by construction to their original condition or better (e.g., through bioengineering or by adding woody debris or gravel)	X	X	X	X	
Promoting native low-growing vegetation to reduce habitat contrasts with the surrounding landscape and edge effects, and to promote perviousness to wildlife movements	X	X	X		
Controlling public access	X	X	X	X	X
Controlling noxious weeds (such as Himalayan blackberry and Scot's broom) where necessary (as indicated by monitoring) during vegetation maintenance along the pipeline, including the permanent 10-foot-wide mowed vegetation zone and 30-foot-wide small tree and shrub zone over the pipeline.	X	X	X	X	X
Keeping ATWS areas 150 feet away from critical waterbodies	X				
Creating the permanent 10-foot-wide mowed vegetation zone (excluding developed land and roadways) over the pipeline.					X

Mitigation for impacts on riparian habitat would include increasing the depth of the pipeline trench such that the backfill would be deep enough to support shrubs and shallow-rooted trees that can provide shading and woody debris recruitment to waterbodies. Oregon LNG would provided off-site compensatory mitigation for permanent impacts on Category 3 and 4 forests by acquiring land at a 2 to 1 area ratio, and temporary impacts on Category 3 and 4 forests would mitigated at a 1 to 1 ratio. As described in Oregon LNG's Conceptual Mitigation Plan (see appendix F3), mitigation according to the ODFW's Fish and Wildlife Habitat Mitigation Policy may include the purchase of conservation easements for upland and riparian areas, riparian enhancement or restoration within the same watershed as the impacts, or removal of barriers to fish passage.

Oregon LNG would monitor mitigation performance during construction and operation, in coordination with resource agencies. Monitoring would include periodic surveys of vegetation survival in restored areas, benthic macroinvertebrate recovery, and aquatic habitat enhancement efforts following construction. As described in section 2.1.1.3, Oregon LNG would form an Adaptive Management Team consisting of representatives from the FWS, NMFS, ODF, ODFW, and WDFW to review specific mitigation proposals prior to implementation.

4.1.7.4 Big Game Habitat

Big game habitat that would be affected by the project is defined as either "major" or "peripheral." Major big game habitat is typically characterized by sparsely developed forested areas which may be defined as "sensitive" in some counties. Peripheral big game habitat is usually characterized by agricultural lands adjacent to these forested areas, which may be defined as "marginal" in some counties.

Virtually all of the forest lands along the pipeline in the State of Oregon are considered big game habitat. The ODFW reviewed the pipeline route and determined that no critical or winter range for big game exists in the Coast Range. However, some of the Coast Range is considered to be sensitive or

peripheral for big game (Biederbeck, 2008). The pipeline would pass through 61.6 miles of big game habitat and 11.3 miles of peripheral big game habitat.

This includes about 34.3 miles of major big game habitat and 6.3 miles of peripheral big game habitat in Clatsop County, 3.3 miles of major big game habitat in Tillamook County, and 24.0 miles of big game habitat and 5.0 miles of peripheral big game habitat in Columbia County. Big game that may be present within these habitats includes the black-tailed deer, mule deer, and Roosevelt elk. The State of Washington does not map big game habitat. There is no big game habitat present at the terminal site.

Black-tailed deer west of the Cascades are generally found in heavy brush areas at the edges of forests and chaparral thickets, but not in dense forests. Black-tailed deer prefer early successional stages created by clear-cuts or burns, providing grasses, forbs, and shrubs (Csuti et al., 2001). Most summer in the high Cascades and winter at lower elevations on the west slope, although some wintering may occur east of the Cascade crest. Winter loss of black-tailed deer is generally far less than for mule deer, because the snow would not remain on the valley floors for extended periods and a crust would not form on the surface as it does on the east side of the Cascades.

The Roosevelt elk occupy most of western Oregon with concentrations in the Cascade and Coast Ranges. They are sensitive to disturbance from humans and predators, such as motorized travel on and off roads (Rowland et al., 2000), as well as seasonal weather patterns. Roads are generally avoided by elk when they are open, but are heavily utilized by elk as travel rights-of-way when closed. Summer elk forage usually occurs at higher elevations within wet meadows, springs, and riparian areas in close proximity to forested stands. Winter range is usually within forested sites that provide protection against weather, but may consist of other habitat types such as grassy meadows, recent clear-cuts, industrial forest lands, agricultural fields, orchards and urban edges.

Big game is expected to be displaced by construction-related disturbances. In general, deer and elk would return to habitats they have vacated within a relatively short period of time, which would depend on the time of year, available hiding cover, and duration of local disturbances. Following construction, big game may utilize the right-of-way for travel and foraging. To minimize disturbance to wildlife, Oregon LNG would establish signage along roads and instruct project personnel to reduce vehicle speeds along roads where big game occur to avoid vehicle-animal collisions. Project personnel would also be instructed not to approach big game (either adults or young) at any time.

Following construction, there could be increased harvest rates of big game as a result of increased access by hunters using the pipeline right-of-way to access remote areas (Comer, 1982). In addition, big game species utilizing a cleared right-of-way may be more likely to be harvested than animals in forested habitat. Access could also increase poaching of game animals and nongame wildlife on a local level. Enforcement of wildlife regulations is the responsibility of the Oregon State Police. Oregon LNG would report individual incidences of illegal harvest to the Oregon State Police, if observed.

Oregon LNG would address mitigation for permanent impacts on big game species through compliance with the ODFW Habitat Mitigation Policy. With these measures in place, we conclude that the project would not significantly impact big game species.

4.1.7.5 Migratory Birds

Section 703 of the MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the U.S. Department of the Interior. The BGEPA prohibits harming eagles, their nests, or their eggs. The

National Bald Eagle Management Guidelines are intended to ensure that project actions avoid injury, decreased productivity, or nest abandonment. For example, the guidelines recommend buffers around nests to screen nesting eagles from noise and visual distractions caused by human activities.

On March 31, 2011, FERC and the FWS signed an MOU that identifies specific activities where cooperation between FERC and FWS would contribute to the conservation of migratory birds and their habitat, and outlines a collaborative approach to promoting the conservation of migratory bird populations and furthering implementation of the migratory bird conventions, the MBTA and the BGEPA.

Oregon LNG searched Oregon and Washington databases and performed preliminary field surveys to identify locations of bald eagle or other raptor nest sites within the pipeline right-of-way. Fifteen bird species that may occur within the Oregon LNG Project area are considered migratory birds of conservation concern by the FWS, these include bald eagle, black oystercatcher, Caspian tern, long billed curlew, marbled godwit, marbled murrelet, olive sided flycatcher, peregrine falcon, pink footed shearwater, purple finch, rufous hummingbird, short-billed dowitcher, vesper sparrow, western grebe, and willow flycatcher. Field surveys were performed in 2007 and 2012, and two migratoy bird species of conservation concern were observed (bald eagle and caspin tern), amoug other species. Also, aerial observations of the pipeline route were made by helicopter during 2007. No bald eagle nests were observed or are known to be present in the proposed pipeline right-of-way. There are four bald eagle nests within 0.5 mile of the pipeline route. According to comments provided by the NPS, there is an active bald eagle nest on the Lewis and Clark National Historical Park about 660 feet from the pipeline near MP 5.0. The nearest known American peregrine falcon nest location is greater than 1 mile from the terminal, in Astoria.

Construction Impacts

Construction activities associated with the terminal that may affect migratory birds are land clearing, placement of fill, grading, and construction of the terminal facilities on the East Bank Skipanon Peninsula. Actions at the terminal also include construction of a pier and dock, use of artificial lighting, and the transit of LNG marine carriers. Construction activities associated with the pipeline that would affect migratory birds are comprised of a series of sequenced activities: tree felling, ground clearing, installation of pipe (by conventional trenching and HDD), and site restoration.

The effects of construction activities would likely include temporary and permanent displacement of many bird species from the immediate vicinity of the construction zone and adjacent areas as a result of habitat modification and loss, as well as from temporarily increased noise and visual disturbance. However, the birds in the project action area are primarily migratory and therefore are not dependent on the proposed terminal site or pipeline corridor for transitional areas to provide all of their life history requirements. Many of the bird species present are adaptive to changing habitat conditions and possess the capability to temporarily expand or shift their home ranges to find alternative sources of food, water, and shelter until the proposed pipeline corridor habitats become reestablished (Taulman, 1998; ODF, 2010). Individuals of species that are less adaptive to a changing environment (e.g., many raptors) may be displaced more easily and for a longer duration than species that are more tolerant (e.g., song sparrow). While some individual birds may be displaced, no effects are expected on any migratory species at the population level.

Removal of mature trees and shrubs would change habitats for migratory birds if the trees and shrubs have been used for nesting, perching, for food source, or for cover (BPA, 2000). The effects on migratory birds from habitat loss or alteration in habitats lacking substantial woody vegetation would be relatively limited, given that most of the these areas are in an early seral stage that mostly attracts species

adapted to edges and open habitats (e.g., dusky Canada goose, other raptors, song sparrow, streaked horned lark, and western meadowlark).

Land clearing to establish a permanent pipeline right-of-way would result in vegetation removal, tree removal, and could increase habitat fragmentation. Fragmentation is associated with increased edge habitat. The 100-foot-wide pipeline construction corridor would be pervious to bird movement after restoration, thus favoring species using edge habitat or more open areas. Increased disturbance during clearing operations, pipeline laying, and HDD operations would be expected to temporarily displace migratory birds that are within auditory and visual range of the source. The extent and magnitude of this effect would be dependent on baseline habitat conditions and the timing of disturbance. Tree felling in the late spring/early summer could adversely affect birds that are actively nesting adjacent to the area of disturbance, but would minimize or avoid direct disturbance to species that nest near streams or those that forage on fish or aquatic invertebrates. Birds that nest in proximity to the pipeline corridor could be at most risk of displacement. Extended displacement could result in nest failure. However, disturbance would be short-term and localized.

Operations Impacts

During operation, the terminal may provide perches for migratory birds, especially on mooring dolphins and other pier infrastructure. A potential effect of birds perching at the pier and dock is increased predation on fish, a critical concern during out-migration of juvenile salmon. Although there would be limited suitable nesting habitat in the developed areas of the terminal, habitat suitable for birds would be enhanced in a new 50-foot-wide buffer installed along the southern property line that would comprise native trees and shrubs. As discussed previously in section 4.1.7.1, artificial lighting at the terminal could affect avian behavior and/or migration. Specific effects may include temporary disorientation from and attraction to artificial light, structural-related mortality as a result of disorientation, and temporary effects on the light-sensitive cycles of many species.

The FWS has not provided any guidelines on avoiding avian collisions with storage tanks or marine docks such as those at the LNG terminal. However, in 2000, the agency published interim guidelines on another type of vertical structure, the telecommunications tower (FWS, 2000a). Guideline 2 recommends installing towers less than 199 feet above ground level. Guideline 5 specifies that, unless otherwise required by the FAA, only white (preferable) or red strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. The use of solid red or pulsating red warning lights at night should be avoided. Oregon LNG would follow these guidelines for the LNG storage tanks.

Migratory birds follow broad routes called “flyways” between breeding grounds in Canada and the United States and wintering grounds in Central and South America. Because the Columbia River estuary is one of the most important sites on the Pacific Flyway for migratory birds, they could be disturbed by LNG marine carriers during feeding trips to nearshore habitats and accompanying flight to and from roosting grounds. However, this disturbance is unlikely due to the already high current level of tanker traffic on the Columbia River.

Vegetation maintenance over the pipeline would result in short-term (measured in terms of minutes or hours at a given location) noise, visual disturbance, and habitat alteration. Pruning or herbicidal control of woody vegetation may result in habitat loss if the affected vegetation is used for nesting, cover, or forage. Many species would likely respond favorably to operational habitat conditions along the pipeline (Moran, 1994; Yahner, 1998) because vegetation maintenance would favor native vegetation, which generally provides higher quality forage and nesting habitat for migratory birds.

Noxious weed control and control of woody vegetation can result in increased herbaceous plant growth near edges, which can benefit foraging species (Arner, 1994). Ground-foraging birds and birds that forage on insects may benefit from activities that maintain herbaceous vegetation.

Mitigation Measures

Oregon LNG would take measures to avoid and minimize the taking of birds protected by the MBTA and BGEPA. These measures are in addition to those that may be imposed to protect birds protected under the ESA, such as northern spotted owl, and marbled murrelet (see section 4.1.8). Oregon LNG provided a technical memorandum *Migratory Birds – Regulatory Review and Mitigation* (see appendix F6) that was intended to summarize project actions that may affect migratory birds; describe measures that Oregon LNG would implement to avoid and minimize negative effects on migratory birds; and describe proposed mitigation measures that Oregon LNG would implement to compensate for unavoidable negative effects from the project on migratory birds. However, this memorandum does not fully address the migratory birds species of concern in the MOU between the FWS and FERC to protect birds listed under the MBTA and BGEPA. **Therefore we recommend that:**

- **Prior to construction of the Oregon LNG Project, Oregon LNG should file with the Secretary a Migratory Bird Conservation Plan, along with documentation of consultation and approval by the FWS.**

The terminal would be constructed on sandy dredge spoils, most of which is devoid of vegetation or covered by poor-quality nesting habitat (Scot's broom and Himalayan blackberry), generally avoiding impacts on migratory bird habitat. To prevent birds from roosting on the pilings at the terminal, the tops of the pilings would be capped with cones designed to prevent roosting. Any signs of persistent avian roosting would be recorded. During the first year of operation, Oregon LNG would file a report with designated ODFW and NMFS offices every 6 months and an annual report thereafter. If after 2 years, no avian predators have been observed, reporting would cease but monitoring would continue. In the event that predatory birds begin using the platform, terminal, or access trestle, Oregon LNG would implement an adaptive management plan in consultation with local ODFW and FWS biologists to prevent roosting.

Lighting at the terminal and onshore facilities would likely include a mixture of low-power fluorescent lighting and higher intensity security lighting. Proposed measures to minimize the potential for lighting impacts on migratory birds include the use of the following equipment: (a) directional lighting facing onshore to the extent possible, (b) screens or lighting hoods, (c) motion-activated lighting, (d) full-cutoff light fixtures, which have no direct uplight, help eliminate glare, and are more efficient by directing all lighting down to the intended area only, and (e) strobing lights to the greatest extent practicable.

Pipeline construction would follow Oregon LNG's Plan and Procedures. The Plan and Procedures would help to avoid, minimize, and mitigate potential impacts on wildlife and wildlife habitat by establishing best practices for construction. The timing of vegetation clearing is an important consideration for avoiding or minimizing impacts on nesting migratory birds. To minimize negative impacts on MBTA birds and their habitats, Oregon LNG would cut trees and other woody vegetation outside the migratory bird nesting season (generally March 15 through August 15 for most bird species).

Oregon LNG would conduct preconstruction surveys or search for MBTA birds and their active nests if unforeseeable circumstances require cutting trees and other woody vegetation between March 15 and August 15. A qualified wildlife biologist would conduct a survey no more than 1 week prior to clearing trees and shrubs in the migratory bird nesting season. Surveys would be conducted in the construction right-of-way and an additional 135-foot (for nonraptors) to 250-foot (for raptors) buffer from

where potential suitable nesting habitat is present. One or more biologists familiar with the songs of Pacific Northwest migratory birds would conduct the survey on foot not more than 30 days prior to the start of ground-clearing activities.

To the extent practicable, Oregon LNG would schedule heavy and loud equipment within a compressed timeframe rather than spreading out construction activities and noise over a prolonged period of time. To avoid and minimize construction-related impacts, Oregon LNG has restricted the size of construction areas to the extent practicable. The width of clearing typically would be 100 feet. Oregon LNG would cross 20 waterbodies using 11 HDDs to limit riparian vegetation clearing at other waterbody crossing locations to reduce temporary habitat loss. The extensive use of existing logging roads for access in the Coast Range, rather than new access road construction would also minimize impacts on bird habitat. Pipeline storage yards would be in developed areas, therefore avoiding impacts on migratory birds and their habitats.

In the event that MBTA bird eggs or chicks (nestlings or fledglings) are found out of a nest during construction, the following actions would be taken. The FWS would be contacted immediately during normal business hours. If eggs or chicks can be salvaged (i.e., if not cracked or dead), then they would be taken to a federally and state permitted wildlife rehabilitation center (such as the Portland Audubon Society Wildlife Care Center) by a person authorized to handle migratory birds. The environmental inspector would maintain a log of MBTA bird salvage efforts, including unintentional mortalities and transfer to wildlife rehabilitation care facilities. The inspector would file a report with the FWS within 24 hours of an occurrence and send a copy to the ODFW.

Immediately after construction has been completed, Oregon LNG would restore the construction right-of-way and additional temporary workspaces with native vegetation to reestablish preconstruction habitat conditions. Native tree and shrub species would be established outside the maintenance corridor (30-foot-wide for trees and 10-foot-wide for shrubs) centered over the pipeline.

Oregon LNG proposes the following impact minimization measures during construction specific to bald eagles.

- Adhere to the following protection measures, as feasible: 1) retain active roost trees; 2) retain staging trees; 3) retain a forested buffer not less than 300 feet around the outermost active roost tree; and 4) during the critical period of use, avoid disturbance within 0.25 mile of active roost trees unless eagles have line-of-sight vision from these trees, then avoid disturbance within 0.5 mile of roost trees.
- Prior to construction, review the most recent bald eagle nesting survey database for current nest locations.
- Minimize construction, operation, and maintenance activities within 0.5 mile of any nest (or 0.25 mile if any nest is within line-of-sight of the project), or to nonbreeding season (October 31 to December 31).
- In the event that bald eagles are unexpectedly encountered during construction activities conducted outside of the breeding season, establish a setback of at least 660 feet from bald eagle nests where project activities are visible, and 330 feet where project activities are not visible from the nests. During the breeding season, a setback of at least 0.5 mile would be established from bald eagle nests where project activities are visible and 0.25 mile where project activities are not visible from the nest.

Oregon LNG would comply with the ODFW's Fish and Wildlife Habitat Mitigation Policy. Specific mitigation ratios are detailed in Oregon LNG's Conceptual Mitigation Plan. Key elements of the Mitigation Plan include provisions to preserve and enhance habitats, including old-growth, riparian, oak savanna, upland prairie, and wetland prairie. Compensatory mitigation is proposed to preserve, restore, and enhance riparian habitat that supports indicator species including bald eagle, great blue heron, little willow flycatcher, purple martin, yellow-breasted chat, osprey, acorn woodpecker, and a variety of raptors. Compensatory mitigation is also proposed for forested habitats in the Coast Range. Specifically, Oregon LNG would place conservation easements on large blocks of land and manage them to create late-successional and old-growth habitat suitable for interior forest species such as olive-sided flycatcher, marbled murrelet, northern spotted owl, and other forest-dwelling raptors.

To mitigate for the potential loss of raptor nesting trees, Oregon LNG would install three artificial nest platforms for every nest or nest platform that must be relocated. In addition, to minimize impacts on raptors known to nest within 300 feet of the construction corridor, Oregon LNG would increase the distance between the pipeline and artificial nest platforms by relocating existing nest platforms.

In summary, construction activities may cause minor temporary and short-term impacts on migratory birds through displacement, while no effects are expected on any migratory species at the population level. Oregon LNG would implement mitigation measures to reduce impacts on migratory birds during construction and operation and has also proposed compensatory mitigation for habitat that supports migratory birds. We are recommending that Oregon LNG consult with FWS to prepare a Migratory Bird Conservation Plan. Therefore we conclude that the overall impact of the project on migratory birds would be minor.

4.1.8 Threatened, Endangered, and Other Special Status Species

Section 7 of the ESA (19 U.S.C 1536(c)), as amended, requires that any actions authorized, funded, or carried out by a federal agency do not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of federally listed designated critical habitat. The action agency is required to consult with the FWS and/or NMFS to determine whether federally listed endangered or threatened species or designated critical habitat are found within the vicinity of the project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal action agency must prepare a BA for those species that may be affected. The action agency must submit its BA to the FWS and/or NMFS and, if it is determined that the action is "likely to adversely affect" a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, the FWS and/or NMFS will issue a biological opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

As the lead federal agency in conducting the NEPA analysis, FERC is also analyzing project-related activities authorized by the USACE and recommended by the Coast Guard that would potentially affect federally listed endangered and threatened species. In compliance with Section 7 of the ESA and the MSA, FERC staff is preparing a BA and EFH assessment for the project for submittal to the FWS and NMFS prior to issuance of the final EIS. The BA and EFH assessment will detail the environmental baseline for federally listed species, designated critical habitat, and EFH; direct, indirect, interdependent and interrelated, and cumulative effects; proposed conservation measures; and determinations of effect. A general summary of the information that will be included in the BA and EFH assessment and our preliminary conclusions are provided in this EIS. Our consultation with NFMS and FWS and preparation of the BA is in progress, and our final determinations regarding the effects on species are pending. Therefore, **we recommend that:**

- **Oregon LNG should not begin construction activities until FERC staff completes any necessary Section 7 ESA consultation with NMFS and the FWS, and Oregon LNG receives written notification from the Director of OEP that construction may begin.**

In addition to the federal ESA, Oregon and Washington have endangered species provisions that protect native vertebrates and plants on state lands (ORS 496.172 to 496.192; 498.026; 564.100 to 564.135, and WAC 232-12-297; WAC 365-196-485) and require consideration of the impacts of forest practices on threatened and endangered species (ORS 527.610). Most species that are listed by Oregon or Washington as either threatened or endangered are also listed as federally threatened or endangered.

For purposes of this environmental analysis, special status species of plants and animals include:

- species that are listed by the federal government as endangered or threatened, or are candidates for listing;
- species listed by Oregon or Washington as endangered, threatened, or candidates for listing; and
- species identified by federal or state agencies as rare or sensitive (this includes Oregon special status species) with the potential to occur in the vicinity of the project.

To assess potential impacts on special status species and designated critical habitat, FERC staff (assisted by Oregon LNG, as our nonfederal representative) informally consulted with the FWS, NMFS, ODFW, and WDFW.

We received comments from state and federal agencies expressing concerns about the analysis of impacts on threatened, endangered, and other listed species and their habitats. Specific concerns included:

- effects on individual and populations of federally listed species;
- degradation of the production and biological capacity of aquatic, riparian, wetland, and upland habitats; critical habitat; and EFH;
- invertebrate habitat loss and individual/population level impacts;
- construction timing and timing conflicts between listed species (i.e., in-water work periods, noise/blasting restrictions, and vegetation clearing restrictions for upland listed species);
- impacts on water quality (temperature, turbidity, point source, erosion/sedimentation) during construction and operation and the subsequent impacts on listed species;
- impacts on species habitat and the proposed mitigation measures for potential impacts;
- construction noise and sound abatement mitigation;
- air quality impacts on listed species; and
- inclusion of a mitigation plan for listed and nonlisted species and habitat to be included as part of the mitigation process.

As discussed in section 2.1.1.3, Oregon LNG has developed a Conceptual Mitigation Plan (see appendix F3) in consultation with state and federal agencies that describes proposed mitigation actions to offset adverse project impacts on both listed and nonlisted species. The mitigation actions that would offset impacts on federally listed species include wetland enhancement at the Youngs River site, removal of existing fish barriers, acquisition of mature forests for conservation, wetland enhancement in the Nehalem River floodplains, and protection of riparian habitat along high-quality salmonid waterbody habitat. The plan also includes on-site mitigation, avoidance and minimization measures as well as adaptive management strategies. Because species status or habitat conditions in the project area may change prior to construction, **we recommend tha**t:

- **Prior to construction of the Oregon LNG Project, Oregon LNG should file with the Secretary its agency-approved Mitigation Plan (for sensitive species and their habitats), developed in consultation with the USACE, ODFW, USFWS, WDFW, and NMFS.**

4.1.8.1 Federally Listed Threatened and Endangered Species

Species listed under the federal ESA as threatened or endangered are afforded the highest level of protection to limit impacts on the species and its habitat. Through informal consultation with the FWS and NMFS, FERC staff identified 38 federally listed threatened, endangered, or candidate species as potentially occurring in the project area. These species include 8 marine mammals, 4 bird species, 4 sea turtles, 16 fish species (not including bull trout), 1 mammal, 1 invertebrate (butterfly), and 3 plant species. Many of these species have designated critical habitat (habitats that are considered to be essential for the recovery of the species) that are crossed by the project and one species has proposed critical habitat (yellow billed cuckoo). In addition, the Columbia River is designated as critical habitat for bull trout; however, this species is not known to occur in the project area.

Table 4.1.8-1 identifies the federally listed species potentially occurring in the project area, their state status, the portion of the project area where the species may occur, preferred habitat, and effect determination.

Table 4.1.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status [a]		Project Component of Potential Occurrence			Preferred Habitat	Determination [d]		Survey Status
	Federal	State	Marine	Columbia River [b]	Pipeline		Species	Critical Habitat	
Marine Mammals									
Blue whale (*Balaenoptera musculus*)	E	OR – E WA – E	X			North Pacific Ocean from Japan west to the Gulf of Alaska and south to California. Not known to migrate through coastal waters of Oregon.	NLAA	NA	Not required
Fin whale (*Balaenoptera physalus*)	E	OR – E WA – E	X			Temperate zones of both the northern and southern hemispheres. Found beyond the slope of the continental shelf.	LAA	NA	Not required
Humpback whale (*Megaptera novaeangliae*)	E	OR – E WA – E	X			Migratory; spending the summer and fall along the Pacific Coast and winter and spring in the warmer waters of coastal Central America and Mexico.	NLAA	NA	Not required
Killer whale (*Orcinus orca*)	E [c]	OR – NL WA – E	X			Colder offshore waters in both the northern and southern hemispheres. Occasionally observed at the mouth of the Columbia River.	NLAA	NE	Not required
North Pacific right whale (*Eubalaena japonica*)	E [c]	OR – E WA – NL	X			Gulf of Alaska and the Bering Sea.	LAA	NE	Not required
Sei whale (*Balaenoptera borealis*)	E	OR – E WA – E	X			Temperate waters of the northern Pacific Ocean, with few recorded observations in coastal waters of the Pacific Northwest.	LAA	NA	Not required
Sperm whale (*Physeter macrocephalus*)	E	OR – E WA – E	X			Found throughout the northern Pacific Ocean, offshore, and over the continental slope.	NLAA	NA	Not required
Western DPS Steller sea lion *(Eumetopias jubatus)*	E [c]	OR - NL WA - T	X			Western DPS Steller sea lions range along the northern Pacific Rim from northern Japan to California, but most are found in the Gulf of Alaska and Aleutian Islands.	NLAA	NLAA	Not required
Mammals									
Columbian white-tailed deer	T	OR – T WA – E			X	Closely associated with riparian (riverside) habitats.	NLAA	NA	Survey prior to construction

Table 4.1.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status [a]		Project Component of Potential Occurrence			Preferred Habitat	Determination [d]		Survey Status
	Federal	State	Marine	Columbia River [b]	Pipeline		Species	Critical Habitat	
Birds									
Marbled Murrelet (*Brachyorampus marmoratus*)	T [c]	OR – T WA – T	X	X	X	Forage in the Pacific Ocean. Nest in old-growth trees in Coast Range forests.	LAA	LAA	Survey between May 1 - August 5 for areas where data is lacking
Northern spotted owl (*Strix occidentalis*)	T [c]	OR – T WA – E			X	Use old-growth forests for nesting, roosting, foraging, and dispersal. Characteristics include complex multitiered, multiple-species canopy forests that have a predominance of large overstory trees with moderate to dense canopy closure.	LAA	LAA	Survey all suitable habitats within the project area prior to construction
Streaked horned lark *(Eremophila alpestris strigata)*	T [c]	OR – NL WA – E			X	Upland grasslands, pastures, Christmas tree farms, and Oregon white oak.	NLAA	NE	Survey at the terminal and between MPs 80 and 121 if construction would occur during the nesting season (March and July)
Yellow-billed cuckoo *(Coccyzus americanus)*	T	OR - C WA - C			X	Cottonwood dominated floodplains along the Willamette and Columbia Rivers and Puget South lowlands.	NLAA	NDAM, provisional NE	Survey between MPs 80.0 and 86.8 prior to construction
Amphibians and Reptiles									
Green sea turtle (*Chelonia mydas*)	T [c]	OR – E WA –T	X			High energy ocean beaches (nesting), convergence zones in pelagic habitat (juvenile feeding), and benthic feeding grounds in shallow protected waters (adult feeding). Unlikely to occur in Oregon.	NLAA	NE	Not required

Table 4.1.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status [a]		Project Component of Potential Occurrence			Preferred Habitat	Determination [d]		Survey Status
	Federal	State	Marine	Columbia River [b]	Pipeline		Species	Critical Habitat	
Leatherback sea turtle (*Dermochelys coriacea*)	E [c]	OR – E WA – T	X			Highly migratory, prefers warmer waters off the coast of southern California and Mexico. Unlikely to occur in Oregon.	NLAA	NLAA	Not required
Loggerhead sea turtle (*Carretta carretta*)	T [c]	OR – T WA – T	X			Forages off the coast of southern California along coral reefs, rocky bottoms, and shellfish beds in waters <50 meters deep. Nests in warm temperate and subtropical regions; no known breeding sites within the U.S.	NLAA	NE	Not required
Olive (Pacific) ridley sea turtle (*Lepidochelys olivacea*)	T	OR – T WA – NL	X			Pelagic, occurs along the continental margins and oceanic islands. No known nesting sites within the U.S.	NLAA	NA	Not required
Fish									
Chinook Salmon *(Oncorhynchus tshawytscha)*									
Lower Columbia River ESU	T [c]	OR – C WA – C	X	X	X	Anadromous; spawn in freshwater streams with gravel substrate. Rear in stream habitat with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Require migration corridors free of obstruction.	LAA	LAA	Not required
Snake River Fall-run ESU	T [c]	OR – T WA – C	X	X			LAA	LAA	Not required
Snake River Spring/Summer-run ESU	T [c]	OR – T WA – C	X	X			LAA	LAA	Not required
Upper Willamette River ESU	T [c]	OR – C WA – NL	X	X			LAA	LAA	Not required
Upper Columbia River Spring-run ESU	E [c]	OR – NL WA – NL	X	X			LAA	LAA	Not required
Chum Salmon (O. keta) Columbia River ESU	T [c]	OR – C WA – C	X	X	X	Anadromous, spawn in side channels of the Columbia River. Rear in the estuary before migrating to the ocean.	LAA	LAA	Not required

Table 4.1.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status [a]		Project Component of Potential Occurrence			Preferred Habitat	Determination [d]		Survey Status
	Federal	State	Marine	Columbia River [b]	Pipeline		Species	Critical Habitat	
Coho Salmon (*O. kisutch*)									
Lower Columbia River ESU	T [c]	OR – E WA – NL	X	X	X	Anadromous; spawn in the headwater streams in areas with low water velocity and small-sized gravel. Rear in complex stream habitat before migrating to ocean.	LAA	LDAM; LAA provisional	Not required
Oregon Coastal ESU	T [c]	OR – NL WA – C	X		X		LAA	LAA	Not required
Eulachon *(Thaleichthys pacificus)*	T [c]	OR – NL WA – NL	X	X		Anadromous; spawn in shallow sandy bottom areas in freshwater and migrate to the ocean to forage.	LAA	NLAA	Not required
Bull trout (*Salvelinus confluentus)* Columbia River DPS	T [c]	OR – NL WA – C		X		Cold water habitat with stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors.	NE	NLAA	Not required
North American Green Sturgeon *(Acipenser medirostris)* Southern DPS	T [c]	OR – NL WA – NL	X	X		Near river mouths, estuaries, and large coast rivers along the West Coast, including the lower Columbia River. Anadromous; spawns in freshwater areas then migrates to foraging areas in ocean.	NLAA	NLAA	Not required
Sockeye Salmon (*O. nerka*) Snake River ESU	E [c]	OR – NL WA – C	X	X	X	Spawning in tributaries, and lakes, to the Snake River. Require migration corridors free of obstruction.	LAA	LAA	Not required
Steelhead (*O. mykiss*)									
Lower Columbia River DPS	T [c]	OR – C WA – C	X	X	X	Anadromous; spawn in freshwater streams with small gravel substrate. Rear in complex stream habitat with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Require migration corridors free of obstruction.	LAA	LAA	Not required
Middle Columbia River DPS	T [c]	OR – C WA – C	X	X			LAA	LAA	Not required
Upper Columbia River DPS	T [c]	OR – NL WA – C	X	X			LAA	LAA	Not required
Upper Willamette River DPS	T [c]	OR – NL WA – NL	X	X			LAA	LAA	Not required

Table 4.1.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status [a]		Project Component of Potential Occurrence			Preferred Habitat	Determination [d]		Survey Status
	Federal	State	Marine	Columbia River [b]	Pipeline		Species	Critical Habitat	
Snake River Basin DPS	T [c]	OR – NL WA – C	X	X			LAA	LAA	Not required
Invertebrate									
Oregon silverspot butterfly (*Speyeria zerene hippolyta*)	T [c]	OR – NL			X	Coastal salt spray meadows, stabilized dunes, and mountain meadows. Currently endemic to coastal Oregon.	NE	NE	Prior to construction, survey suitable habitat where access was denied
Plants									
Bradshaw's lomatium (Lomatium bradshawii)	E	OR – E			X	Seasonally saturated or flooded prairies, adjacent to creeks and small rivers in the southern Willamette Valley.	NLAA	NA	Survey during flowering season prior to construction
Nelson's checkermallow (*Sidalcea nelsoniana*)	T	OR – T			X	Wetland prairies and riparian areas, roadsides, and fallow fields. Often occurs in areas where prairie merges with deciduous woodland.	LAA	NA	Survey during flowering season prior to construction
Water howellia (Howellia aquatilis)	T	OR – NL			X	Shallower waters of sloughs, oxbows, and ponds. Slow-moving water along pond edges, lake edges, and river oxbows.	NLAA	NA	Survey during flowering season prior to construction

[a] T = threatened, E = endangered, D = delisted, C = candidate, P = proposed for listing. NL = not listed

[b] Includes LNG marine carrier waterway, terminal area, and dredged material disposal sites.

[c] Critical habitat designated or proposed for species.

[d] NLAA = Not Likely to Adversely Affect; LAA = Likely to Adversely Affect; LDAM: Likely to Destroy or Adversely Modify; NDAM = Will Not Destroy or Adversely Modify; DPS = Distinct Population Segment; ESU = Evolutionary Significant Unit; NA = not applicable; NE = No Effect

Marine Mammals

We received comments expressing concerns about the analysis of direct and indirect impacts specific to marine mammals from habitat alteration, entrainment of fish (food source) in ballast and cooling water intakes, ship strikes, increased noise, and increased light levels.

To export LNG to Asia from the proposed terminal, an estimated 125 LNG marine carriers would make round trips following the North Pacific Great Circle Route, shown in figure 4.1.8-1, between the Pacific Northwest and East Asia. The Great Circle route passes in an arc through the Aleutian Islands, primarily through Unimak Pass and also west of Tanaga Island. As shown in figure 4.1.8-1, LNG marine carriers would pass through the Oregon EEZ and the Alaskan EEZ. The 125 round trips to and from the terminal would increase current ship traffic on the Great Circle route by about 6 percent. LNG marine carriers would enter and exit the Oregon EEZ roughly parallel to the Columbia River.

Import LNG marine carrier traffic would be infrequent, up to two a year, most likely in the wintertime, and only occurring in the event of a major natural gas supply emergency on the Pacific Northwest pipeline grid during periods of peak heating demand. Two shipping routes are assumed for import: one along the Pacific Coast from San Diego to the mouth of the Columbia River, and a Great Circle entry into the mouth of the Columbia River that would be perpendicular to the EEZ. The Pacific Coast route would account for LNG tankers transiting from Middle East ports and around South America. Great Circle entry into the Columbia River would account for LNG tankers transiting from Asian markets. The additional two round trips a year along the west coast EEZs would increase existing shipping traffic much less than 1 percent.

Seven species of whales potentially occur off the coasts of Oregon, Washington, and Alaska that are federally listed as endangered under the ESA and considered "depleted" and "strategic" under the MMPA. These species include the blue, fin, humpback, North Pacific right, sei, Southern Resident killer, and sperm whales. Whales tend to feed during the summer in the northern latitudes and migrate to the tropical southern latitudes in the winter for breeding. Whales can be encountered throughout the year off the coasts of Oregon, Washington, and Alaska.

All the whale populations discussed below have been depleted by hunting over the past two centuries and continue to face various anthropogenic threats (Carretta et al., 2007). Current and ongoing threats include ship strikes, spills, climate change, and commercial fishing operations. Whales are affected by commercial fishing operation when they get tangled in gear (e.g., gillnets, trawls, and longlines) which can result in injury or death. NMFS also considers anthropogenic noise, primarily resulting from coastal development, as an additional habitat concern that may affect whales (NMFS; 1998a, 1998b). It is suspected that additional noise may compromise migration routes and seasonal habitats.

Whale Species

Blue Whale

Blue whales offshore of Oregon are part of the Eastern North Pacific Stock, with an estimated population of about 1,700 whales (Carretta et al., 2013). Blue whales are listed as endangered both federally and by the states of Oregon, Washington, and Alaska. No critical habitat has been designated or proposed for blue whales. Blue whales, a baleen species, forage off the coast between California and the Gulf of Alaska. Surveys of blue whales showed the greatest densities off the coast of southern California (Carretta et al., 2007). They spend about half of their time each year outside the EEZ. Studies indicate that blue whales are present off the coast of Oregon from late July until January as they migrate to southern waters (Stafford et al., 1999).

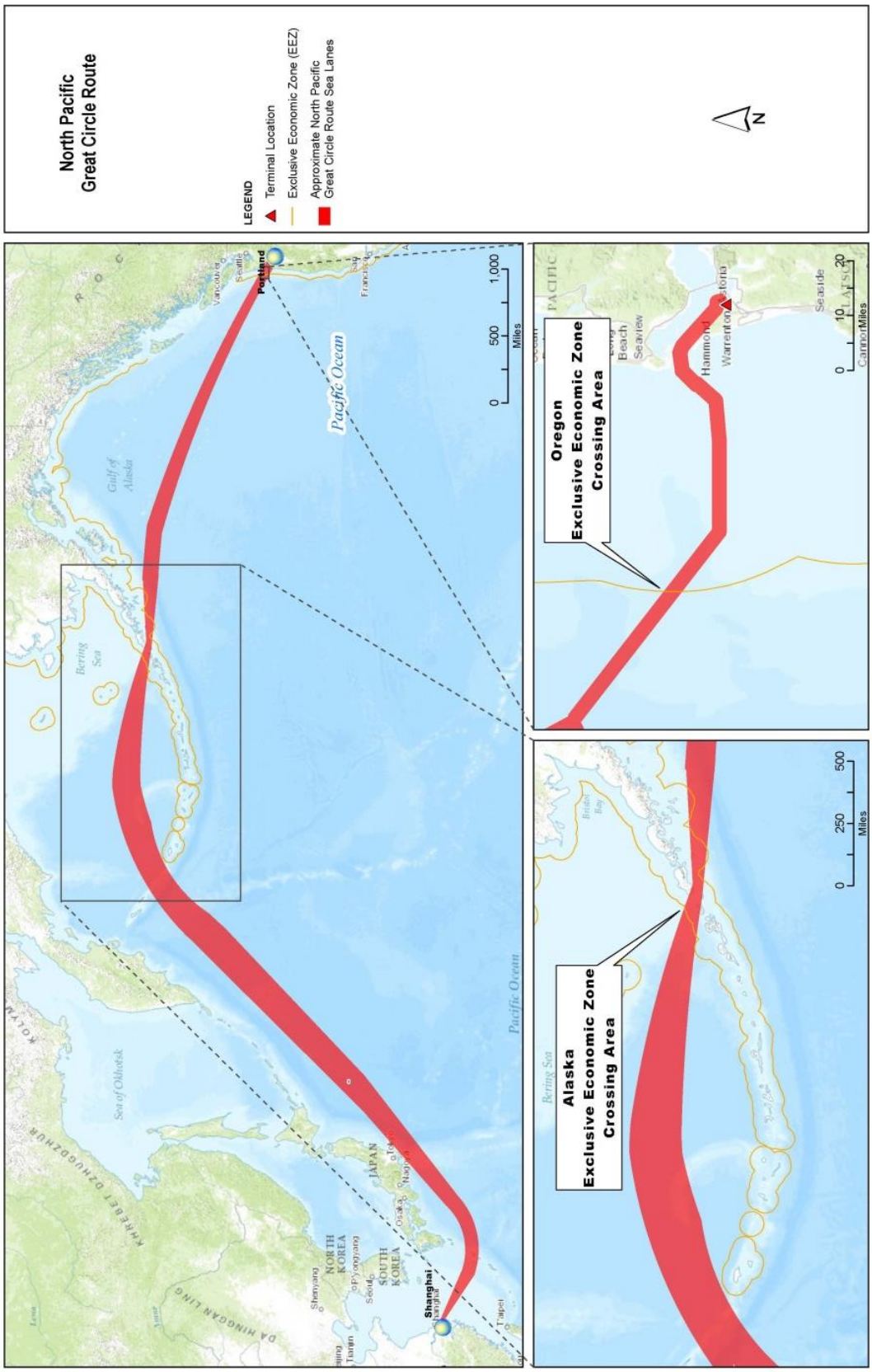


Figure 4.1.8-1: North Pacific Great Circle Route

Fin Whale

The fin whale is listed as endangered both federally and by the states of Oregon and Washington. No critical habitat has been designated or proposed for fin whales. For management purposes, three populations are recognized in the Pacific Ocean: Alaska (Northeast Pacific), California/Oregon/Washington, and Hawaii (NMFS, 2006a); however, none are recognized as a DPS. The population of fin whales along the California coast was estimated to be about 1,600 to 3,200 and 280 to 380 off the coasts of Oregon and Washington (Barlow and Taylor, 2001; Barlow, 2003). The population is thought to be stable to slightly increasing (Carretta et al., 2007). Fin whales are present off the California, Oregon, and Washington coasts year-round, with the highest concentrations noted in the summer and fall (NMFS, 2006a). Migratory patterns of the fin whale are not well understood and the majority of sightings are beyond the slope of the continental shelf. In Alaska, the full range of fin whales has not been surveyed, but a minimum population estimate of about 5,700 has been made for the area west of the Kenai Peninsula (Allen and Angliss, 2013). Fin whale calls have been detected in Alaska year-round.

Humpback Whale

The humpback whale is listed as endangered both federally and by the states of Oregon, Washington, and Alaska. No critical habitat has been designated or proposed for humpback whales. The California/Oregon/Washington and Mexico stock spends summer and fall along the Pacific Coast before migrating to Central America and Mexico during winter and spring (Carretta et al., 2005; Carretta et al., 2013). The population was between 6,000 and 8,000 in the mid-1990s over the North Pacific; however, the current abundance estimate for the North Pacific is about 20,000 whales (NMFS, 2014a). The population was growing at an annual rate of 6 to 7 percent during the 1990s and the early 2000s (Carretta et al., 2008). Humpback whales are most likely present offshore of Oregon from May to November. They are primarily found in coastal waters but range over the continental shelf and slope. The Central North Pacific stock of humpback whales overwinters in the Hawaiian Islands and spends summers in Southeast Alaska, the Gulf of Alaska, and the Bering Sea and Aleutian Islands (Allen and Angliss, 2013). Humpback whales are present throughout the Aleutian Islands in summer and fall. In June 2014, NMFS announced they are considering delisting the Central North Pacific stock from the ESA.

Killer Whale

The Southern Resident killer whale DPS is listed as endangered both federally and by the state of Washington. Critical habitat was designated in November 2006 for the Southern Resident population. However, none of the Critical Habitat Units (CHU) for the Eastern North Pacific Southern Resident stock occurs within the project area.

The killer whale is a toothed whale that prefers colder waters in both the northern and southern hemispheres. Two different populations are recognized: residents and transients (Baird, 2001). They may be further subdivided into southern and northern stocks. Residents forage primarily on fish, whereas transients forage primarily on other marine mammals. Killer whales of coastal Oregon and Washington are part of the Eastern North Pacific Southern Resident Stock, numbering 87 in 2011 (Carretta et al., 2013). Killer whales are social, living in pods. Of the three Eastern North Pacific Southern Resident Stock pods, two spend most of their time offshore and the other spends most of its time in inland waters ((NMFS, 2013a). In the Pacific Northwest, most sightings of killer whales occur seasonally in the inland waters of Washington and British Columbia. Killer whales are occasionally seen off the mouth of the Columbia River (FERC, 2007; NMFS, 2013b). The Southern Resident Stock occurs in the inland waters of Washington and British Columbia, with the peak occurrences happening in the summer and fall months (Whale Museum, 2005). Killer whales in Alaska are not federally listed.

Killer whales face many anthropogenic threats, including prey reduction, climate change, elevated levels of PCBs, and historically live-capture for aquariums and hunting. Over the past 150 years there has been a pronounced reduction in prey, primarily salmon, for Southern Resident killer whales. This decline in prey is linked to a reduction in killer whale populations (NMFS, 2006b). Vessel traffic alters the habitat of killer whales and may influence movement patterns and disrupt feeding (Lusseau et al., 2009). PCBs have been found in killer whales in the Southern Resident Stock and increasing levels of these toxins are being found in ocean habitats.

North Pacific Right Whale

The North Pacific right whale is listed as endangered both federally and by the states of Oregon and Alaska. In 2008, critical habitat was designated south of Kodiak Island in the Gulf of Alaska, and in the southeastern Bering Sea; each of these areas is outside the project area. The North Pacific right whale is extremely rare, with a population estimated to be fewer than 100 (Carretta et al., 2013). Between 1900 and 1994, only 29 sightings were verified along the Pacific Coast (Carretta et al., 2005). The population status and migratory behavior of the right whale are poorly understood.

In the Pacific Ocean, right whales occur mainly in coastal waters or shelf waters between central Mexico and southern Alaska, but also move into deep waters farther offshore. In general, their distribution is strongly correlated to the distribution of their prey. In winter months, right whales occur in lower latitudes and coastal waters where calving takes place. The specific location of this whale during winter remains largely unknown. Right whales migrate to higher latitudes during spring and summer (NMFS, 2013c).

Ship strikes and spills are considered a threat for any whale species but due in part to their low numbers; this species has not been implicated in whale strikes along the coasts of Oregon and Washington (NMFS, 20013c).

Sei Whale

The sei whale is listed as endangered both federally and by the states of Oregon and Washington. No critical habitat has been designated or proposed for sei whales. The sei whale, another baleen whale, is similar to the fin whale. It is distributed in temperate waters. Sei whales occur most often beyond the continental shelf with few recorded observations in coastal waters of the Pacific Northwest (NMFS, 2011a; Carretta et al., 2005).

The estimated population size of the Eastern North Pacific Stock of sei whales is about 126 (Carretta et al., 2013), with only 56 sightings recorded out to 300 nautical miles off the coast of California, Oregon, and Washington (Barlow, 2003). The Eastern North Pacific Stock migrates between coastal waters of the Pacific Coast and Vancouver Island (Rice, 1977). Sei whales have been recorded within the EEZ during the summer months. The Platforms of Opportunity database includes four sightings of sei whales since 1958. Of these, one sighting occurred in shelf waters, one occurred along the slope, and two occurred offshore. Shipboard surveys between 1991 and 2001 did not record any sightings of the sei whale within the EEZ (Caretta et al., 2005; Green et al., 1992).

Sperm Whale

Sperm whale is a toothed whale that occurs throughout the northern Pacific Ocean. The California-Oregon-Washington stock of sperm whales is listed as endangered both federally and by the states of Oregon and Washington. No critical habitat has been designated or proposed for sperm whales. Sperm whales are widely scattered within the EEZ of California, Oregon, and Washington (Carretta et al., 2007). Sperm whales have been recorded offshore and over the continental slope from the spring through

the fall (Green et al., 1992). The California-Oregon-Washington Stock is estimated to be about 971 whales (Carretta et al., 2013). The North Pacific stock of sperm whales, found throughout Alaska, is also federally listed as endangered (Allen and Angliss, 2013). Estimated population size and trend are not known for this stock, which appears to occur in Alaska year-round with increased numbers in the summer months, especially in the Aleutian Islands.

Over the past two centuries at least 436,000 sperm whales were hunted and killed (Carretta et al., 2007). Given their tendency to occur far from shore, effects from commercial fishing are less of a threat to sperm whales than to other whale species, though offshore gillnets are a threat. Sperm whales may be adversely affected by toxins, such as PCBs, in the environment (NMFS, 2006b).

Impacts

The potential impacts on the whales that may occur near the project are similar; therefore, the impacts discussed below apply for all the species described above.

Construction

Construction of the terminal would generate underwater noise that exceeds the disturbance thresholds for marine mammals. However, the area affected by construction noise (e.g., pile driving) would be limited to a portion of the Columbia River near the terminal and it is unlikely that whales would be exposed this noise, as whales do not enter the Columbia River. Tugs used to haul dredged material to the nearshore or offshore dredged material disposal sites would produce underwater sounds that exceed the continuous underwater sound disturbance threshold for marine mammals ($120dB_{RMS}$). While continuous sounds for tugs pulling barges have been reported to range from 145 to 166 dB re 1 µPa-m (RMS) at 1 meter from the source, they are generally emitted at dominant frequencies of less than 5 kHz (Richardson et al. 1995). Thus, the dominant noise frequencies from tug propellers are less than the dominant hearing frequencies for marine mammals.

Assuming underwater ambient noise levels in the project area are equivalent to $120dB_{RMS}$ and using Collins et al.'s (2007; as cited in NMFS, 2014b) Source Noise (166, 145) - 18.4 Log(R) – 0.00188 spreading model, the distance to the 120 dB_{RMS} noise threshold would be 24 to 316 meters (75 to 1,036 feet) from the tug boat. Considering that there is such a high degree of variability in reported underwater noise associated with tug use, use of the mean distance to $120dB_{RMS}$ isopleth is recommended, particularly considering the existence of vessel traffic in the Lower Columbia River. Therefore, it can be assumed that the mean distance to the $120dB_{RMS}$ disturbance level for continuous underwater noise for marine mammals would be approximately 555 feet, in all directions from the vessel, along its entire route. Therefore, if whales are present in close proximity to tugs and barges, they could be temporarily disturbed by underwater noise associated with project-related vessels.

Operations

The following section addresses potential effects on whales that could occur as a result of project operations. Direct effects on whales could occur from strikes by LNG marine carriers moving through the EEZ en route to and from the terminal.

Noise

Operation of the project has the potential to impact whales due to periodic increases in both underwater and surface noise. This noise would be generated by ship engines as they transit to and from their port of origin, through the EEZ, and to and from the terminal on the Columbia River. The marine environment contains many natural and anthropogenic sources of noise. Natural noise includes surf, wind, and biological activity. Anthropogenic sources include noise generated to locate submerged

objects, measure environmental features, and conduct industrial activities (e.g., sonar). Noise can be neutral background acoustical clutter, or can impede acoustic communication or other biological functions (NMFS, 2005b).

Cargo ships are the largest component of commercial vessel traffic and also generate higher levels of low frequency noise than other vessels. LNG marine carriers are similar to cargo and tanker vessels, which are known to emit high levels of low frequency sound ((6.8 to 7.7 hertz (Hz) at 181 to 190 dB_{RMS}, re: 1 µPa) capable of traveling long distances (Richardson et al., 1995). Based on Collins et al.'s (2007; as cited in NMFS, 2014b) Source Noise spreading model, whales could be exposed to underwater noise that exceeds the marine mammal continuous noise disturbance threshold (120dB_{RMS}) within 1.5 to 5 miles of the LNG marine carriers. Noise generated by LNG marine carriers is generally greater on the sides of the vessel and weaker on the front and rear of the ship. The omni-directional, moving sound source may be the reason that whales do not always avoid oncoming ships and are thus struck and either injured or killed.

Whales tend to either react strongly or not at all to the noise generated by oncoming ships. These reactions often occur in response to changes in engine and propeller speed. Baleen whales generally avoid approaching vessels and exhibit a greater tendency to avoid vessels moving at higher speeds. For instance, baleen whales have been recorded moving more than 1 mile from their original location to avoid an approaching vessel.

Vessel Strikes

Whale strikes by vessels occur infrequently, especially when considering the millions of miles of ship traffic, annually, along the Pacific Coast. However, vessel-whale strikes are a concern for the recovery of depleted whale populations. For instance, NMFS' Recovery Plan for Northern Atlantic Right Whales places high priority on reducing ship strikes (NMFS, 1991). Carriers transporting LNG to and from the Oregon LNG terminal are assumed to travel along the North Pacific Great Circle route, entering the EEZ parallel to the Columbia River. Traveling along the North Pacific Great Circle route, Oregon LNG marine carriers would generate a 2.5 percent increase in traffic (50,000 LNG marine carrier nautical miles (nm)/2 million total nm of traffic).

Whale distribution and density in relationship to ship distribution and density are other contributing variables to strikes. For example, surveys of blue and humpback whales show that they occur more frequently in the waters off the coast of southern California than Oregon and Washington (Carretta et al., 2008). Therefore, we would expect the rate of strikes (strikes per mile of ship travel) for LNG marine carriers traveling in Oregon or Washington to be lower in Oregon and Washington than in California waters.

Oregon LNG estimates that the increase in whale strikes per year would average 0.05 or fewer individuals per year per species. Table 4.1.8-2 summarizes the estimated likelihood of a whale strike by species as a result of increased vessel traffic by LNG marine carriers.

Table 4.1.8-2

Estimated Whale Strikes from LNG Marine Carriers in Oregon and Washington EEZ

Species	Average Whale Strikes per Year Along Oregon and Washington Coasts	Estimated LNG Marine Carrier Strikes per Year	Upper Range Increase in Strikes per Year
Blue whale	0.18	0.01	0.03
Fin whale	0.36	0.02	0.05
Killer whale	No records of cargo ship strikes	none	NA
Humpback whale	0.55	0.03	0.03
Sei whale	0.33	0.02	0.03
Sperm whale	0.18	0.01	0.03
Gray whale	1.00	0.06	0.08

NA = not applicable

Only one whale strike has ever been reported from the Aleutian Islands (NMFS, 2012). In 2010, a humpback whale was struck near King Cove, Alaska. The lack of strike data does not indicate that whale strikes do not occur in this region, but that strikes are rarely reported and necropsies to determine cause of death are rarely performed in this remote region. As a result of the lack of strike data in this region, modeling likelihood of future whale strikes for most species is not feasible for the Aleutian Islands. For humpbacks, strike data from 2003 through 2008 was used to estimate an average of 0.2 strikes annually (1 strike in 5 years) near the Aleutians. An estimated 3,115 vessel passages occur annually in the Aleutian Islands portion of the Great Circle Route (Nuka Research and Planning Group, 2006). LNG marine carriers passing through the Aleutian Islands would represent about an 8 percent annual increase in vessel traffic through this area. The estimated increase in strikes as a result of LNG marine carrier trips is 0.03 strikes annually for humpback whales. The margin of error is unknown because of the uncertainties in both whale strike rates and overall ship traffic levels.

The number of whales that might be struck over the life of the Oregon LNG project (50 years) was estimated by assuming that the per-mile rate of whale strikes would remain constant over the entire period. For example, through the EEZ off the coast of Oregon, at 50,000 nm per year, LNG marine carriers would travel 2,500,000 nm over the 50-year life of the project, which approximates the number of ship miles traveled by large ships in the Great Circle Route in recent years. Therefore, over the life of the project, the number of whale strikes by LNG marine carriers for the Great Circle Route would be expected to be the same as for all vessels in an average year (see table 4.1.8-3).

Table 4.1.8-3

Estimated LNG Marine Carrier Strikes on Whales Over 50 Years

Species	Estimated Strikes Over 50 Years	Number of Years Until LNG Marine Carrier Would Strike a Whale
Oregon and Washington		
Blue whale	0.6	88.9
Fin whale	1.1	44.4
Killer whale	none	NA
Humpback whale	1.7	29.1
Sei whale	1.0	48.4
Sperm whale	0.6	88.9
Gray whale	1.3	40.0
Right whale	0	0
Aleutian Islands		
Humpback whale	0.25	200.0

NA = not applicable

Spills and Leaks

Spills in the marine environment have the potential to affect whales. A fuel oil spill from an LNG marine carrier would have an effect on whales. Such products are stored in small quantities relative to tankers carrying oil products as cargo. From 2002 through 2007 there were six recorded marine spills that exceeded 10,000 gallons and only two of these spills occurred in the project area (Cameron, 2008). Since beginning commercial operations in 1959, LNG marine carriers have not experienced a loss of LNG cargo or other significant petroleum-based spill. A catastrophic spill of LNG with the assumption of a fire would affect a whale only if a whale surfaced at the same time and location as the spill of LNG. Such an occurrence, although possible, is remote. Presumably, a whale coming into contact with an LNG vapor cloud or fire would dive below the surface and swim from harms way.

Mitigation

Oregon LNG would incorporate the following vessel strike avoidance measures (NMFS, 2008b) in the terminal use agreement with operators of LNG marine carriers.

- Vessel operators and crews should post a watch to detect whales in order to avoid striking sighted animals.
- When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.
- Reduce vessel speed to 10 knots or less when whales are observed near the vessel, as safety permits.

Oregon LNG would implement the following NMFS-recommended measures reporting any vessel strikes on whales (NMFS, 2008b).

- Vessel crews would report sightings of any injured, entangled or dead whales as soon as possible to the Northwest Stranding Hotline, regardless of whether the injury or death was caused by the crew's vessel.

- If a whale strike occurs, the vessel crews must report the incident to the U.S. Coast Guard and NMFS Northwest Regional Office.
- LNG marine carriers would likely be traveling more than 50 nm offshore until they approach the mouth of the Columbia River. As ships approach the Columbia River, they would slow to speeds below 15 knots, reducing the likelihood of a strike.

In addition to the vessel strike avoidance and reporting measures listed above, in its terminal use agreements with LNG suppliers, Oregon LNG would incorporate the following restrictions.

- LNG marine carriers transiting within the Oregon and Washington EEZ would establish a maximum speed of 15 knots when travelling over or east of the continental shelf.
- When traveling within 10 miles of the shoreline of Oregon and Washington, LNG marine carriers would establish a maximum speed limit of 12 knots during the 8 months when whale observation rates are the highest (i.e., January, March, April, July, August, September, October, and December).

LNG marine carriers would maintain a SOPEP, as required by international convention, which would minimize the risk of a spill, leak, or accidental release of hazardous materials that would adversely affect whales. In the event that a carrier strikes a marine mammal or there is a spill from the ship, the LNG marine carrier operator would immediately report the incident and take actions to minimize effects on whales.

Effect Determination

LNG marine carriers are unlikely to strike whales, but based on the provided analysis, impacts would be expected over the life of the project for certain species. Given the total abundance of species, and based on the effects discussed above, along with the conservation measures that would be implemented by Oregon LNG to avoid negative impacts, the proposed action would ***likely adversely affect***, fin whale, Pacific right whale, and sei whale (as well as gray whales, which are listed as endangered by the State of Oregon) due to possible whale strike during the life of the proposed project (see table 4.1.8-3). Though sei whales are less likely to be struck by an LNG marine carrier than some other species (e.g., humpbacks), the consequences of such a strike would be greater because of the rare occurrence of this species. The proposed action would ***not likely adversely affect*** killer whale, blue whale, humpback whale, and sperm whale.

Pinniped - Western DPS Steller Sea Lions

Steller sea lions range along the northern Pacific Rim from northern Japan to California (Csuti et al., 2001), but most are found in the Gulf of Alaska and Aleutian Islands. Steller sea lions spend the majority of their time at sea (NMFS, 1993a). LNG marine carriers would transit within the range of the Western DPS in the EEZ of the Aleutian Islands. Steller sea lions are not considered migratory, but they have large ranges and move considerable distances (Baba et al., 2000).

Impacts

Oregon LNG expects that all of the trips between Asia and the terminal, up to 250 LNG marine carrier transits per year (125 round trips annually to and from the terminal), would be via the North Pacific Great Circle Route, which includes crossing the Alaska EEZ through the Aleutian Islands. Along this route, there are several major rookeries and haulouts, such as near Unimak Pass and Tanaga Island (NMFS, 1993a). Critical habitat was designated for the Western DPS of Steller sea lions in Alaska and

includes major rookeries, haulouts, and foraging areas that are located throughout the Alaska Peninsula and the Aleutian Islands, as well as portions of the Bering Sea (NMFS, 1993a).

Direct effects on Steller sea lions would occur if an LNG marine carrier were to strike a Steller sea lion. Between 2006 and 2010, two Steller sea lion mortalities were attributed to vessel collisions (Carretta et al., 2013). The sizes of the vessels were not identified and NMFS does not consider strikes from large ships to be a threat to pinnipeds (Barre, 2008).

Mitigation and Conservation Measures

No species specific mitigation is proposed by Oregon LNG as Steller sea lion are not expected to be affected by LNG marine carriers transiting an existing commercial shipping route through the Alaska EEZ. However, implementation of the LNG marine carrier's SOPEP would also benefit Steller sea lion as it would minimize the risk of accidental spills of hazardous materials.

Effects Determination

The proposed project would ***not likely adversely affect*** Western DPS Steller sea lions. Sea lions are highly mobile and thus unlikely to be struck by ships, as indicated by the limited reports of vessel strikes on Steller sea lions. Therefore, an increase in LNG ship traffic would not lead to additional adverse effects on this species. In addition, LNG marine carrier traffic would ***not likely adversely affect*** designated critical habitat for Steller sea lions because LNG marine carriers would maintain a SOPEP to minimize the risk of the accidental spill or leak of petroleum products.

Mammal—Columbian White-tailed Deer

The Columbian white-tailed deer is the western-most subspecies of white tailed deer and are found in low-elevation riparian habitats, especially along the lower Columbia River. The current range of this species is restricted to fragmented isolated habitats within the Columbia River floodplain from Knappa in Clatsop County, Oregon, upstream to Ridgefield National Wildlife Refuge in Cowlitz County, Washington (FWS, 2013a; FWS, 2013b).

Suitable habitat for Columbian white-tailed deer is often comprised of open forest habitat containing a mosaic of cover and meadow, as well as mixed deciduous habitat with moderate cover (FWS, 2013a). This deer subspecies generally avoids pastures, presumably because of the limited cover (Verts and Carraway, 1998), and deer density is usually the greatest in areas where woodland cover exceeds 50 percent (Smith, 1987). Columbian white-tailed deer are not migratory and home ranges (around 500 acres) tend to be very stable in space and time. Roads and water boundaries (e.g., wide channels, ditches) strongly influence the shape of the home ranges of deer found at the Julia Butler Hansen National Wildlife Refuge (WDFW, 2004).

The nearest documented occurrence of Columbian white-tailed deer near the pipeline is at the northern end of Ridgefield National Wildlife Refuge (FWS, 2013a), about 5 miles south of the pipeline crossing of the Columbia River (ORNHIC, 2009; ORBIC, 2011; WDFW, 2013a). Based on the species' preference for cover relatively close to open habitats at low elevations, the pipeline corridor contains very limited suitable habitat for the species. However, Columbian white-tailed deer are quite mobile on land and in water and could access the project area.

The limited portion of the pipeline corridor with potential to support Columbian white-tailed deer is in the area near the Columbia River (between MP 80.2 and 85.3) that is primarily agricultural fields supporting crops such as Christmas trees, hay, and corn. The irrigation ditches and hedgerow areas surrounding these fields may offer cover to deer, but this habitat is marginal as Columbian white-tailed

deer prefer habitat with dense, tall native shrub or trees. On the west side of the Columbia River, the pipeline would cross potentially suitable habitat on the southern end of Deer Island around the areas of Milton Creek (MP 81.5) and Dyno Nobel Channel (MP 81.7). There is abundant suitable habitat on Deer Island north of the pipeline, outside the construction right-of-way.

The terminal site has no existing habitat for the species but Columbian white-tailed deer are known to occur on Svenson and Karlson Island over 10 miles east of the terminal. Several urban areas, including the cities of Astoria and Warrenton, are between the terminal and these known deer populations, likely limiting access to the terminal.

Impacts

Columbian white-tailed deer habitat may be lost during construction of the pipeline. This effect would be temporary and of short duration. In addition, habitat impacts would be minor because the species' habitat in the pipeline corridor is limited and of low quality relative to the quality of the surrounding habitat, the affected habitat (i.e., primarily agricultural fields) would be returned to preconstruction conditions, and only a small amount of potentially suitable habitat would be affected.

If Columbian white-tailed deer are present within the pipeline construction area, they could be directly affected by increased noise and visual disturbance. Adults are highly mobile and would likely avoid the project area during construction. However, during fawning (June 1 through July 15), both does and fawns could be disturbed, potentially leading to mortality if fawns are abandoned. Because the availability of suitable habitat is very limited within the pipeline corridor and deer are less likely to use habitat in the pipeline corridor compared to more suitable habitat in the surrounding area, we conclude that the likelihood of adverse effects from noise and activity within the corridor is low.

Mitigation and Conservation Measures

Oregon LNG would implement the following conservation measures to avoid or minimize effects on Columbian white-tailed deer.

- Preconstruction surveys would be conducted in suitable habitat within construction work area between MP 80.8 to MP 85.6 to identify presence or recent signs of Columbian white-tailed deer.
- Project personnel would be trained in the identification of Columbian white-tailed deer and instructed to reduce vehicle speeds to 15 mph around the project site in areas of potentially suitable habitat (MP 80.8 to MP 85.6) to avoid vehicle-deer collisions. Project personnel would also be instructed not to approach adults or fawns at any time.
- If Columbian white-tailed deer are observed within the pipeline corridor during preconstruction surveys or during construction, Oregon LNG would consult with FWS, ODFW, or WDFW to identify appropriate mitigation. For example, construction and restoration activities generating noise and visual activity above local ambient noise and visual activity levels in areas that support Columbian white-tailed deer (MP 80.8 to MP 85.6) may be avoided during the fawning season from June 1 through July 15.
- Nonagricultural areas disturbed by construction would be re-vegetated with native species to provide suitable habitat for deer browsing.

Effect Determination

Columbian white-tailed deer are not known to occur in the project area and potentially suitable habitat in the project area is very limited and of relatively low quality compared to the general vicinity.

We conclude that there is a low likelihood that this species would occur in the area during construction, and Oregon LNG would conduct preconstruction surveys to verify their absence. Therefore, we conclude that Columbian white-tailed deer would not be exposed to adverse effects and the Oregon LNG Project would ***not likely adversely affect*** Columbian white-tailed deer. Because no critical habitat has been designated for the species, the proposed action would have ***no effect*** on designated critical habitat for this species.

Birds

We received comments expressing concerns about the analysis of impacts on listed bird species habitat (alteration and loss), requirements in the Northwest Oregon State Forests Management Plan regarding listed species and possible amendments to the plan, and construction timing conflicts between vegetation clearing and in-water work timing periods.

Marbled Murrelet

The FWS designated marbled murrelet as a threatened species under the ESA in Washington, Oregon, and California in 1992 (FWS, 1992a). Marble murrelet is also listed by the states of Oregon and Washington as threatened under state laws. Designated critical habitat for the species was revised by FWS in 2011 and currently covers an area of 3.7 million acres in Washington, Oregon, and California within 24 distinct CHUs.

The marbled murrelet is a seabird that nests in old-growth trees within 52 miles of the coast (FWS, 1997a). They forage opportunistically in the marine environment on a variety of prey species in variable nearshore areas, mainly within 1.3 miles of the coast. During nesting season, May through August, marbled murrelets fly inland from the coast, often using waterways as flight corridors to nesting areas. Marbled murrelets use nesting "platforms" present in live conifer trees. Nesting platforms can be composed of a wide bare branch, moss or lichen covering a branch, mistletoe, witches' brooms, or other deformities (Turnstone Environmental Consultants [TEC], 2008; Evans Mack et al., 2003). Nests are typically built 200 feet above the ground, although nests have been recorded as low as 30 feet above the ground.

Marbled murrelets prefer older interior forests with a buffer zone at least 300 feet from high-contrast edges, such as road or clear cuts, because interior forests have less wind throw, a lower risk of predation on murrelet nests, and a more stable microclimate. Older forests surrounded by recently harvested areas are generally not used by marbled murrelets (Ripple et al., 2003).

Oregon LNG used a standardized protocol for delineating potential marbled murrelet habitat developed by the Pacific Seabird Group (PSG) (Evans Mack et al., 2003) to identify suitable habitat along the pipeline between MPs 0.0 and 79.5. Habitat east of the pipeline at MP 79.5 is outside of the marbled murrelet's range of 52 miles from the coast line and therefore was not surveyed. Through a combination of aerial photo interpretation, GIS analysis, and field reconnaissance, Oregon LNG identified and delineated eight suitable habitat units (SHU) within 0.25 mile of the pipeline. Three marbled murrelet habitat categories were evaluated within each SHU for the purpose of analyzing effects. Those included suitable habitat, recruitment habitat, and capable habitat.

- **Suitable Habitat.** Generally includes old-growth forests within 52 miles of the coast and characterized by large trees, multi-storied stands, and moderate-to-high canopy coverage. Nest trees can be remnant old-growth trees in a stand of younger forest, but nest trees must have large branches or deformities such as high, moss-covered branches or branches

with growths of dwarf mistletoe, which serve as nest platforms. Suitable habitat can be occupied or unoccupied, as described below.

- **Occupied Suitable Habitat.** Habitat is considered occupied suitable habitat if it meets any of the following criteria.
  - *Occupied Stand.* A stand that has been surveyed per the PSG protocol (Evans Mack et al., 2003) and that encompasses an "occupied site."
  - *Historically Occupied Stand.* A stand that was previously known to be occupied by marbled murrelet, including stands where more recent surveys have indicated that the status is not currently "occupied."
  - *Unsurveyed Suitable Habitat.* An area or forested stand identified as potential nesting habitat that has not been surveyed following the PSG protocol, including areas with incomplete survey data.
- **Unoccupied Suitable Habitat**. A continuous stand of suitable habitat that has been surveyed per PSG protocol and classified as either "probable absence" or "presence."
- **Recruitment Habitat.** Forested stands age 60 years or greater without marbled murrelet nesting structure within 52 miles of the coast.
- **Capable Habitat.** Forested stands less than 60 years old within 52 miles of the coast that are capable of becoming suitable habitat within the life of the project's effects.

Six of the eight SHUs were surveyed following the PSG protocol for at least two consecutive years between 2009 and 2014 with probable absence (TEC, 2009, 2013a, 2014b). The remaining two SHUs are assumed occupied because they have incomplete survey coverage. Additional details on survey results are provided in appendix B of Oregon LNG's Conceptual Mitigation Plan (see appendix F3).

The preservation of both marine foraging habitat and terrestrial nesting habitat is important to the recovery of the species; however, only terrestrial nesting habitat has been designated as critical habitat for the marbled murrelet. In its recovery plan for marbled murrelet (FWS, 1997a), the FWS describes two primary constituent elements (PCE) that define marbled murrelet critical habitat.

- **PCE 1:** Forested stands with trees generally more than 32 inches in diameter (at breast height) that have potential nesting platforms at least 33 feet above the forest floor.
- **PCE 2:** Surrounding forest within 0.5 mile of the aforementioned stand must have a canopy height of at least one-half the site-potential tree height.

The pipeline intersects one FWS-designated CHU (OR-01-d) in eight distinct areas, from about MP 34.0 to MP 42.0. Most of the land within this CHU is owned by the ODF, and a small portion is under private ownership. Most of the forested areas within the pipeline corridor that intersects the CHU have been clear-cut harvested or partially thinned within the last 60 years. The pipeline right-of-way in the CHU does not contain both PCEs of marbled murrelet critical habitat. However, within the boundaries of designated critical habitat, areas that contain at least one PCE are still considered critical habitat.

Generally, forests in the vicinity of the pipeline are relatively young and generally lack characteristics that contribute to nesting habitats for marbled murrelet. Murrelets are not likely to forage or nest within the vicinity of the project site. Impacts on murrelets flying to and from foraging trips to the ocean are low due to the current ambient noise levels in the area and overall size and use of the area by marbled murrelet.

Historical records and observations indicate that murrelets were common and regularly seen along Washington and Oregon coastlines (USACE, 2012a). Marbled murrelets forage just beyond the breaker-line and along the sides of river mouths where greater upwelling and less turbulence occurs where they feed on invertebrates and small fish such as anchovy, herring, and sand lance (Marshall, 1988). Marbled murrelets would be expected to occur in the general vicinity of the nearshore habitats along the LNG waterway and dredge disposal locations (see section 2.1.1.1 for locations) throughout the year with higher densities during the breeding season. But, overall species density would be low in the lower Columbia River estuary and open ocean near the mouth of the Columbia River because of the nature of the Columbia River mouth (i.e., with silty waters that are little used for foraging), and the general lack of suitable nesting habitat in northern Oregon Coast Range.

Impacts

The proposed action may result in direct and indirect effects on marbled murrelet and their habitat. Construction and maintenance of the terminal and pipeline may have effects that include noise disturbance, forest fragmentation, and creation of a new linear high-contrast forest edge.

There are no marbled murrelets recorded within 2 miles of the terminal (ORNHIC, 2009). Forests in the vicinity of the terminal are relatively young and generally lack characteristics that contribute to nesting, foraging, and roosting habitats for marbled murrelet. Although they may fly over the terminal to capture and transport food to inland nest sites, murrelets are not likely to forage or nest within the vicinity of the terminal site. Marbled murrelets are also unlikely to forage on or near the surface of open water near the terminal site due to the nature of the lower Columbia River estuary habitat (i.e., silty waters and shallow water estuarine habitats). This species is also quite mobile and generally does not exhibit any site fidelity to open water areas.

Although marbled murrelets are unlikely near the mouth of the Columbia River, they are diving seabirds and could be exposed to underwater noise generated by piling driving during construction of the berth. The FWS's guidelines for in-water auditory injury on marbled murrelets (i.e., permanent threshold shift in hearing due to permanent loss of cochlear hair cells) due to impact pile driving is 202 dB SEL, and 208 dB SEL for nonauditory injury (i.e. barotrauma; WSDOT, 2014). Within the action area, in-water noise from unmitigated pile driving is predicted to attenuate to the auditory injury guideline at 705 feet and to the nonauditory injury guideline at 282 feet. With mitigation proposed by Oregon LNG, which is expected to reduce sound levels by 20 dB, attenuation to the auditory and nonauditory injury guidelines would occur at around 33 feet and 13 feet, respectively. Based on these relatively small areas and the low likelihood of marble murrelet foraging near the terminal, we conclude that underwater noise due to pile driving would not impact marbled murrelet.

Use of heavy equipment and pile driving during construction of the terminal would generate in-air noise levels that could disturb marbled murrelet if they nest nearby. In its 2013 programmatic biological opinion for activities in the Olympic National Forest, the FWS defined in-air noise thresholds for marbled murrelet based on type of noise generating activities and distance to known occupied marbled murrelet nest trees. According to these thresholds (FWS, 2013c), the typical in-air noise levels from construction equipment, such as heavy trucks, excavators, graders, and chainsaws, would have no effect on marbled murrelets nesting at distances greater than 0.25 mile. The same distance threshold of in-air noise (i.e., 0.25 mile) also applies to pile driving (FWS, 2013c). Since there is no known or suitable marbled murrelet nest habitat within 0.25 mile of the terminal, we conclude that in-air construction noise at the terminal would not impact marbled murrelet.

There is minimal habitat for murrelets near the proposed dredged material disposal site; therefore, the occasional placement of dredged material would have negligible effects on this species (USACE,

2012a). Marbled murrelets may fly in the vicinity but could easily avoid the disposal area. Dredged disposal may affect sand lance, an important prey for marbled murrelet.

Operational activities that would generate noise at the terminal during typical operations include ship mooring and unloading, and the operation of a number of pumps, compressors, submerged combustion vaporizers, fans, and blowers. Marbled murrelets flying to and from foraging trips to the ocean are currently exposed to high levels of ambient noise in the terminal area and the additive impacts from construction and operations noise effects would be minor.

Marbled murrelets may be attracted to artificial lights at the terminal, particularly when the sky is cloudy or the ceiling is low (Gauthreaux and Belser, 2006) during dusk and dawn, when the bird is most likely to be transiting between marine areas and forested habitat. But the terminal lighting would be similar to surrounding industrial uses and Oregon LNG would implement measures to reduce lighting impacts (see section 4.1.7.1).

Construction and operation of the pipeline could impact marbled murrelet habitat between MPs 0.0 and 74.0. Possible impacts include noise disturbance, tree removal, habitat fragmentation, and changes in habitat.

Construction disturbance, such as noise or attraction of corvid species, could directly affect marbled murrelets if they are present nearby during construction. Such disturbance would be particularly harmful during the nesting season if it caused incubating adults to flush from the nest, leaving eggs susceptible to nest failure. Noise levels from the loudest equipment during pipeline construction would typically range from about 80 to 90 dBA at 50 feet from the source on land.

Noise associated with timber clearing, construction, and operation of the pipeline facilities could disturb nesting or roosting murrelets. Studies from other bird species suggest that disturbance can affect productivity by nest abandonment, egg and hatchling mortality due to exposure and predation, longer periods of incubation, premature fledgling or nest evacuation, depressed feeding rates of adults and offspring, reduced body mass or slower growth of nestlings, and avoidance of otherwise suitable habitat (U.S. Forest Service [USFS] et al., 2008).

The disturbance threshold for in-air noise for marbled murrelets is 70 dBA and the injury threshold is 92 dBA (WSDOT, 2014). Using the spreading loss model (WSDOT, 2014), Oregon LNG estimates that noise from construction equipment would attenuate below the disturbance threshold (70 dBA) within about 315 feet from the edge of the construction right-of-way. In addition, research conducted in the Nooksack River Valley in Washington suggests auditory activities, such as vehicular traffic and logging operations, appear much less disturbing if visual contact is obscured or lacking (Stalmaster, 1976) as would likely be the case given the forested nature of the project alignment and that no occupied murrelet nesting habitat was identified within 0.25 mile of the pipeline during surveys. In the two areas of suitable habitat that have not been surveyed, representing less than 1 percent of the pipeline right-of-way, the likelihood of impacts from construction-related noise and visual activity is expected to be low due to the lack of surrounding suitable habitat. The compressor station would be outside the range of marbled murrelets, and noise associated with its operation would not affect marbled murrelets.

Within the eight SHUs delineated by Oregon LNG, pipeline construction would clear 2.1 acres of unoccupied suitable habitat, 8.2 acres of recruitment habitat, and 23.2 acres of capable habitat. Separately, construction would clear about 40 acres of FWS-designated critical habitat; however, only 4.3 acres of this critical habitat meets the definition of PCE 2 with the remainder (36.3 acres) being young

forest types or managed right-of-way that does not provide suitable nesting habitat for marbled murrelet. Maintenance of the permanent right-of-way within critical habitat would indefinitely preclude about 17.6 acres from becoming suitable marbled murrelet habitat in the future. In addition, where the right-of-way intersects with the CHU at the eight distinct locations, a 2.9-mile-long, high-contrast forest edge would be created, which is approximately the same as the loss of 246 acres of interior forest (TEC and CH2M HILL, 2015).

Fragmentation of marbled murrelet habitat can affect population viability and size, and result in local or regional extinctions, displacement, fewer nesting attempts, failure to breed, reduced fecundity, reduced nest abundance, lower nest success, increased predation and parasitism rates, and reduced adult survival (FWS, 2006b). Removal of suitable habitat on the edge of an occupied or presumed occupied stand may result in removal of a nest or potential nest tree. To reduce the fragmentation of forest stands and impacts on marbled murrelet habitat, Oregon LNG would collocate the pipeline with existing transmission line corridors and roads where possible.

Short-term impacts on marbled murrelets would be likely to last from initiation of timber clearing until 1 to 3 years after restoration/revegetation. Long-term impacts on murrelets and suitable nesting habitat would last 4 years or more and the maintained pipeline right-of-way would be permanently changed due to operational requirements. Other potential indirect or secondary effects by the project include increased human presence as a result of the requirements of the action itself (the workforce needed to construct or operate the project), increased recreation (including off-road vehicle use, hunting along the pipeline corridor), habitat degradation, increased illegal harvest of trees (Comer, 1982), and possible movement of individual birds into other areas already occupied.

Mitigation and Conservation Measures

To offset unavoidable impacts on marbled murrelet, and to mitigate for temporal effects from pipeline clearing in designated critical habitat and estimated nesting habitat, Oregon LNG proposes to acquire land for securing conservation easements. Compensatory mitigation for the marbled murrelet is part of Oregon LNG's overall conservation strategy for effects on northern Coast Range forest habitat.

Oregon LNG has committed to the following measures to avoid and minimize impacts on marbled murrelets.

- Survey for marbled murrelets in all suitable habitats within the project area where current survey data are deficient. Two separate 2-year protocol surveys were completed from 2008 to 2009 and from 2012 to 2013.[3] If marbled murrelets are detected during preconstruction surveys then Oregon LNG would consult with FWS prior to construction in those areas. Oregon LNG would provide the FWS with the results of 2 years of protocol surveys as they become available.
- Avoid removal of any known occupied habitat during the critical nesting period (April 1 through August 5).
- Avoid construction within 100 yards of occupied sites during the critical nesting period (April 1 through August 5).
- Avoid construction within 0.25 mile of occupied and assumed occupied sites during the critical breeding period (April 1 to August 5), except for the transportation of heavy

[3] Due to changes in the project design, the first 2-year protocol survey period was initiated in 2007 and the second was initiated in 2012. Restricted access on private land limited the ability of Oregon LNG to survey some areas with suitable habitat for marbled murrelet.

equipment on high use roads. Construction activities which would occur during the late breeding period and within the disturbance distance (0.25 mile) but greater than 100 yards from occupied sites would adhere to daily dawn-to-dusk timing restrictions that would limit activities to work hours between 2 hours after sunrise and 2 hours before sunset.

- Minimize clearing Douglas-fir, Sitka spruce, western hemlock, or Western red cedar trees that have potential nesting platforms within the CHU, to the greatest extent possible. Maintaining these trees would accelerate the recruitment of suitable habitat within the CHU. Oregon LNG would reduce the width of the construction corridor to 75 feet where PCE 1 trees are within the CHU.
- Minimize clearing and construction for new access roads to reduce removal of potential recruitment or suitable habitat and creation of new forest edges.
- Implement a lighting plan at the terminal that incorporates the following elements: (a) directional lighting facing onshore to the extent possible, (b) screens or lighting hoods, (c) motion-activated lighting, (d) full-cutoff light fixtures, which have no direct uplight, help eliminate glare, and are more efficient by directing all lighting down to the intended area only, and (e) strobing lights to the greatest extent practicable.
- Use vibratory hammers for pile driving at the terminal to the extent possible to reduce the use impact pile driving. When impact hammers are used for pile driving, use pile caps and bubble curtains to minimize underwater noise from pile driving.
- Although blasting is not anticipated, should it be determined necessary within a mile of suitable habitat, avoid blasting during the critical breeding season (April 1 to August 5); minimize the quantity of charges to the least amount required; and use blasting mats, sand, or crushed rock to reduce sound generation.

The Recovery Plan (TEC, 2008; FWS, 1997a) recommended that restoration efforts concentrate on maintaining occupied sites, minimizing the loss of unoccupied but suitable habitat, and decreasing the time for development of new habitat. Oregon LNG has planned its pipeline route to avoid occupied sites and minimize the loss of unoccupied but suitable habitat. The Recovery Plan further recommended that efforts be directed at the conservation of suitable and occupied marbled murrelet nesting habitat in the Elliott State Forest, Tillamook State Forest, and Siuslaw National Forest to help restore the north-south distribution of marbled murrelet populations and suitable habitat in Zone 3 (TEC, 2008; FWS, 1997a). To offset the short- and long-term impacts on marbled murrelet habitat along the pipeline, Oregon LNG has proposed to acquire forest habitat according to mitigation ratios developed in coordination with the FWS that would be similar to the 2014 *Revised Conservation Framework for the Northern Spotted Owl and Marbled Murrelet: Jordan Cove Energy and Pacific Connector Gas Pipeline Project* (Conservation Framework; FWS, 2014a). The mitigation ratios for habitat acquisition acres to impact acres range between 8 to 1 and 1.5 to 1 with greater ratios used for higher level impacts on suitable habitat and lower ratios used for lower level impacts on currently nonsuitable habitat (e.g., capable habitat). See section 4 of Oregon LNG's Conceptual Mitigation Plan in Appendix F3 for a summary of mitigation ratios and impact acres.

The Conservation Framework places the highest priority for habitat acquisition on in-kind habitat that matches the type and quality of habitat disturbed by construction. However, Oregon LNG may be unable to find suitable lands for habitat acquisition depending on market conditions, availability of willing sellers, and conditions of the lands at the time of acquisition. Due to this uncertainty, Oregon LNG developed, in cooperation with the FWS, a set a habitat acquisition ratios for out-of-kind mitigation.

Under this scenario, Oregon LNG could acquire more acres of a lesser quality habitat (e.g., capable habitat) to compensate for the lack of available in-kind habitat (e.g., suitable habitat), or conversely acquire less high-value habitat to meet the obligation of low-value in-kind habitat.

Forest lands selected for marbled murrelet conservation by habitat acquisition would be within 52 miles of the coast (i.e., the inland extent of marbled murrelet nesting) and protected by conservation easements. Oregon LNG would develop site specific management plans that could involve silviculture treatments, such as tree planting, thinning, or selective timber harvest, that are intended to promote development of suitable marbled murrelet habitat in the future. Oregon LNG would establish an endowment fund that would support land management over the life of the project's effects.

We conclude that Oregon LNG's commitment for habitat acquisition and associated long-term management actions of acquired lands is adequate to offset the project's impacts on marbled murrelet habitat.

Effect Determination

Pipeline construction would indirectly affect marbled murrelets by modifying or removing 2.1 acres of suitable nesting habitat and 8.2 acres of recruitment habitat. Therefore, due to this habitat loss, we conclude that the project would ***likely adversely affect*** marbled murrelets. Because of the permanent removal of about 3.7 acres of PCE 2 habitat and the preclusion of 17 acres from becoming habitat in critical habitat due to permanent right-of-way habitat modification, both of which result in the removal of habitat elements essential to the conservation of marbled murrelet, the proposed project would ***likely adversely affect*** designated critical habitat for marbled murrelets. Proposed mitigation would offset impacts on critical habitat but it may take more than 60 years for forest in acquired lands to become suitable marbled murrelet habitat.

Northern Spotted Owl

The northern spotted owl is listed as threatened federally and in Oregon and Washington. Northern spotted owls are found in contiguous, mature, old-growth forests in the Pacific Northwest. Northern spotted owls generally require forests composed of old-growth trees for nesting, roosting, foraging, and dispersal. Habitat characteristics include complex multi-tiered, multiple-species canopy forests that have a predominance of large overstory trees with moderate to dense canopy closure (Thomas et al., 1990). According to the FWS (2008b), northern spotted owls generally rely on large home ranges (about 4,500 acres in the Oregon Coast Range) and use large tracts of land containing older forests to meet their biological needs. Fragmented habitats may be used for dispersal and foraging.

Most nest and roost sites are within forest stands with trees that are older than 200 years, but spotted owls also utilize mature forests 80 to 200 years old. Foraging and dispersal habitats may be in younger, more open and fragmented forests than those associated with nesting and roosting (FWS, 1992b). Suitable habitats also have many large standing snags, a predominance of dead wood on the ground, and open space in the upper and lower canopies for flight paths for the owls. The northern spotted owl was originally listed in 1990 due to loss of habitat from logging operations and fire (FWS, 1990). Currently, recovery of the northern spotted owl is hampered by competition from the nonnative barred owl (*Strix varia*) (FWS, 2007a). Population numbers are declining throughout the species' range, including the northern portion of Oregon's Coast Range. In developing a recovery strategy for northern spotted owl, FWS identified focal areas of habitat necessary for the recovery of the species. These areas are known as Mapped Owl Conservation Areas; of which none are found in the vicinity of the pipeline or terminal.

In Oregon, critical habitat for the northern spotted owl was designated in 1992 (FWS, 1992b) and then revised in 2008 (FWS, 2008a) and again in 2012 (FWS, 2012a). About 860,000 acres were designated as critical habitat for the species in the Oregon Coast Range (FWS, 2012a). The pipeline would be in the vicinity of two northern spotted owl activity centers, which are known core areas used in previous years for nesting and roosting. The pipeline right-of-way would intersect with one CHU (NCO-04) near MP 41.3. This CHU also passes within 300 feet of the project in two other nearby locations (TEC, 2013a).

Oregon LNG reviewed public and private data resources for information relating to previous evaluations of spotted owl habitat within the project area. Any area that previously required spotted owl surveys and had not been recently harvested was considered to be suitable habitat. Between 2008 and 2009, Oregon LNG conducted surveys along the pipeline on properties owned by Weyerhaeuser Corporation, Stimson Lumber Company, Oregon Board of Forestry, and assorted smaller, private landowners. Surveys were conducted in areas adjacent to the pipeline (within a 1.5-mile radius) that contained potentially suitable spotted owl habitat. Following survey guidelines recommended by FWS, Oregon LNG completed 101 calling stations covering 17,864 acres of potentially suitable spotted owl habitat were surveyed. In 2012, Oregon LNG surveyed a total of 16 calling stations in areas of the pipeline on land owned by ODF and Weyerhaeuser Corporation. No spotted owl surveys were conducted by Oregon LNG in 2013 because of landowner restrictions.

Oregon LNG did not observe a spotted owl response during the 2008 and 2009 survey season. There were no incidental sightings or encounters with spotted owls while in the field, working in the project area, conducting ground-truthing, or during broadcast calling station setup. No spotted owls were identified during the 2012 surveys conducted by Oregon LNG, but surveyors reported observations of barred owls and northern saw-whet owls.

Impacts

The terminal is sited in an urban setting that currently, and likely historically, lacks suitable habitat for spotted owl. Therefore, we conclude that construction and operation of the terminal would have no effects on the northern spotted owl. Pipeline-related impacts on spotted would include construction noise during right-of-way clearing and pipeline installation, and removal of suitable nesting, roosting, and foraging habitat. To minimize these impacts, Oregon LNG selected a pipeline route that avoided forest habitat types preferred by spotted owl. Therefore, current habitat conditions along the pipeline route are generally unsuitable for spotted owl and potential encounters during construction are unlikely. The project may have long term effects on future spotted owl habitat, as the permanent pipeline right-of-way would be maintained as low stature vegetation. To decrease the overall extent of possible long term habitat loss, Oregon LNG collocated its pipeline route with existing corridors, where possible. Multiple surveys in the pipeline project area found no northern spotted owl activity within the potential area of impact.

Disturbance (both visual and noise) from construction, maintenance, and operation of the Oregon LNG pipeline that would occur include: 1) use of chainsaws and heavy equipment during vegetation clearing and pipeline construction, 2) use of helicopters to inspect the pipeline once per year during the life of the project, and 3) brush control (i.e., mowing and cutting) within the permanent right-of-way every 3 to 5 years for the life of the project. Disturbance associated with operational noise would be less frequent, more localized, and of shorter duration.

FWS defined the noise disturbance threshold for spotted owls as 70 dBA and the injury threshold as 92 dBA (WSDOT, 2014). Oregon LNG estimated that noise from construction equipment would attenuate below the disturbance threshold (70 dBA) within about 315 feet. If present along the pipeline

during construction, northern spotted owls would be directly affected by noise and disturbance related to construction, which would result in diminished reproductive success or survival. Disturbed northern spotted owls fleeing as a result of construction could be more vulnerable to injury. The FWS has concluded that loud noise (20 to 25 dB greater than ambient noise levels) and human presence can result in a significant disruption of breeding, feeding, or sheltering behavior of northern spotted owls such that it creates the potential for injury to the individuals (i.e., incidental take in the form of harassment). Because northern spotted owls are primarily nocturnal predators, construction activities that occur during the day are not likely to disrupt foraging behavior.

Indirect effects on northern spotted owl populations and individuals would include the removal or modification of potentially suitable habitat, forest fragmentation, and the creation of hard edges between the forest patches and clear-cuts or roads is a concern for northern spotted owl. There are no patches of interior forest 80 years old or more found along the pipeline routes. The pipeline facilities would permanently convert forest in the permanent right-of-way to a managed landscape for the life of the project and thereby limit the development of future mature forest habitat. Oregon LNG estimates that pipeline construction would remove about 188.8 acres of habitat outside of known home ranges that could be used by northern spotted owl. Specifically, pipeline construction would clear about 19.5 acres of nesting, roosting, and foraging habitat, 17.6 acres of dispersal habitat, and 24.6 acres of capable habitat. Capable habitat for northern spotted owls is habitat that is capable of becoming nesting, roosting, and foraging habitat within the lifetime of the project.

As previously described, the pipeline would cross one CHU. Construction related clearing would remove 11.3 acres of owl habitat in designated critical habitat that is currently suitable or may become suitable for northern spotted owl in the future (i.e., capable habitat). Maintenance and clearing of the permanent pipeline right-of-way would indefinitely preclude 3.9 acres of designated critical habitat from becoming suitable habitat in the future; furthermore, the permanent right-of-way would create a 0.6-mile-long, high-contrast forest edge in critical habitat.

Mitigation and Conservation Measures

Oregon LNG would implement the following measures to avoid, minimize, or restore impacts and promote the recovery of northern spotted owls:

- avoid the removal of suitable northern spotted owl nesting, roosting, and foraging habitat during the breeding season (March to September);
- avoid pipeline installation and access road construction activities within 35 yards of owl sites during the critical breeding period (March 1 to July 7);
- avoid more than three consecutive days of any construction activities within 0.25 mile (greater than 35 yards) of owl sites during the critical breeding period;
- restrict habitat removal within suitable, dispersal, or capable habitat areas to avoid the critical breeding period;
- restrict construction use of heavy equipment, chainsaws, and cable yarding within 0.25 mile of occupied sites;
- restrict blasting and slash disposal within 0.25 mile of an occupied site during the breeding season; and
- restrict helicopter yarding over an occupied site or its associated buffer zone during the breeding season.

Similar to the mitigation described above for marbled murrelet, Oregon LNG proposes to acquire land that would be set aside for northern spotted owl habitat conservation. Oregon LNG would follow mitigation ratios (ranging from 6 to 1 and 1.5 to 1) outlined in the Conservation Framework to adequately offset the spatial and temporal loss of habitat due to pipeline construction (see section 3 of Oregon LNG's Conceptual Mitigation Plan in appendix F3 for mitigation ratios).

The pipeline would cross mostly industrial forest lands that are unlikely to regrow into suitable owl habitat given current and likely future forest management activities on private land. Accordingly, project impacts on capable habitat on industrial forests would not be subject to mitigation in line with the Conservation Framework. The area that would be subject to mitigation for northern spotted owl due to pipeline construction would amount to about 41.6 acres of nesting, roosting, and foraging habitat, and 168.6 acres dispersal habitat. No high-quality nesting, roosting, and foraging habitat would be affected.

Like for marbled murrelet mitigation, Oregon LNG may need to acquire out-of-kind habitat due to the limited availability of suitable owl habitat in the Coast Range. Oregon LNG developed ratios for out-of-kind mitigation in cooperation with the FWS, and under the worst case scenario for out-of-kind land acquisition Oregon LNG would be obliged to purchase up to 2,517 acres of capable habitat, or over 11 times the amount of indirect removal impacts. Oregon LNG may also meet its mitigation obligations for northern spotted owl by implementing silvicultural treatments on lands not directly acquired by Oregon LNG or by providing financial support to the FWS for barred owl management. In its Revised Recovery Plan for the Northern Spotted Owl (FWS, 2011b), the FWS recognized competition from barred owl as a limiting factor in the recovery of northern spotted owl and devised plans to conduct experimental removal of barred owl (FWS, 2013d). Therefore, funding of barred owl management could be an effective means for Oregon LNG to meet its mitigation obligations, although habitat acquisition would be prioritized over the silviculture or barred owl management options.

We conclude that with implementation of the above mitigation and conservation measures and Oregon LNG's commitment for habitat acquisition and associated long-term management actions of acquired lands, Oregon LNG would adequately offset the project's impacts on northern spotted owl.

The conditions of northern spotted owl and marbled murrelet habitat are likely to change prior to the start of pipeline construction due to ongoing timber harvesting that is likely to occur along the proposed pipeline route. Therefore, Oregon LNG would conduct the final assessment of impacts on marbled murrelet and northern spotted owl habitat and determination of corresponding mitigation obligations within 2 years of the onset of construction. Because mitigation is pending future assessment of habitat condition, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary its final impact assessments and mitigation documentation for marbled murrelet and northern spotted owl.**

Effect Determination

The pipeline crosses known and potential northern spotted owl habitat, and individual northern spotted owls may be exposed to project activities that may kill or injure birds, impair essential behaviors by adversely affecting occupied or unsurveyed suitable breeding habitat, or cause significant disturbance of breeding birds, leading to reduced reproductive success.

Northern spotted owls would be unlikely to permanently abandon the project area as a result of the construction noise disturbance, and a relatively small amount of habitat would be altered. With the incorporation of conservation measures, including preconstruction clearance surveys and avoidance of

noise-inducing construction during the species' critical period (if spotted owls are identified during preconstruction surveys), the likelihood of direct effects on individual birds is discountable. However, we expect the habitat loss due to forest clearing would cause long-term indirect effects on northern spotted owl. Therefore, we determined the project would ***likely adversely affect*** northern spotted owl. Likewise, with the clearing of 7.5 acres of designated critical habitat containing PCEs, and the removal of habitat elements essential to the conservation of northern spotted owls, the proposed project would ***likely adversely affect*** designated critical habitat for northern spotted owls.

Streaked Horned Lark

The streaked horned lark is a rare subspecies of the horned lark that occurs in Oregon and Washington. Although most horned lark subspecies migrate south to wintering locations, most streaked horned larks are found in Oregon and Washington year-round, with the largest concentrations present in the mid-Willamette Valley (Robinson and Moore, 2005). Wintering sites commonly consist of a relatively large percentage of bare ground as well as sites with low, sparse vegetation such as perennial rye grass fields (Robinson and Moore, 2005). Some birds may be resident throughout the year at or very close to their breeding sites. Within the species' range in Oregon, wintering habitat is limited to the Willamette Valley and the historical floodplain of the Columbia River (Robinson and Moore, 2005).

The primary limiting factor for the survival of the streaked horned lark is the availability of suitable breeding sites and predation. This subspecies requires open, sparsely vegetated sites for nesting. Populations of the streaked horned lark have declined in large part because of the loss or modification of breeding habitat. Suitable breeding sites continue to be converted to agriculture or developed for residential, industrial, or recreational purposes (FWS, 2008b). Less than 1 to 3 percent of the native grassland and savanna is estimated to remain (FWS, 2008c). Other causes of decline include encroachment of woody vegetation and invasion of nonnative plant species (e.g., Scot's broom, sod-forming grasses, and beach grasses) (FWS, 2008b).

Suitable habitat for streaked horned larks includes portions of the project area that support upland grasslands, pastures, Christmas tree farms, and Oregon white oak woodlands. These habitat types are limited to the portion of the pipeline corridor in Cowlitz County, and the terminal site. The streaked horned lark may be present in small numbers in these portions of the project area throughout the year.

There are no records of streaked horned lark within 2 miles of the proposed pipeline route or terminal (ORNHIC, 2009; ORBIC, 2011; WDFW, 2012a). However, there is marginal streaked horned lark habitat between MP 82.7 and MP 86.8 on actively cultivated agricultural fields. These fields offer an open landscape context preferred by larks but contain fairly dense vegetation that likely precludes use by larks for most of the year. The closest reported occurrence is about 8 miles north of the pipeline near Kalama, Washington (WDFW, 2013a). The terminal site also has marginal streaked horned lark habitat, as the existing network of roads on east Skipanon Peninsula creates areas of bare ground. The FWS reports that a key attribute for lark habitat selection is an open landscape context, and most sites where larks are found are flat and treeless landscapes of 300 acres or more (FWS, 2012b). However, in the lower Columbia River, larks use smaller sites, typically islands, that can be less than 100 acres. The bare ground areas of the terminal site are relatively small (less than 15 acres) and surrounded by dense vegetation trees that limit visual connectivity with the Columbia River (i.e., no open landscape context). Therefore, there is low likelihood that streaked horned lark would nest or forage at the terminal site.

The nearest designated critical habitat to the pipeline is Subunit 3M (Sandy Island), which is about 4.9 miles north of the pipeline. The nearest designated critical habitat to the terminal is the Miller Sands island near the Lewis and Clark National Wildlife Refuge, about 10 miles east of the terminal. There has been documented breeding on these sand islands (FWS, 2012b).

Impacts

As ground nesting birds, streaked horned larks are most vulnerable to disturbance during their nesting season between March and July. Elevated noise and visual disturbance from construction equipment and workers could temporarily displace individual streaked horned larks to adjacent areas. If displaced individuals abandon their nests, reproductive success could be reduced. Direct mortality could occur if nests were crushed by construction equipment. To avoid disturbance to nesting birds, Oregon LNG would conduct preconstruction surveys prior to ground disturbing activities in potential lark habitat (between MP 82.7 and 86.8). If lark nests are detected in the construction right-of-way, Oregon LNG would postpone construction until after fledging.

Streaked horned larks may use the agricultural fields crossed be the pipeline. Disturbed agricultural areas would be restored at the discretion of the individual landowners, but are expected to return to preconstruction conditions. Therefore, we conclude that there would not be significant habitat loss due to project construction or operation.

Mitigation and Conservation Measures

Oregon LNG has indicated that it would incorporate the following conservation measures to minimize impacts on streaked horn larks:

- survey for streaked horn lark nests along the pipeline between MP 82.7 and MP 86.8 and in marginally suitable habitat at the terminal site using standard nest searching protocols if construction were to occur during the nesting season (March and July);
- if nests are found in the construction area, postpone or reschedule construction until the completion or natural failure of nesting and fledging;
- maintain a speed limit of 15 mph in areas of known or assumed occupied habitat to avoid flushing birds into oncoming traffic; and
- restore affected native habitats with an ODFW-approved native seed mix.

Direct effects on the streaked horned lark and critical habitat are unlikely to occur as a result of the proposed action. Oregon LNG does not propose compensatory mitigation specifically targeted for the streaked horned lark, because:

- no streaked horned larks have been detected along the pipeline during surveys conducted by Oregon LNG;
- neither the pipeline nor terminal area crosses critical habitat; and
- agricultural habitats that may provide suitable habitat for streaked horned lark would be restored to preconstruction conditions.

If future preconstruction surveys result in streaked horned lark detection within 325 feet[4] of the pipeline, Oregon LNG would notify and consult with the FWS to identify measures necessary to prevent "take" or "harassment." Possible measures include construction deferment, habitat replacement via land acquisition, or route changes (as practicable). If nests are detected near the construction right-of-way, Oregon LNG may implement the following actions depending on site conditions: (1) install and maintain an avoidance buffer (defined through consultation with FWS) until the young have fledged or the nesting

[4] This distance is based on the average territory size (0.77 hectare) by assuming the territory is a circle and calculating the diameter.

season ends; (2) modify the pipeline route (if practicable); or (3) provide compensatory mitigation in the form of land acquisition.

Effect Determination

Effects on individual streaked horn lark may result from temporary displacement, direct mortality/injury, or disturbance of potentially suitable habitat during construction of the pipeline. We conclude that the proposed action would ***not likely adversely affect*** the species. This determination is based on potential effects on individuals that may be present in suitable habitat along the pipeline construction corridor.

Because designated critical habitat for streaked horned lark would be well outside of the project area, the proposed action would have ***no effect*** on designated critical habitat for the species.

Yellow-billed Cuckoo

The yellow-billed cuckoo is a neotropical migrant that inhabits riparian forests. At present, yellow-billed cuckoos are rare to locally common over most of their western range. The FWS listed the western DPS of yellow-billed cuckoo as threatened on October 3, 2014 (FWS, 2014b). Critical habitat was proposed on August 15, 2014 (FWS, 2014c).

Western yellow-billed cuckoos breed in large blocks of riparian habitats, particularly woodlands with cottonwoods and willows (Ehrlich et al., 1988). The subspecies' preferred habitat contains a combination of a dense willow understory for nesting and a cottonwood overstory for foraging (Gaines and Laymon, 1984). Suitable breeding sites generally consist of wooded patches of 50 acres or greater (Hughes, 1999). A study conducted in eastern California found that optimal cuckoo habitat consisted of patches greater than 200 acres in size and wider than 1,950 feet (Laymon and Halterman, 1989).

The primary threat affecting the western DPS is habitat loss from conversion to agricultural uses, such as crops and livestock grazing; and modification and degradation of riparian habitat from dam construction and operations, water diversions, river flow management; stream channelization and stabilization (Center for Biological Diversity, 1998). Habitat loss has also occurred as a result of urban and transportation infrastructure and increased incidence of wildfire. Other threats include habitat rarity and small and isolated population sizes that cause the remaining yellow-billed cuckoo populations to be increasingly susceptible to further declines through lack of immigration, reduced populations of prey species, pesticides, and collisions with tall vertical structures during migration (Center for Biological Diversity, 1998).

Based on historical accounts, the western yellow-billed cuckoo was widespread and locally common in portions of Oregon and Washington (FWS, 2013e), including the willow bottoms along the Willamette and Columbia Rivers in Oregon, and in the Puget Sound lowlands and along the lower Columbia River in Washington (FWS, 2013e). In Washington, the last confirmed breeding records of yellow-billed cuckoos are from the 1930s (FWS, 2013e) and the WDFW considers the cuckoo a historical species in the state.

In Oregon, the last confirmed breeding records were in the 1940s. However, four cuckoo sightings were made west of the Cascade Mountains between 1970 and 1994 near the Sandy River Delta, and there are at least 20 records east of the Cascades (Gilligan et al., 1994). In 2008, a single cuckoo was documented at the Sandy River Delta (USFS, 2009) and another was reported there in 2009 (Midvalley Birding, 2009).

The ORNHIC/ORBIC and PHS databases have no records of this species within 2 miles of the pipeline or terminal (ORNHIC, 2009; ORBIC, 2011; and WDFW, 2013a). The nearest documented observation of a yellow-billed cuckoo is from the Sandy River Delta in Oregon, about 31 miles southeast of the pipeline route (USFS, 2009).

The project area contains only a few small patches (all less than 10 acres in size) of cottonwood riparian forest that lacks a willow understory. These areas are located along and near the pipeline corridor on both the west and east sides of the Columbia River crossing in Columbia County and Cowlitz County, respectively. On the west side of the crossing, where the largest cottonwood patch near the corridor is about 7 acres, the cottonwood habitat is quite dense and intergrades into mixed deciduous forest. A narrow, discontinuous fringe of cottonwood riparian also occurs along both Milton Creek and Dyno Nobel Channel. On the east side of the crossing, there is one small patch (about 6 acres) immediately east of the crossing on the south side of the corridor, a second 1.1-acre patch about 0.3 mile east of Dike Road, and a third patch measuring 2.5 acres in size about 0.4 mile east of Dike Road.

Impacts

No riparian cottonwood trees would be removed from the small patches of cottonwood riparian habitat along the pipeline corridor. A few cottonwoods may be removed from mixed deciduous stands within the project area, but these areas are not considered suitable habitat for the western yellow-billed cuckoo. Therefore, no habitat loss is expected as a result of the project. Western yellow-billed cuckoos are very rare in Oregon and Washington, but should they occur near the construction area, increased levels of noise and activity may cause them to avoid the area. However, because any cuckoos occurring in the project area would be irregular migrants, no breeding birds would be affected.

No indirect impacts on western yellow-billed cuckoos would occur as a result of the project because of the absence of suitable nesting habitat within or adjacent to the pipeline corridor.

Mitigation and Conservation Measures

Oregon LNG would implement the following conservation measures to avoid or minimize effects on western yellow-billed cuckoos.

- The west and east banks at the pipeline crossing of the Columbia River would be surveyed for potential suitable nesting habitat. Surveys would be conducted in the year prior to pipeline construction across the Columbia River. If, in the unlikely event a nesting cuckoo is confirmed during the preconstruction nest surveys, FWS would be contacted for guidance on developing appropriate avoidance measures, which could include avoiding construction during the species' sensitive breeding period (about early June through August).
- The results of preconstruction nest surveys would be submitted to FWS prior to beginning construction.

No effects are expected on western yellow-billed cuckoos as a result of the project; therefore, Oregon LNG proposes no mitigation for the subspecies.

Effect Determination

The proposed action would result in ***no effect*** on the western yellow-billed cuckoo because the species is not known or expected to occur in the project area; areas with cottonwoods are sub-optimal because they do not include dense understories of willows and are very small in size; and in the unlikely event that an irregular migrant were present at the site, it would be expected to temporarily avoid the area.

No individual cuckoos would be affected by the proposed action. Likewise, the project would have no effect on proposed critical habitat for western yellow-billed cuckoo.

Marine Reptiles

We received comments expressing concerns about impacts on marine turtles and their habitat. In particular, comments focused on potential impacts on marine turtles from entrainment in ballast and cooling water intakes, vessel strikes, and increased noise.

Four species of sea turtles have been documented off the coasts of Oregon and Washington. All four are listed under the federal ESA and state law as threatened or endangered (see table 4.1.8-1). These include the green, olive ridley, leatherback, and loggerhead sea turtles. Sea turtles nesting on beaches in the United States are under the jurisdiction of the FWS; sea turtles occurring in U.S. waters are under the jurisdiction of NMFS. None of the listed sea turtles are known to nest along the Pacific Coast of the United States (NOAA et al., 1998a; 1998b; 1998c; 1998d).

Designated critical habitat for the green and leatherback sea turtles would not occur within the project area. Critical habitat has not been designated for olive ridley or loggerhead sea turtles.

All four species of sea turtles potentially affected by the project are highly migratory. Although sea turtles are generally considered a warm temperate marine reptile, green, olive ridley, leatherback, and loggerhead sea turtles have been recorded off the coasts of Oregon and Washington (Green et al., 1992). Green et al. (1992) conducted a study to assess the presence and abundance of federally-listed species off the Pacific Coast of the United States. This study collected both aerial and shipboard marine fauna data along the Washington and Oregon coasts between 1989 and 1990. During this time, 16 sea turtles were observed; all sightings were leatherback sea turtles and all occurred between June and September, when water temperatures are warmest. Most (63 percent) of these sightings occurred over the continental slope waters, with the remainder found over the continental shelf.

Marine Turtle Species

Green Sea Turtle

The green sea turtle is listed as threatened under the federal ESA and endangered by the state of Oregon. Green sea turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean and benthic feeding grounds in coastal areas. In the eastern North Pacific, green sea turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south.

The principal cause of the historical, worldwide decline of the green sea turtle is long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Incidental capture in fishing gear, primarily in gillnets, but also in trawls, traps and pots, longlines, and dredges is a serious ongoing source of mortality that also adversely affects the species' recovery. Green sea turtles are also threatened in some areas of the world by a disease known as fibropapillomatosis (NOAA et al.,, 1998d). On the west coast of the United States, which includes portions of the project area, the three primary threats are debris, boat collisions, and incidental capture of turtles from fishing operations (NOAA, NMFS and FWS, 1998d). Other threats include environmental contaminants and dredging.

Leatherback Turtle

The leatherback sea turtle is listed as endangered both federally and by the state of Oregon. After nesting, female leatherbacks migrate from tropical waters to more temperate latitudes, which support high densities of jellyfish prey in the summer.

Leatherback sea turtles face threats on both nesting beaches and in the marine environment. The greatest causes of decline and the continuing primary threats to leatherbacks worldwide are long-term harvest and incidental capture in fishing gear. Illegal harvest of eggs and adults occurs on nesting beaches while juveniles and adults are harvested on feeding grounds. Incidental capture primarily occurs in gillnets, but also in trawls, traps and pots, longlines, and dredges. Together these threats are serious ongoing sources of mortality that adversely affect the species' recovery (NOAA et al., 1998c).

In 2012, NMFS designated about 46,100 square miles within the EEZ off the southern coast of California as critical habitat, in addition to about 24,500 square miles within the EEZ off the coasts of Oregon and Washington (north of the Columbia River estuary); this area would be traversed by LNG marine carriers. Proposed areas of critical habitat are confined to the marine environment and do not include the terminal site on the Columbia River. Within these marine areas, NMFS cites two PCEs: one related to the occurrence of prey species, including jellyfish, and a second related to conditions along migratory pathways to allow for safe and timely passage to and from foraging areas

Olive Ridley Sea Turtle

The olive ridley sea turtle is listed as threatened both federally and by the state of Oregon. The olive ridley is mainly a "pelagic" sea turtle, but has been known to inhabit coastal areas, including warm water bays and estuaries.

The principal cause of the historical, worldwide decline of the olive ridley sea turtle is long-term harvest of eggs and adults on nesting beaches. These harvests continue in some areas of the world and compromise efforts to recover this species. Incidental capture in fishing gear, primarily in shrimp trawls, but also in gill nets, traps and pots, longlines, and large circle hooks is a serious ongoing source of mortality that also adversely affects the species' recovery. Further threats to the long-term survival of olive ridley populations include degradation and destruction of natural conditions at nesting beaches from coastal developments and climate change (NOAA et al., 1998a).

Loggerhead Turtle

The loggerhead sea turtle is listed as threatened both federally and by the state of Oregon. Loggerheads occupy three different ecosystems during their lives: the terrestrial zone, the oceanic zone, and the neritic zone or nearshore coastal areas. In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California.

Loggerheads face threats both on nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. Directed harvest for loggerheads still occurs in many places (e.g., the Bahamas, Cuba, and Mexico) and is a serious and continuing threat to loggerhead recovery. The primary threat to loggerhead turtles on the U.S. west coast is natural disasters and incidental take by fisheries (NOAA et al., 1998b).

Impacts

Potential impacts on marine turtles resulting from increased vessel traffic would include vessel strikes, spills or leaks of hazardous materials, and increases in underwater noise.

Vessel Strikes

Sea turtles would be vulnerable to vessel strikes as a result of the project. Vulnerability to collision with an LNG marine carrier would be greatest while sea turtles feed, swim, breathe, and rest near the surface of the water. In areas of intense ship traffic, sea turtles can experience propeller or collision injuries; however, most of these injuries are caused by small, fast moving vessels (NMFS, 2004). In contrast, LNG marine carriers push a considerable bow wave when underway on the open ocean because of their design and large displacement tonnage. Given the limited occurrence of sea turtles within Oregon coastal waters, the addition of 125 LNG marine carriers through the EEZ annually would not result in measurable additional vessel strike-related mortality or injury to sea turtles off the coast of Oregon. However, due to a lack of reported vessel strikes on sea turtles in general, potential effects on sea turtles due to LNG marine carriers are difficult to estimate. The possibility of vessel strikes by LNG marine carriers paralleling the California coast may be higher because reports of strikes in California are more frequent, however, a maximum of two LNG marine carriers per year would take this southern route. LNG marine carriers are expected to transit at least 50 nm off the coast and so would be expected to avoid nearshore feeding areas that are used by sea turtles off the coast of southern California.

Spills and Leaks

Spills, a potential operations effect, would directly affect sea turtles if they come in contact with environmental contaminants and would indirectly affect sea turtles through effects on their foraging habitats (NOAA et al., 1998c). If a sea turtle were to encounter a spill, leak, or accidental release of fuels, lubricants, or other hazardous substance from an LNG marine carrier, a turtle would be at risk due to impacts on respiratory system, skin, blood chemistry, and salt gland function (NMFS, 2004). Sea turtles are susceptible to the effects of spills either by direct encounter or ingestion of contaminated prey. Fuel (e.g., diesel) used for vessel propulsion or auxiliary/emergency generators could spill or leak. However, fuel on each ship is protected by the vessel's double hull. In the 6-year period 2002 through 2007 there were six marine oil spills along the West Coast (Cameron, 2008). In addition, in the very unlikely event of an LNG spill, the LNG would spread out and quickly vaporize after making contact with the water. The mobility and diving capabilities of sea turtles would enable them to escape a potential spill. An LNG fuel spill, an unlikely event, would have to occur in the vicinity of a nesting beach to have a significant population effect. Furthermore, each LNG marine carrier would maintain a SOPEP, which would contain measures to be implemented in the event of a petroleum release (see section 4.1.3.2). In addition, the presence of the vessels involved in spill control and clean-up would discourage sea turtles from approaching spill areas.

Noise

Engine noise produced by LNG marine carriers would result in temporary increases in underwater noise levels near the transiting ships. However, because sea turtles are mobile, it is anticipated that they would avoid areas with high noise levels during operation of the project.

The hearing capabilities of sea turtles are poorly known and there is very little available information on the effects of noise on sea turtles. Some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. McCauley et al. (2000) noted that decibel levels of 166 dB_{RMS} re 1µPa were required before any behavioral reaction (e.g., increased swimming speed) was observed, and decibel levels above 175 dB_{RMS} re 1µPa elicited avoidance behavior of sea turtles. McCauley et al. (2000)

suggested that decibel levels above 201dB$_{RMS}$ may result in injury to sea turtles. As no studies have been done to assess the effects of impulsive and continuous noise sources on sea turtles, McCauley et al. (2000) serves as the best available information on the levels of underwater noise that may produce a startle, avoidance, and/or other behavioral or physiological response in sea turtles.

Based on this, vessel engine noise may elicit a behavioral avoidance response for turtles in close proximity to a LNG marine carrier, but sound levels would not approach injury levels. Sea turtles would not be expected to occur in the Columbia River, and therefore would not be exposed to underwater pile driving noise.

Mitigation

On average, LNG marine carriers would likely be traveling about 50 nm offshore until they approach the mouth of the Columbia River (assuming a Pacific Coast route) and thus avoid nearshore feeding areas. The conservation measures proposed for avoiding and minimizing vessel strikes on whales (see earlier section) would also benefit sea turtles. For example, Oregon LNG would instruct LNG marine carriers to slow their speeds to below 15 knots when travelling over or east of the continental shelf. When traveling within 10 miles of the shoreline of Oregon and Washington, LNG marine carriers would establish a maximum speed limit of 12 knots during July, August, and September, when the turtles are more likely to be in the project area. At slower speeds, collisions with sea turtles would be even less likely to occur.

LNG marine carriers would also maintain a SOPEP, as required by international convention, which would minimize the risk of a spill, leak, or accidental release of hazardous materials, or the response time to clean the spill, should one occur, that would harm sea turtles.

Effect Determination

Because sea turtles occur within the marine transit route for LNG marine carriers, there is potential for individuals to be negatively affected by vessel strikes due to the proposed increase in ship traffic. This potential effect would be restricted to 125 LNG marine carriers per year within the EEZ during foraging seasons. However, we conclude that the proposed project would ***not likely adversely affect*** the federally listed sea turtles described above because: (1) vessel strikes are unlikely, especially given the distance from nearshore feeding areas; (2) the increase in annual ship traffic due to the proposed action is expected to cause an immeasurable increase for potential vessel strikes on sea turtles; (3) Oregon LNG would incorporate conservation measures in terminal use agreements with shippers that would include reducing LNG marine carrier speeds over the continental shelf (as discussed previously); and (4) the likelihood of a fuel spill or release of hazardous materials at sea would be extremely remote, and if a spill did occur, the carrier would implement its SOPEP.

Fish

We received comments from state and federal agencies expressing concerns about the project's impacts on threatened, endangered, and other listed fish species and their habitats. Comments included concerns about impacts on federally listed fish, construction impacts related to in-water work timing, maintaining fish passage, water quality affects (temperature changes, increased turbidity/sedimentation, dredging impacts, entrainment in ballast and cooling water intakes, hydrostatic testing), and noise (pile driving). Juvenile salmonid fish screening practices following NMFS requirements (addressed in section 4.1.3.2) were noted for intake structures associated with the terminal, pipeline, and LNG marine carriers. In addition, concerns were expressed about potential habitat impacts from temporary and permanent loss of habitat and critical habitat and potential conflicts with existing and future fish habitat restoration projects.

Fish Species

Federally listed fish in the project area include five species of anadromous salmonids (i.e., Chinook, chum, coho, sockeye salmon, and steelhead trout), green sturgeon, and eulachon. These fish occur in the Columbia River estuary near the terminal at various times of the year (see table 4.1.8-4).

Table 4.1.8-4

Typical and Approximate Timing of Federally Listed Fish in the Vicinity of the Terminal

Species ESU/DPS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Salmon (Oncorhynchus tshawytscha)												
Snake River Fall												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Snake River Spring/Summer												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Upper Columbia River Spring												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Lower Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Upper Willamette River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Sockeye Salmon (*O. nerka*)												
Snake River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Steelhead Trout (*O. mykiss*)												
Snake River Basin												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Upper Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												

Table 4.1.8-4

Typical and Approximate Timing of Federally Listed Fish in the Vicinity of the Terminal

Species ESU/DPS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Middle Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Lower Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Upper Willamette River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Chum Salmon (*O. keta*)												
Lower Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Coho Salmon (*O. kisutch*)												
Lower Columbia River												
Adult Migration												
Juvenile Migration												
Juvenile Rearing												
Sturgeon												
Green Sturgeon *(Acipenser medirostris)*												
Adult and Subadult												
Smelt												
Eulachon[a] *(Thaleichthys pacificus)*												
Adult Migration												
Eggs												
Juvenile Migration												

Represents peak level of use.

Represents lesser level of use.

Represents known presence with uniform or unknown level of use.

[a] Source: ODFW, 2003. CH2MHILL, 2013e.

Except for the HDD crossing of the Columbia River and Lewis and Clark River, the pipeline project area includes streams and rivers that provide habitat for three federally listed Pacific salmon ESUs Oregon Coast (OC) coho (which would not occur in the terminal area), Lower Columbia River Chinook, and Lower Columbia River coho. Burris Creek in Washington is listed as providing habitat for lower Columbia River DPS steelhead trout, but its connection to the Columbia River is blocked by a pump station, and steelhead are unable to access the portion of Burris Creek that would be crossed by the pipeline. Eulachon do not occur in the streams crossed by the pipeline, except the Columbia River.

Green sturgeon are likely only present in the lower reaches of the larger tributaries to the lower Columbia River estuary (the Skipanon, Lewis and Clark, and Youngs Rivers).

For conservation and ESA-listing purposes, NMFS subdivided steelhead trout populations into DPSs and subdivided the remaining four salmon species into ESUs, which are described in the following sections.

The current presence of bull trout in the lower Columbia River near the terminal and mouth of the Columbia River is likely limited to a few individuals that may use the river as a migration corridor. There are no documented runs of bull trout currently known to occur in the lower Columbia River, and bull trout are absent from streams crossed by the pipeline (Buchanan et al., 1997; Fish Passage Center, 2013; Streamnet 2014a). Therefore, we conclude that the project would have ***no effect*** on bull trout. Critical habitat for bull trout is designated in the mainstem Columbia River. The amount of currently occupied proposed critical habitat that would be degraded by project operation and construction is minor considering the amount of critical habitat in the lower Columbia River. Because the project would affect a limited amount of critical habitat, and the limited, if any, occupancy of habitat in the terminal and dredged material disposal area, potential adverse effects on designated critical habitat are unlikely. Therefore, the project is not likely to adversely affect designated critical habitat for Columbia River bull trout.

Chinook Salmon

There are five populations of Chinook salmon that occur in the project area.

Lower Columbia River Chinook

In March 1999, NMFS listed lower Columbia River Chinook salmon as threatened under the ESA (NMFS, 1999a). This ESU includes all spring and fall-run native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls.

The predominant life history type for this ESU is the fall run, which consists of an early component that returns to the Columbia River beginning in early to mid-August and spawns within a few weeks (Kostow, 1995); and a later returning component, which returns to the Lewis and Sandy Rivers (Washington State Department of Fisheries [WDF] et al., 1993). ODFW (2003) indicates that adult fall-run Chinook enter the lower Columbia River near the terminal from mid-July to mid-October, with a peak in August and September. The smaller spring run enters the lower Columbia River in March and April.

Fall-run Chinook salmon juveniles are most likely to occur in the lower Columbia River near the terminal and nearshore dredged material disposal areas from February through early August, with a peak in mid-April through mid-June (ODFW, 2003; Fish Passage Center, 2008)

Near the LNG terminal, lower Columbia River Chinook salmon may occur in the Columbia River and nearby tributaries, including the Skipanon Slough, which is just west of the LNG terminal site. Skipanon Slough may support juvenile rearing for lower Columbia River Chinook. The Skipanon River, a tributary to the Columbia River just downstream of the terminal location, is not currently occupied by fall Chinook, though it may have historically provided habitat (E&S Environmental Chemistry, Inc. and Skipanon River Watershed Council, 2000).

Along the mainline route, lower Columbia River Chinook may be present within tributaries to Youngs Bay in the Lower Columbia River estuary, and they may spawn and rear in the mainstem and tributaries of the Lewis and Clark River. They may also occur in the Clatskanie River, but well downstream of the pipeline crossing location. Peak migration periods for adults in these waterbodies is

from mid-September through November, while juvenile outmigration and rearing occur from March through mid-April. In freshwater spawning tributaries of Youngs Bay, lower Columbia River Chinook spawn from mid-October through mid-December, and eggs incubate from November though February.

NMFS designated critical habitat for lower Columbia River Chinook salmon in September 2005 (NMFS, 2005c). The terminal would be in critical habitat of lower Columbia River Chinook. However, NMFS excluded the Youngs River watershed, including both the Lewis and Clark River and the Youngs River, from the final critical habitat designation for lower Columbia River Chinook. Therefore, except for the Columbia River HDD pipeline crossing, portions of the pipeline in Oregon would not cross critical habitat for lower Columbia River Chinook. Burris Creek in Washington is designated as critical habitat, and listed by Streamnet as providing habitat for lower Columbia River Chinook (Streamnet, 2014a). However, Burris Creek's connection to the Columbia River is blocked by a pump station and, therefore, it is assumed that lower Columbia River Chinook are not present.

Upper Columbia River Spring-run Chinook

In March 1999, NMFS listed upper Columbia River spring-run Chinook salmon as endangered under the ESA (NMFS, 1999a). The ESU includes stream-type Chinook salmon spawning above Rock Island Dam, including the Wenatchee, Entiat, and Methow Rivers in Washington.

Adult upper Columbia River spring-run Chinook salmon migrate upstream through the lower Columbia River from March through May. Most spring-run Chinook pass Bonneville Dam in late April. Peak runs through the lower Columbia River near the terminal and nearshore dredged material disposal areas typically occur from the end of March through mid-May. Outmigrating juvenile fish are likely to pass by the terminal area from late April through early July, with the majority present in mid-May to mid-June. Juveniles from this ESU are not expected to rear extensively in the lower Columbia River estuary. Upper Columbia River spring Chinook salmon do not occur in waterbodies that would be crossed by the pipeline, except at the crossing of the Columbia River.

The Columbia River is designated as critical habitat (rearing and migratory corridor PCEs) for the upper Columbia River Spring-run Chinook salmon ESU. The designation defines the lateral extent of critical habitat for each designated stream reach as the width of the stream channel defined by its bankfull elevation. Critical habitat includes the Columbia River in the terminal area and at the pipeline crossing. Relatively small portions of the north jetty and shallow water disposal sites are within the Columbia River and are thus also included in designated critical habitat.

Snake River Fall Chinook

The NMFS listed Snake River fall-run (SRF) Chinook salmon as threatened in April 1992 (NMFS, 1992) and this status was reaffirmed in 2003 (70 FR 37160–37204). This ESU includes all naturally spawned populations of fall-run Chinook salmon from the mainstem Snake River and below Hells Canyon Dam and in the Tucannon, Grande Ronde, Imnaha, Salmon, and Clearwater Rivers, as well as four artificial propagation programs.

Adult SRF Chinook utilize the Columbia River in the project area as a migration corridor from July to October (Waples et al., 1991) and move quickly through the estuary in deepwater, largely using the shipping channels, on their way to upstream holding and spawning areas. Based on fish passage data at Bonneville Dam, it is assumed that juvenile SRF Chinook may be present near the terminal and nearshore dredged material disposal areas from February to November, with a peak in May and June. Outside of this peak, juvenile SRF Chinook are likely present in the lower Columbia River estuary in very low numbers. Because of the distance SRF Chinook travel, even the earliest juvenile outmigrants that

move past the terminal and nearshore dredge disposal areas are relatively large in size and with greater swimming ability than Chinook from other ESUs. As a result, SRF Chinook likely use deeper water habitats. The pipeline would not cross any SRF Chinook migration areas, aside from the HDD crossing under the Columbia River.

In the project area, the Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the SRF Chinook salmon ESU (58 FR 68543 – 68554). Adjacent riparian zones are included in the designation, defined as those areas within 300 feet of the normal line of high water of a stream channel (i.e., areas extending 300-feet shoreward at the terminal location on the Skipanon Peninsula). Also included in SRF Chinook critical habitat is the: "Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock Jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers" (NMFS, 1993b). As such, portions of the north jetty and shallow water disposal sites are also included in critical habitat. With the exception of the pipeline crossing of the Columbia River, the proposed pipeline would not cross any critical habitat for this ESU. The entry point for the Columbia River HDD would be approximately 1,300 feet inland from the high-water mark on the west shoreline, and the exit point would be approximately 1,500 feet inland from the eastern shoreline. Therefore, the HDD crossing of the Columbia River would be outside of the riparian habitat included as part of designated critical habitat for this ESU.

Snake River Spring/Summer-run Chinook

The NMFS listed Snake River spring/summer-run Chinook salmon as threatened in April 1992 (NMFS, 1992) and this status was reaffirmed in 2005 (70 FR 37160– 37204). This ESU includes all naturally spawned populations of spring/summer-run Chinook salmon from the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins, as well as 15 artificial propagation programs.

Snake River spring- and summer-run Chinook salmon use the Columbia River near the proposed terminal location as a migration corridor and move quickly through the estuary in deepwater, largely using the shipping channels, on their way to upstream holding and spawning areas. Snake River spring/summer-run Chinook are likely in the terminal and dredged material disposal areas from mid-February to August, with peak from mid-April to mid-May for spring-run Chinook and from late June to mid-July for summer-run Chinook (Matthews and Waples, 1991). Juvenile Snake River Chinook exhibit a stream-type life history and migrate swiftly to the ocean as yearling smolts and are not expected to rear in the terminal area (Schreck et al., 1986). The pipeline would not cross any migration habitat for this ESU, aside from the HDD crossing of the Columbia River.

The Columbia River is designated critical habitat (migratory corridor PCE) for the Snake River spring/summer-run Chinook salmon ESU (58 FR 68543 – 68554). Adjacent riparian zones are included in the designation, defined as those areas within 300 feet of the normal line of high water of a stream channel. With the exception of the Columbia River HDD crossing, the pipeline would not cross any critical habitat for this ESU. As described above for SRF Chinook, the HDD crossing of the Columbia River would avoid riparian habitat included as part of designated critical habitat for this ESU.

Upper Willamette River Chinook

NMFS listed the upper Willamette River Chinook salmon as threatened in March 1999 (NMFS, 1999a), and the threatened status was reaffirmed in June 2005 (NMFS, 2005d). This ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the

Willamette River, and its tributaries, above Willamette Falls. This ESU also includes seven artificial propagation programs, which are listed in 70 FR 37160 (NMFS, 2005d).

Adult and juvenile upper Willamette River spring Chinook are likely to be present in the Columbia River near the terminal and nearshore dredged material disposal sites. Upper Willamette River Chinook typically exhibit an ocean-type life history and enter the estuary at a younger age; they are smaller in size than other salmon that rear longer in streams (Bottom et al., 2005). Thus, ocean-type fish like upper Willamette River Chinook are more likely to be found within the shallow subtidal and intertidal flats habitat near the terminal area. Upper Willamette River Chinook do not occur in the waterbodies that would be crossed by the pipeline, except at the Columbia River HDD crossing. Species timing at the HDD crossing would be similar to their timing within the estuary.

The Columbia River mainstem (including the terminal area), the Columbia River pipeline crossing location, and small portions of the potential dredged material disposal locations, are included in the designated critical habitat for the upper Willamette River Chinook salmon ESU (70 FR 52630-52858). The rearing and migratory PCEs are present within the project areas.

Chum Salmon

In March 1999, NMFS listed the Columbia River chum salmon as threatened (NMFS, 1999b) and reaffirmed this status in June 2005 (NMFS, 2005d). Current distribution of chum salmon occurs in the mainstem Columbia River and tributaries downstream of Bonneville Dam.

Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum typically spawn in coastal areas, and juveniles out-migrate to the estuary almost immediately after emerging from the gravel. This means survival and growth in juvenile chum salmon depends less on freshwater conditions than on favorable estuarine conditions.

Adult chum enter the Columbia River near the terminal and nearshore dredged material disposal areas beginning in late September, with some reaching the Lewis, Kalama, Cowlitz, and Sandy Rivers as early as October (Johnson et al., 1997). The run typically peaks in mid-November. According to ODFW timing tables, adult chum may occur in the vicinity of the terminal from October through November (see table 4.1.8-4). Outmigrating juvenile chum salmon should pass the terminal area from early February through May, with the majority passing from mid-March to mid-May (ODFW, 2003). There is a small chance that chum salmon may be present in low numbers in Youngs Bay tributaries crossed by the pipeline route. If any chum are present in these tributaries, their time of usage would likely coincide with their presence in the lower Columbia River.

The Columbia River is designated as critical habitat (rearing, migratory corridor, and spawning PCEs) for the Columbia River chum salmon ESU (70 FR 52630–52858). The designation defines the lateral extent of critical habitat for each designated stream reach as the width of the stream channel as defined by its bankfull elevation. With the exception of the Columbia River HDD crossing, Oregon LNG's pipeline would not cross any waterbodies included in the designation.

Coho

Two populations of coho occur in the project area: lower Columbia River coho and Oregon Coast (OC) coho.

Lower Columbia River Coho

NMFS listed the lower Columbia River coho salmon as threatened under the ESA in June 2005 (NMFS, 2005d). This ESU includes all naturally spawned populations of coho salmon from Columbia River tributaries below the Klickitat River on the Washington side and below the Deschutes River on the Oregon side (including the Willamette River as far upriver as Willamette Falls), as well as coastal drainages in southwest Washington between the Columbia River and Point Grenville.

Adults are expected to migrate past the terminal location from August to February, with the peak (as reported by ODFW, 2003) from mid-August to mid-October. However, there may be some late- run native fish arriving at the Clackamas River from November to March (Johnson et al., 1991). Smolts out-migrate through the lower Columbia River between April and June; and juveniles rear throughout the year in nearshore habitat of the Columbia River mainstem, lower Columbia River islands, and the accessible low gradient reaches of Columbia River floodplain sloughs. The Skipanon Slough potentially provides at least seasonal refugia during high flow for juvenile coho salmon.

Although lower Columbia River coho can, and in some years do, occur in areas crossed by the pipeline, previously, NMFS concluded that all natural populations outside the Sandy and Clackamas Rivers were probably extinct, and since the mid-1970s there has been no natural reproduction in the Clatskanie River during most years (PSU, 2001). However, in recent years the number of coho in the Clatskanie River system has increased (Lewis et al., 2012). In waterbodies that would be crossed by the pipeline, potential spawning, rearing, and/or migration habitat is present for lower Columbia River coho in the Lewis and Clark River and its tributaries and the Clatskanie River. The lower Columbia River and Willamette Basin streams crossed by the pipeline in Oregon (the Clatskanie River, Merrill Creek, Milton Creek, and their tributaries) also provide habitat for lower Columbia River coho. Burris Creek in Washington is listed as providing habitat for lower Columbia River coho (Streamnet, 2014a). However, its connection to the Columbia River is blocked by a pump station and, therefore, it is assumed that lower Columbia River coho are not present. In the Lower Columbia River tributaries and the Clatskanie River subbasin, adult migration occurs from September through December, with spawning from late November through February. Juveniles may rear year-round in tributaries.

Critical habitat for lower Columbia River coho salmon was proposed on January 14, 2013. The terminal and Columbia River pipeline crossing would be included in proposed critical habitat. In estuarine and marine areas, rearing and migratory PCEs are present. Streams that would be crossed by the pipeline that also include proposed critical habitat for lower Columbia River coho include: Adair Slough (MP 1.0), Lewis and Clark River (MP 3.1, 5.7, and 11.0), Barrett Slough (MP 4.5), Heckard Creek (MP 7.9), Clatskanie River (MP 70.7), Little Clatskanie River (MP 71.8), Milton Creek (MP 73 and 74.9), and Merrill Creek (MP 76.4). In the freshwater pipeline crossing locations, PCEs include rearing, spawning and migratory corridors.

Oregon Coast Coho

In February 2008 (NMFS, 2008c), NMFS listed the OC coho salmon ESU as threatened. The ESU includes all naturally spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco, including the Cow Creek coho hatchery program (ODFW stock number 37).

Adult OC coho enter Oregon coastal estuaries, not including the Columbia River, from October through mid-January. The adults may hold in the upper tidal portion of the bay until flows increase in the fall in tributary streams and rivers. Most spawning occurs in small to medium-size tributaries in areas with low to moderate gradient. Several waterbodies that would be crossed by the pipeline in the Nehalem

Basin provide habitat for OC coho, including the Nehalem River, Alder Creek, Rock Creek, North Fork Wolf Creek, Clear Creek, and Cedar Creek. In the Nehalem River watershed, the peak period of adult migration occurs between November and December. Juvenile outmigration peaks from March through mid-May, and rearing may occur year round.

The NMFS designated critical habitat for OC coho in February 2008 (NMFS, 2008c), which includes waterways, substrate, and adjacent riparian zones within the project area, up to the bankfull elevation. The pipeline would cross OC coho critical habitat in the Nehalem River watershed at Alder Creek (MP 31.4), Nehalem River (MP 33.5), Rock Creek (MP 41.0), tributaries to South Fork of Rock Creek (MP 42.3 and 42.7), Bear Creek (43.4), North Fork Wolf Creek (MP 47.6), Clear Creek (MP 50.5) Cedar Creek (MP 55.7), Rock Creek (MP 57.7), and Nehalem River (MP 63.8). The PCEs that are present in these waterbodies include nearshore marine rearing areas, and freshwater spawning, rearing, and migration areas.

Sockeye

The NMFS listed Snake River sockeye salmon as endangered in November 1991 (NMFS, 1991). The ESU includes all anadromous and residual sockeye salmon from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program.

Adult Snake River sockeye salmon typically migrate through the mainstem Columbia River near the proposed terminal and nearshore dredged material disposal areas between mid-May and early August (Gustafson et al., 1997; Good et al., 2005). Adults generally migrate quickly through the estuary in deepwater, largely using the shipping channels, on their way to upstream holding and spawning areas. Juveniles out-migrate primarily between April and June. Snake River sockeye probably spend part of their first year in the ocean in the Columbia River plume (NMFS, 2008d). With the exception of the mainstem Columbia River crossing, sockeye salmon do not occur in waterbodies that would be crossed by the pipeline.

The Columbia River is designated critical habitat (migratory corridor PCE) for the Snake River sockeye salmon ESU (58 FR 68543–68554). Critical habitat includes the adjacent riparian zone defined as those areas within 300 feet of the normal line of high water of a stream channel. The terminal and portions of the nearshore dredge disposal locations would be within the Snake River sockeye salmon ESU's critical habitat; however, with the exception of the Columbia River pipeline crossing (HDD crossing), the pipeline would not.

Steelhead

Lower Columbia River Steelhead

The NMFS listed the lower Columbia River steelhead trout as threatened in March 1998 (NMFS, 1998) and reaffirmed the status in 2005 (71 FR 834). The DPS occupies Columbia River tributaries between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River basin above Willamette Falls (which are included in the upper Willamette River DPS) and steelhead from the Little White Salmon and Big White Salmon Rivers, Washington (which are part of the Middle Columbia River DPS).

Lower Columbia River steelhead exhibit two distinct run timings: summer and winter (Myers et al., 2006). The majority of summer-run lower Columbia River steelhead DPS enter freshwater between May and October and spawning occurs between January and June, with peak spawning between late February and early April. Adult winter steelhead enter the lower Columbia River near the terminal and

dredged material disposal areas between December and May and spawn between February and June, with peak spawning from late April to early May (Myers et al., 2006).

Juvenile steelhead in this DPS generally smolt at 2 years of age. Downstream migration of both summer-run and winter-run steelhead through the lower Columbia River begins in March, peaks in April and May, and declines through July (Dawley et al., 1986). These smolts are large in comparison with ocean-type salmonids and move quickly downstream to the ocean. Therefore, they are expected to pass the terminal location quickly.

Burris Creek in Washington is listed as providing habitat for lower Columbia River DPS steelhead trout (Streamnet, 2014a). However, its connection to the Columbia River is blocked by a pump station, therefore, it is assumed that lower Columbia River steelhead are not present. The lower Columbia River Basin streams crossed by the pipeline in Oregon (the Clatskanie River, Merrill Creek, and their tributaries) provide habitat for the southwest Washington steelhead trout DPS (which is not listed under the ESA). Therefore, the lower Columbia River steelhead DPS would not likely occur in any of the waterbodies (with the exception of the Columbia River) that would be crossed by the pipeline.

The Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the lower Columbia River steelhead DPS (70 FR 52630–52858). The lateral extent of critical habitat for each designated stream reach is the width of the stream channel as defined by its bankfull elevation. Critical habitat includes the Columbia River within the terminal area; at the HDD pipeline crossing of the Columbia River, and small portions of the potential disposal areas at offshore locations off the mouth of the Columbia River, where Oregon LNG proposes to dispose of dredged materials. Critical habitat PCEs that are present in these areas include those related to adult and juvenile migration.

Middle Columbia River Steelhead

In March 1999, NMFS listed middle Columbia River steelhead trout as threatened under the ESA (NMFS, 1999c) and reaffirmed this listing in January 2006. This inland steelhead DPS occupies the Columbia River basin and tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon upstream to, and including, the Yakima River in Washington. Steelhead of the Snake River basin are excluded from this DPS.

Most of the adults migrate upstream through the Columbia River near the terminal and dredge disposal areas from mid-April through October, with a peak in abundance from mid-July through early September. In addition, there are several populations that have later runs, which enter freshwater in August and continue in the lower Columbia River through October or November. The winter run to the Klickitat River and Fifteenmile Creek enters freshwater in January. On the basis of this information, it appears that at least some adult fish from this DPS would occur in the vicinity of the terminal and nearshore dredged material disposal areas from April through January, with the main peak from mid-July to mid-September (see table 4.1.8-4).

Juvenile downstream migration occurs through the lower Columbia River from late March through June, with peak abundance occurring from late April through mid-May. Use of the terminal area is expected to be very limited, with the large stream-type fish migrating rapidly past the proposed berth and turning basin. With the exception of the Columbia River, middle Columbia River steelhead do not occur in waterbodies that would be crossed by the pipeline.

The Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the middle Columbia River steelhead DPS (70 FR 52630–52858), as well as offshore locations off the mouth of the Columbia River, where Oregon LNG proposes to dispose of dredged materials. The lateral extent

of critical habitat for each designated stream reach is the width of the stream channel as defined by its bankfull elevation.

Snake River Basin Steelhead

The NMFS listed Snake River Basin steelhead trout as threatened in August 1997 under the ESA (NMFS, 1997a) and reaffirmed this status in January 2005 (NMFS, 2006c). This inland steelhead DPS occupies the Snake River basin of southeast Washington, northeast Oregon, and northwest Idaho and migrates through the Columbia River to the Pacific Ocean.

Snake River steelhead enter the Columbia River near the terminal and dredged material disposal area from June to October (Good et al., 2005; Busby et al., 1996) and spawn during the following spring from March to May. Peak migration generally occurs from mid-July to mid-September (NMFS, 1997a).

Summer steelhead juveniles occur in the proposed terminal and dredged material disposal areas from March through June, with a peak in April and May. Because of the distance traveled, however, this ESU would be expected to occur in these areas during the latter part of this interval and also to extend into July. Only yearling fish use the lower Columbia River estuary (Fresh et al., 2005), and rearing is expected to be minimal. Snake River steelhead do not occur in waterbodies that would be crossed by the pipeline, except at the Columbia River pipeline crossing.

The Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the Snake River Basin steelhead DPS (70 FR 52630–52858), and the terminal and HDD crossing of the Columbia River would be in critical habitat. The lateral extent of critical habitat for each designated stream reach is the width of the stream channel as defined by its bankfull elevation.

Upper Columbia River Steelhead

In January 2006, NMFS downlisted upper Columbia River steelhead trout from endangered to threatened status (NMFS, 2006c). This inland steelhead DPS occupies the Columbia River basin upstream from the Yakima River, Washington, to the U.S./Canadian border. The principal tributary rivers include the Wenatchee, Entiat, Okanogan, and Methow Rivers.

Adults typically move upstream past the terminal area from June through October and overwinter in the mainstem Columbia River reservoirs. Based on passage data at McNary Dam, juvenile upper Columbia River steelhead typically migrate downstream between April and June, peaking in late April (Fish Passage Center, 2008). Because Upper Columbia Basin steelhead trout smolts rear in the streams and small rivers where emergence occurs, they do not spend substantial time rearing in the lower Columbia River. These fish probably pass Bonneville Dam between mid-May and late June and are expected to pass through the terminal area soon after. Only yearling fish are currently present in the lower Columbia River estuary (Fresh et al., 2005), and rearing is expected to be minimal.

The Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the upper Columbia River steelhead DPS (70 FR 52630), including the terminal and HDD crossing of the Columbia River. The lateral extent of critical habitat for each designated stream reach is the width of the stream channel as defined by its bankfull elevation.

Upper Willamette River Steelhead

The NMFS listed the upper Willamette River steelhead DPS as threatened in March 1999, and reaffirmed this status in January 2006 (71 FR 834) (NMFS, 1999c and 2006c). This DPS includes all

naturally spawned anadromous populations below natural and manmade barriers in the Willamette River and its tributaries in Oregon upstream from Willamette Falls to the Calapooia River.

Upper Willamette River steelhead adults enter the Willamette River beginning in January and February, but they do not ascend to their spawning areas until late March or April through mid-May (Myers et al., 2006). Based on this timing, and ODFW timing tables for winter steelhead in the lower Columbia River (ODFW, 2003), adults from this DPS would be expected in the terminal area from November through April, with a peak from December through March. Wild steelhead smolt out-migration starts in March, peaks in May, and is essentially complete by mid-July (Domina; 1997, 1998, as cited in CH2MHILL, 2013e). ODFW (2003) indicates that juvenile winter steelhead migration occurs in the lower Columbia River from March through June, with a peak in April and May. However, based on other data (Domina, 1997, 1998 as cited in CH2MHILL, 2013e; Fresh et al., 2005), significant juvenile rearing would not likely take place in the estuary and juvenile presence is likely limited to the downstream migration for upper Willamette River steelhead. Steelhead from the upper Willamette River DPS do not occur in streams crossed by the pipeline, except at the HDD crossing of the Columbia River.

The Columbia River is designated critical habitat (rearing and migratory corridor PCEs) for the upper Willamette River steelhead DPS (70 FR 52630–52858). The terminal would be within critical habitat of the Columbia River and the pipeline would cross critical habitat only at the Columbia River crossing.

Pacific Eulachon

NMFS listed eulachon (Columbia River smelt) as federally threatened in 2010 (NMFS, 2010). In addition, they are also an Oregon Conservation Strategy (OCS) species and a candidate for listing in the State of Washington.

Eulachon are small fish up to 12 inches in length that are swept out to sea as larvae and return to spawn at age 3 to 5. During spawning, they release eggs over sandy river bottoms. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine and ocean currents. Juveniles are reported to rear in nearshore marine waters (WDFW, 2004; WDFW and ODFW, 2001). Little to no feeding occurs in freshwater during migration to and from spawning grounds (Smith and Saalfeld, 1955, *as cited in* NWPCC 2004; Willson et al. 2006; WDFW and ODFW, 2001).

Eulachon adults and larvae occur in the vicinity of the proposed terminal during migrations through the Columbia River. No spawning habitat occurs within the vicinity of the terminal or dredge disposal area as eggs are unable to survive salinities above 16 parts per thousand (ppt) (Willson et al., 2006). In the Columbia River, upstream migration and spawning are reported to occur from December through May, with a peak in February and March (see table 4.1.8-5). However, sampling at Price Island and Three Tree Point (RM 34.8 and 30.2) suggested that spawning may occur as early as November. While timing of upstream migrations varies based on river conditions such as temperature and flow (NMFS, 2011b), we expect eulachon are likely to be present in the terminal area during the in-water work window (November 1 through February 28).

Major spawning runs occur on the Lower Columbia and Cowlitz Rivers, with occasional runs in the Grays, Skamokawa, Elochoman, Kalama, Lewis, and Sandy Rivers (WDFW, 2004; WDFW and ODFW, 2001). Adult eulachon spawn in the mainstem Columbia River well upstream of the terminal area, between RMs 35 to 75 with primary spawning aggregations upstream of RM 56.0. Their larval offspring drift downstream past the terminal location after hatching (Romano et al., 2002; ODFW and WDFW, 2002). No spawning runs have been documented in any of the waterbodies that would be crossed by the pipeline.

Table 4.1.8-5

Timing of Peak Green Sturgeon, Eulachon and Juvenile Salmonid Abundance

Species	Presence	Peak Abundance	Peak Abundance During Proposed Dredging (June – September)
Chum [a]	Mid-January to mid-July	Mid-April to mid-May	No overlap
Coho [a]	Year-round	April-June	Partial overlap
Yearling Chinook [a]	Year-round	April-June	Partial overlap
Subyearling Chinook [a]	Year-round	May-July	Partial overlap
Sockeye salmon [a]	Limited data	May	No overlap
Steelhead [a]	Year-round	Late-May to mid-June	Partial overlap
Green sturgeon [b]	May-October	August	Partial overlap
Eulachon [c]	November-June	February–May	No overlap

[a] Carter et al., 2009
[b] Lindley et al., 2011
[c] NMFS, 2012

NMFS designated critical habitat for eulachon in 2011 (76 FR 65324). The Columbia River mainstem is included in critical habitat, and thus the terminal, small portions of two of the potential disposal locations, and the Columbia River pipeline crossing would all be within the boundaries of eulachon critical habitat. The lateral extent of critical habitat is to the OHW line. Critical habitat PCEs that are present in the terminal area include estuarine rearing and migration habitat, while nearshore dredge disposal locations contain nearshore marine foraging habitat PCEs. The proposed Columbia River pipeline crossing contains freshwater migration habitat, and may contain freshwater spawning and incubation habitat.

North American Green Sturgeon

Green sturgeon are anadromous and occur along the west coast of the United States and Canada (Erickson and Hightower, 2007). Based on spawning locations, NMFS designated two DPSs for the North American green sturgeon: the Southern DPS and the Northern DPS. The Northern DPS, a federal "species of concern", spawns in the Rogue, Klamath, Trinity, and Eel Rivers in Oregon and California. The Southern DPS, designated as federally-threatened, only spawns in the Sacramento River in California. Tagging studies indicate that both the Northern and Southern DPSs occur within the lower Columbia River estuary and that their use of the terminal area is similar (Adams et al., 2002).

The Southern DPS of green sturgeon spawn in central California from March to July, with peak activity from mid-April to mid-June (NMFS, 2008e). Juveniles rear in their natal streams and estuaries and do not appear to be able to make the transformation to saltwater until about age 1.5 years, but usually enter saltwater at age 3 (NMFS, 2008e). After entering the ocean, many green sturgeon (which are then termed subadults) migrate north and concentrate in coastal estuaries, particularly the Columbia River estuary and coastal Washington estuaries, in late summer and fall. In estuaries, adults and subadults tend to concentrate in deep areas with soft bottoms, although they may move into intertidal areas to feed during high tides (Dumbauld et al., 2008). Adult and subadult green sturgeon are opportunistic carnivores that feed on crangonid shrimp, ghost shrimp, amphipods, clams, juvenile Dungeness crab, anchovies, sand lances, lingcod, and other fish species.

Moser and Lindley (2007) found green sturgeon in Willapa Bay when water temperatures were above 50 ºF. Green sturgeon would likely be found in the Columbia River estuary during the same period

of the year that they are found in Willapa Bay. In the lower Columbia River estuary, mean daily water temperature is above 50 ºF at Tansy Point from about mid-April through mid-November. Peak occurrence is likely in August and September (NMFS, 2009b). According to cumulative monthly commercial gillnet harvest data of white and green sturgeon for the lower Columbia River (conducted from 1981 to 2004), no green sturgeon were collected between RMs 1.0 and 20.0 over the 23-year period during the months of December and January (James, 2004). In November, the recorded number of green sturgeon captured over the 23-year period was 46, and in February the total number captured was 29. Therefore, we expect that a very low number of green sturgeon would be present during the November-February in-water work window for pile driving. Green sturgeon would be present during the proposed May-September dredging period.

On October 9, 2009, NMFS designated critical habitat for the Southern DPS of green sturgeon (74 FR 52300-52351). Critical habitat includes: (1) nearshore coastal marine areas, (2) freshwater riverine habitats, and (3) coastal bays and estuaries. The nearshore coastal marine area includes all U.S. marine waters out to the 360.9-foot depth bathymetry line (relative to MLLW) from Monterey Bay, California, north and east to include waters in the Straight of Juan de Fuca, Washington. The portion of the project area defined by the deepwater dredge disposal areas is included in this designation. The Lower Columbia River and estuary is also included up to RM 46. The PCEs present in the project area include coastal marine PCEs and estuarine PCEs (at the terminal location, nearshore dredge disposal sites, and in tidally influenced portions of the Lewis and Clark River). PCEs for nearshore coastal marine areas include sufficient migratory corridors, water quality, and food resources. The estuarine PCEs include food resources, water flow, depth, and quality, sediment quality, and migratory corridor.

Impacts and Mitigation

The effects of the project on listed fish species are discussed collectively in the following subsections because many of listed fish share similar life history traits and would be affected by the project in similar ways.

Terminal Construction

Impacts on aquatic resources due to the construction and operation of the LNG terminal are described in detail in section 4.1.5.2. The threatened and endangered fish species described above would be affected by terminal construction and operation in similar ways to those previously described, but may be particularly vulnerable to the direct and indirect effects of LNG terminal construction from dredging, dredged material disposal, construction of the pier and access trestle, and construction of onshore facilities. Therefore, a more in-depth analysis of species-specific effects on federally listed fish is presented by topic below.

Dredging

Oregon LNG would dredge the turning basin during construction of the terminal and during maintenance every 3 years.

The impacts on aquatic resources from dredging of the berth and turning basin described in section 4.1.5.2 would also apply to federally listed fish species, with the exception of OC coho, which are unlikely to occupy portions of the Columbia River near the proposed terminal. Potential effects on listed fish would include direct mortality, increased turbidity and suspended sediment, hydrology and salinity modifications, food web effects, and dredge noise. The potential for effects on federally listed fish in the lower Columbia River estuary is dependent upon species timing and overlap with the proposed June through September dredging window (see table 4.1.8-5).

As indicated in table 4.1.8-5, all salmonid species are more abundant during the first portion (primarily June) of the proposed dredge window than they are during the WDFW- and ODFW-approved in-water work period for the Columbia River (November through February). Likewise, green sturgeon are present during the proposed spring/summer dredge window and absent during the standard winter work window. However, juvenile salmonid presence during the last 3 months of the proposed dredging period would not be much greater than during the in-water work window. Further, the proposed June to September dredge period would avoid the bulk of eulachon (adult and juvenile) migrating through the estuary, while the standard winter window overlaps peak eulachon migration. In addition, adult salmon and steelhead may migrate upstream through the lower Columbia River estuary in small numbers year-round, with peak migration from early spring to fall. Therefore, the proposed June through September dredging period would encounter more adult salmonids than the standard winter window. A more detailed analysis of the effects of dredging from June through September, by listed group of fish, is presented below.

Salmonids

Several entrainment studies have been conducted in the lower Columbia River to evaluate the effects of dredging on anadromous salmonids. During a 4-year study on the entrainment of fish during dredging operations, Larson and Moehl (1990 as reported in Reine et al., 1998) reported that no juvenile or adult salmonids were collected even though other pelagic fish species were collected.

Dredging from June through September would likely have the potential to affect more juvenile salmonids than dredging during the WDFW- and ODFW-approved November 1 through February 28 work window. Although adult salmonids would be present during summer and fall dredging, they are strong swimmers that generally migrate mid-column, above the depths where dredging would occur and would not be susceptible either to entrainment during dredging or to burial during dredged material discharge (NMFS, 2012). The Biological Opinion for dredging of the navigation channel during the same months as this project, states that "NMFS is confident any potential for adult fish to be entrained or buried by the dredges is discountable" (NMFS, 2012).

Juvenile salmonids (smolts and subyearling fish) would be present during summer and fall dredging, primarily during June. Outmigrating smolts tend to occur over deeper channels (20 feet in depth and greater), while subyearlings occur primarily in side channels and especially in water 3 to 6 feet deep; although occasionally as deep as 20 feet (NMFS 2012, 2005a). Because terminal dredging would occur in water greater than 20 feet deep, the likelihood is low that subyearling salmonids (primarily Chinook and chum) would be present. Further, according to NMFS (2012), the highest density of juvenile salmonids in shallow-water habitats is in the spring, and the lowest densities occur in the summer and fall. Proposed dredging primarily in summer and fall (June through September) further reduces the likelihood of subyearling entrainment.

Migrating smolts can be found at depths over 30 feet but are generally higher in the water column, with migrating steelhead being found at shallower depths than migrating Chinook (NMFS, 2012). During an entrainment study conducted in the lower Columbia River, Larson and Moehl (1990, as reported in Reine et al., 1998) found that juvenile salmonids were not measurably entrained during hydraulic dredging. NMFS (2012) concluded that "the potential number of smolts entrained by [channel maintenance] dredging operations is likely to be very small in any one year but over the time period of this consultation (50 years) the potential for entrainment of a small number of smolts cannot be discounted." Although they concluded that a small number of smolts may be entrained, NMFS found that due to the "small number of smolts that are likely to be entrained or buried…the proposed action will not cause appreciable reductions in population abundance or productivity for any of the affected salmon or

steelhead species." If clamshell dredging is used, direct harm would be highly unlikely because juvenile salmonids in the size range expected to occur in the dredge area would be able to avoid the clamshell bucket (USACE, 2001).

Initial dredging for the proposed import/export terminal would be conducted over a 4-month period, and maintenance dredging would occur once every 3 years. Dredging for the turning basin will occur over 135 acres in water 20 to 40 feet deep. These depths are consistent with the preferred juvenile (yearling) migration habitat assumed by NMFS (2012). This area represents 0.6 percent of the preferred migration habitat (23,521 acres) from RM 3 to RM 25.2 (representing the first channel navigation segment of the Columbia River from the mouth through Miller Sands). Thus the potential for juvenile salmonid entrainment is far less than the "very small" number of salmonids expected to be entrained during any one year of channel maintenance.

Because dredging would occur over such a small percentage of the available migration area for at most only part of the time active migration is occurring, the conclusions of NMFS (2012) also apply to this project – namely that dredging would have no appreciable effect on salmonid populations. Dredging would occur in relatively deep areas and, therefore, generally avoid areas where listed subyearling salmonids typically occur. Oregon LNG would implement the mitigation measures presented in section 4.1.5.2 to minimize dredging effects on listed fish.

Eulachon

Summer and fall dredging would significantly reduce the overlap of dredging and eulachon migration. No adult eulachon would be susceptible to entrainment and only late outmigrating larvae would be susceptible to entrainment in June. Marko (2008) found eulachon larvae in the estuary near the proposed berth and turning basin from December to May, but the vast majority of the larvae had migrated out by the end of April. Peak larval eulachon density typically occurs in March (Marko, 2008), 3 months before the proposed dredge period. Because of the wide dispersal (vertical and horizontal) of larval eulachon in the estuary, the number of larval eulachon entrained by dredging is expected to be a very small percentage of the total larval eulachon in the lower Columbia River estuary. This, combined with the high natural mortality of larval fishes, indicates that the effect of larval entrainment on adult recruitment would be insignificant.

Green Sturgeon

Recent tagging studies in the Columbia River have shown that green sturgeon range in size from 35 inches fork length to about 55 inches fork length with an average length of 52 inches fork length (Woodbury, 2012). Such large fish (adults and subadults) should be able to escape dredge entrainment. Therefore, we conclude that any green sturgeon, if present in the terminal area, would not be susceptible to entrainment.

Dredged Material Disposal

As described in section 2.1.1.1, Oregon LNG would dispose of dredged material in an existing, approved, and fully permitted disposal area off the mouth of the Columbia River known as the Deepwater Site. The Deepwater Site has undergone extensive evaluation and review regarding its potential effects on listed species. During the permitting process, the USACE examined the potential effects of disposal, including burial of benthic invertebrates, negative effects on water quality (both from resuspension of contaminants and high suspended solids), and noise and disturbance from disposal activity. The analysis concluded that benthic food organisms would quickly recolonize the dredged material, and the reduction of available food would be inconsequential. The dredged material consists of uncontaminated sand with

little silt material, and thus would not resuspend contaminants or clog fish gills. Therefore, dredge disposal would not likely result in adverse effects on growth or survival of listed fish.

During its consultation for ongoing Columbia River navigation channel maintenance, NMFS (2012) conducted an analysis of likely effects on juvenile salmonids, eulachon and green sturgeon at the dredged material disposal site. It concluded that negative effects from disposal offshore at the Deepwater Site were unlikely for the following reasons:

- smolts were found primarily in the upper 40 feet of the water column, while the disposal location was 190 to 300 feet deep;
- although adult eulachon and green sturgeon are often found in deeper water, they should be able to avoid a disposal plume;
- the site was 6 miles offshore, a distance from the mouth at which smolts were expected to be widely dispersed;
- the 5 square nautical mile disposal area was a tiny fraction of the available habitat; and
- the depth of the water would allow any fish encountering the disposal plume to move out of the plume before burial.

Based on these conclusions, we conclude that use of the existing Deepwater Site would not cause adverse, long-term effects that would affect the survival and/or recovery of federally listed species or their critical habitat.

Construction of the Pier and Access Trestle

Acoustic Effects of Pile Driving

As described in section 2.1.1.1, pile driving would be required to install piles for the terminal platform, access trestle, and breasting and mooring dolphins. Pile driving would occur during the WDFW- and ODFW-approved in-water work window for the Columbia River (November 1 through February 28). Oregon LNG's pile driving would create underwater noise, which would have adverse effects on listed fish. Some subyearling Chinook salmon would be present in shallow water areas near the terminal site during the in-water work window. In addition, upper Willamette River, lower Columbia River, and middle Columbia River steelhead adults would be present during the entire in-water work window, along with some chum salmon, and native late-season lower Columbia River coho returning to the Clackamas and Sandy Rivers. While it is possible that some very early-arriving Snake River spring/summer and upper Willamette River Chinook would be present, their numbers would likely be very low. Likewise, adult chum salmon, because their spawning streams are primarily along the Washington side of the river, would be homing to these streams and very few would likely be present in the vicinity of pile driving on the Oregon shoreline. Thus, effects on adult salmonids would be likely confined to the late-returning component of lower Columbia River coho, and upper Willamette River, lower Columbia River, and middle Columbia River steelhead.

Because of the low densities of juvenile salmonids during the November through February in-water work period, the fact that sound attenuates more rapidly in shallow water than in deepwater (Rogers and Cox, 1988), and the proposed mitigation techniques (see section 4.1.5.2), few juvenile salmonids should be affected by pile driving noise. Oregon LNG estimated the level of take of federally listed salmonids as a result of pile driving (CH2M HILL, 2009). Results are summarized in table 4.1.8-6.

Table 4.1.8-6

Juvenile Salmonids Potentially Affected by Pile Driving Noise

Nature of Effect	Noise Threshold	Fish Within the Zones of Impact per Month				Annual Total
		November	December	January	February	
Acute harm	206 dB peak	0.2	0.1	<0.1	1.1	1.3
Cumulative harm (fish > 2 grams)	187 dB SEL	76.9	46.2	NA	NA	123.1
Cumulative harm (fish < 2 grams)	183 dB SEL	NA	NA	23.1	821.3	844.5
Project Total						**968**

The vast majority (85 percent) of the impacts would occur in February. Although 968 fish would potentially be present within the worst-case scenario harm zones (183- and 187-dB levels), it is unlikely that any given fish would actually experience the full duration of pile driving on any 1 day. This is due to two factors.

- The piles would be driven over a maximum period of 9 to 10 daylight hours each day. During this time, the tide would rise and fall with the 6-hour tidal cycle, and fish would move with the rising and falling tide. This daily tidal migration would move any given fish into and out of the "harm" zone during the period when piles are being driven, thus reducing cumulative exposure to noise over time.
- A large number of the piles (about one-fifth) would be in the intertidal zone, and would be out of the water during low tides. Some of these piles would be driven during low and receding tides, thus reducing sound propagation through the water.

Because 85 percent of salmonids are present in February (see table 4.1.8-6), Oregon LNG would make all reasonable attempts to complete pile driving between November 1 and January 31. As construction progresses, the likelihood of completing pile driving during that period would be assessed in early January. If pile driving cannot be completed within one in-water work window, pile driving would cease on January 31 and resume during the in-water work period of the following year. By eliminating or substantially reducing the amount of pile driving in February, this mitigation measure would reduce effects on lower Columbia River subyearling Chinook by 50 to 85 percent. In shallow water, piles would be completely isolated within a dewatered cofferdam, when feasible. Based on this information, beginning pile driving in shallow water habitat (i.e., areas less than 6 feet deep) would further minimize the potential effect of pile driving on juvenile salmonids less than 2 grams.

Because the timing and approach for driving of individual piles could minimize impacts on threatened and endangered species, **we recommend that**

- **Prior to terminal construction, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, its final pile-driving plan, including a schedule for pile driving.**

Adult fish are likely affected much less by pile-driving noise than juveniles because of their larger size. In previous consultations, NMFS has been primarily concerned with noise effects on juvenile salmonids and has discussed negative effects on adult salmonids little, if at all (NMFS 2009a,b; NMFS, 2004). It is assumed that adult fish would be moving steadily upstream past the terminal, rather than holding near pile-driving operations. This is supported by the NMFS finding that, in areas with no habitat features to attract adult salmon to the construction area, they are likely to move through the area quickly

rather than hold near pile-driving operations (NMFS, 2009b). Therefore, it is appropriate to use the NMFS moving fish calculator to estimate negative effects.

Adult salmonid upstream migration speed has been reported in the range of 1.0 to 5.9 feet per second (Tanaka et al., 2001, Salinger and Anderson, 2006). At a swim speed of 2.6 feet per second, the NMFS calculator for moving fish, (assuming 1.5 seconds between hammer strikes, and eight piles driven per day), reports that fish would need to move within 4.9 feet of the piles before they experienced the accumulated 187 dB re: 1 μPa2 sec SEL threshold for harm (see table 4.1.5-4), and within 3.3 feet to experience the instantaneous limit of 206 dB_{PEAK}. At swimming speeds of 1.0 foot per second the fish would need to pass within 13.1 feet of the piles to experience cumulative sound pressures above 187 dB re: 1 μPa2 sec SEL. Because of the construction activity around the piles, adult salmonids are not likely to pass within either 4.9 or 13.1 feet of pile-driving activities. Therefore, it is expected that the negative effects on adult federally listed salmonids would be discountable on both the individual and population scale.

The injury and disturbance noise thresholds described above are currently applicable to all fish species. Therefore, the effects of sound on eulachon would be the same as those described above for salmonids over 2 grams in size. However, because eulachon lack a swim bladder (Carlson and Johnson, 2010), they may be less vulnerable to injury due to noise compared to fish with a swim bladder (e.g., salmon). Adult eulachon would be present during pile driving and, therefore, would be exposed to underwater sound pressure levels that could cause damage to auditory receptors or swim bladders. If they migrate through harm or harassment zones (see table 4.1.8-6**)**, behavioral changes resulting from increased noise in the vicinity of the terminal would include avoidance of the area, modification to or cessation of foraging, increased vulnerability to predation, and alterations of migratory routes.

Based on the extremely low number of documented occurrences of green sturgeon in the lower 20 river miles of the Columbia River during the winter work window, it is highly unlikely that individuals would be present in acoustic harm zones during pile installation or other in-water construction activities. Considering the relative lack of spatial and temporal overlap of the majority of individuals in the terminal area, the risks to green sturgeon from increased noise would likely be low. Further, sturgeon have ducted swim bladders. Hastings and Popper (2009) noted that fish with ducted swim bladders may be able to respond to other types of sound with longer rise and/or fall times that would allow them more time to respond to the change in pressure by releasing air from the swim bladder.

Mitigation measures for pile driving are described in section 4.1.5.2.

Effects of Pier and Trestle Construction on Critical Habitat

Construction of the pier and access trestle would also affect the following salmonid critical habitat PCEs, which will be described in detail in the BA prepared for the project:

- estuarine rearing, by removing forage species and affecting water quality (through temporary sedimentation and potential hazardous materials release); and
- estuarine rearing areas, by removal of estuarine wetlands along the shoreline and replacement of shoreline habitat with industrial development.

Green sturgeon critical habitat PCEs would be largely unaffected, although some green sturgeon food resources may be removed by piling installation and potentially dredging. Eulachon critical habitat PCEs would not be affected to any appreciable degree because adult eulachon do not typically feed during spawning migrations.

Construction of Onshore Terminal Facilities

Impacts described in section 4.1.5.2, including water use for hydrostatic testing, loss of estuarine habitat, hazardous material release, surface water runoff, and construction lighting, may also affect federally listed fish species that occur in the lower Columbia River. Oregon LNG modified the footprint of the onshore facilities several times during conceptual design to avoid and minimize effects on important estuarine habitat. The proposed footprint maintains existing intertidal mudflat habitat and minimizes degradation (through loss of habitat) of high and low marsh habitats to the extent practicable.

During hydrostatic testing of the LNG storage tanks, Oregon LNG would employ the following conservation measures to minimize negative effects on federally listed fish.

- Screen water intake structure in accordance with NMFS intake screen criteria for avoidance of entrainment of juvenile salmonids. Screening criteria include screen openings that do not exceed 0.07 inches in the narrow direction, and appropriate screen areas to allow for approach velocities that do not exceed 0.4 feet per second.
- Maintain the intake depth in the middle of the water column to minimize turbidity and prevent disturbance of the waterbody substrate.
- Maintain adequate stream flow rates to protect aquatic life, provide for waterbody uses, and downstream withdrawals of water by existing users.
- Discharge test water through the POTW and avoid the use of additives.

We conclude that adverse effects on federally listed fish due to hydrostatic testing at the terminal would not be significant.

To limit any adverse effects from hazardous material release and surface water runoff, Oregon LNG would implement its SWPPP and Spill Prevention, Control, and Countermeasures Plan (see appendix F1) to ensure that proper controls would be in place to prevent contaminants from reaching the estuary.

Concrete would be used during construction of the onshore LNG storage tanks for soil improvement, but runoff would be contained with silt fences, straw bales, and other stormwater control devices. Oregon LNG would not pour concrete during storms or extreme high tides. In all cases, Oregon LNG would wash concrete equipment on upland areas away from drainage features and no concrete or runoff would be allowed to enter the lower Columbia River estuary.

Oregon LNG would conduct construction activities during daylight hours, so construction lighting would be minimal. Measures Oregon LNG would implement to minimize the potential for construction lighting effects on fish resources are described in section 4.1.5.2. Construction vessel noise is not anticipated to adversely affect listed fish species. Fish would likely perceive noise from construction tugs and barges, as noises would exceed fish disturbance criteria ($150dB_{RMS}$) in close proximity to the vessels; however, construction vessels would not produce noises that exceed underwater acoustic injury levels for fish.

Terminal Operation

As described in section 4.1.5.2, LNG marine carrier operations, maintenance dredging, and various ongoing facility operations may affect aquatic resources. If present, federally listed fish may be exposed to adverse impacts from these three general operational activities.

LNG Marine Carrier Operations

The movement and operation of LNG marine carriers would affect federally listed fish through entrainment/impingement in cooling and ballast systems, cooling water discharges, exotic species introduction, and potential LNG spills, as described in section 4.1.5.2. As discussed in section 4.1.5.2, Oregon LNG analyzed the potential for bank erosion and fish stranding from ship wakes. Based on this analysis, which considered the low vessel speeds of LNG marine carriers as they traverse the lower Columbia River estuary on their way to the terminal, we conclude that the potential for significant bank erosion is low. Similarly, based on low vessel speeds combined with a lack of shallow-sloping shorelines or reported fish strandings in the vicinity of the project area, we do not expect that fish stranding would occur as a result of increased ship traffic associated with this project.

Cooling water discharged from LNG marine carriers would not be expected to impede migratory behavior of salmonids. Subyearling salmonid fry (Chinook and chum salmon in the lower Columbia River estuary) would potentially be most susceptible to increased water temperatures because they have less swimming ability and, therefore, would be somewhat less able to seek out water within their preferred temperature range. However, fry are unlikely to be present in the location of the discharge plume because they tend to be associated with shallow water (usually less than 10 feet in depth) and prefer peripheral shoreline areas, wetlands/marshes, and shallow, protected sand flats or mudflats (Nightingale and Simenstad, 2001; NMFS, 2002b; Fresh et al., 2003). Both adult and juvenile salmonids are highly mobile and actively seek out optimal water temperatures (Sauter et al., 2001).

Based on water temperature and diffusion modeling information provided by Oregon LNG (CH2M HILL, 2008) the thermal plume generated by the proposed project would be very limited in size, rapidly dissipate within the mixing zone (within a maximum of 2 minutes following discharge), and be completely diffused within a maximum of 67.9 feet of the LNG marine carrier discharge port and to a maximum depth of 19.7 feet. This results in a thermal plume occupying much less than 1 percent of the total cross-sectional area of the Columbia River. As a result, we conclude that the localized temperature increases caused by the proposed cooling water discharge would not negatively affect migrating or rearing salmonids. We expect that any salmonids present within the mixing zone would experience a gradual continuum of increasing temperature as they approached the berth rather than an abrupt thermal change. Because adult eulachon and larval eulachon are present only during winter and early spring when water temperatures are cold, it is unlikely that they would be affected by the water discharges. The last of outmigrating larval eulachon would potentially move downstream past the terminal in mid to late May; however, as presented above, we conclude that the thermal increases would dissipate quickly and should therefore not affect individuals.

Entrainment/Impingement

LNG marine carrier cooling water and ballast water intake would entrain federally listed fish if present while the vessel is docked at the berth and those fish are at the same strata as the sea chests. Oregon LNG conducted an analysis of entrainment potential (Ellis Ecological Services, 2009), described in section 4.1.5.2.

Adult salmon would not be susceptible to entrainment due to their relatively large size and good swimming ability during estuarine migration. There is little evidence that suggests juvenile salmonids are susceptible to entrainment during ballast and cooling water withdrawal (Ruiz and Hines, 1997 and 2000; Wonham et al., 2000). Regardless, Oregon LNG estimated the potential number of individual fish that would be entrained from each listed ESU or DPS, assuming no screening is provided at the vessel sea chests. It should be noted that Oregon LNG conducted the analysis for an import-only terminal, which would have had 100 import ships annually, as opposed to the current estimate of two import ships

annually. Therefore, the potential for salmonid entrainment with an import/export terminal is far less than it would be for an import terminal, and would have essentially no effect on salmonid populations.

For import-only operations, entrainment estimates for salmonids were based on NMFS' seasonal salmonid abundance estimates at Tongue Point (near RM 18), juvenile salmonid swimming abilities, calculated intake velocities at the sea chests, and the information available on salmonid behavior and distribution within the lower Columbia River estuary. Adult salmon would be able to avoid entrainment/impingement because of their swimming ability. Based on Oregon LNG's analysis, the largest number of individual fish potentially entrained of any ESU is lower Columbia River Chinook, with about 14 juveniles entrained per year. The largest impact on any particular ESU (on a percentage basis) would be to Snake River fall Chinook, with a potential entrainment of 0.56 individuals annually for 0.00004 percent of the population. When converted to adult equivalents using Smolt to Adult Return (SAR) ratios from various hatcheries included in the ESUs (Skalski and Townsend, 2005), entrainment due to ballast water withdrawal is responsible for the loss of much less than one adult from all ESUs. Again, Oregon LNG's analysis was based on an import-only facility, and the entrainment estimates are therefore very conservative.

Based on Oregon LNG's entrainment analysis, we conclude that the total number of listed salmonids that would be entrained is discountable, due, in large part, to the size of the lower Columbia River estuary at the terminal location. Because the amount of available habitat near the terminal is so large, the density of juvenile salmonids on any given hour when the ships are at berth would be very low.

Because of their size during residency in the lower Columbia River estuary, and their preference for bottom habitats, green sturgeon would not be susceptible to entrainment/impingement.

Adult eulachon would be able to avoid entrainment/impingement because of their swimming ability. Likewise, eggs are not expected in the terminal portion of the project area because of their low salinity tolerance. Therefore, the only potential for entrainment/impingement is of larval eulachon. Based on seasonal fish larval abundance estimates for the lower Columbia River estuary (Marko, 2008), and average import and export vessel cooling water requirements, Oregon LNG estimated that 1,225,920 larval eulachon would be entrained annually during a period of peak eulachon abundance (see appendix C of Oregon LNG's Conceptual Mitigation Plan, appendix F3). The entrainment of 1,225,920 larval eulachon appears to be a large number; however, in general, only a small percentage of newly hatched eggs and larvae survive to adulthood and natural mortality for larvae can be as high as 96 percent (Comyns, 2003 as cited in CH2M HILL, 2013e).

Oregon LNG's entrainment model findings suggest that entrainment of eulachon larvae would not be meaningful at the population scale (see appendix C of Oregon LNG's Conceptual Mitigation Plan, appendix F3). WDFW and ODFW (2001) report that a female eulachon produces from 7,000 to 31,000 eggs, while Pederson et al. (1995) reported a range of 3,200 to 48,000 with a mean of approximately 23,000. According to Willson et al. (2006), egg to larval survival has been estimated to be from less than 1 percent to 4.8 percent. If each female eulachon is assumed to produce 23,000 eggs, and that egg to larval survival is 2.9 percent (the combined percentage survival in the Kemano and Wahoo rivers reported in Lewis et al., 2002 as cited in CH2M HILL, 2013e), that amounts to 667 larval eulachon produced per female. Thus, removing 1,225,920 larval eulachon would be the equivalent of removing the reproductive output of 1,837 female eulachon.

To put a "lethal take" of 1,837 adult female eulachon in perspective, the estimated bycatch of eulachon (number of individual fish) in all U.S. West Coast fisheries was 929,848 in 2009 or 0.2 percent as compared to the bycatch; and 1,075,102 in 2010 or 0.17 percent as compared to the bycatch (Al-Humaidhi et al., 2012).

In summary, based on Oregon LNG's analysis, we conclude that entrainment of federally listed salmonids and eulachon may occur but not at a measurable level at the population scale. The effects of entrainment of federally listed fish species in ballast and cooling water would be further offset by the mitigation measures described in section 4.1.5.2.

Maintenance Dredging

As described in section 2.1.7, maintenance dredging would be required intermittently throughout the operational life of the facility (about 300,000 cubic yards every 3 years). Because of seasonal navigation concerns over the Columbia River bar, Oregon LNG would conduct maintenance dredging during the June through September window proposed for initial dredging.

Negative effects of maintenance dredging (temporary increases in turbidity and temporary removal of benthic and epibenthic organisms) on federally listed fish are expected to be similar in type to the effects of initial dredging but of shorter duration. Consequently, maintenance dredging would not be expected to result in significant negative effects on listed salmonids on a population level. Likewise, the effects of maintenance dredging on eulachon and green sturgeon are expected to be minor and of a short-term nature.

Terminal Facility Operations

Federally listed fish may be affected by other ongoing LNG terminal facility operational impacts and hazards that include: noise, artificial lighting from over-water and shore-side facilities, shading from over-water facilities, water withdrawals and discharges, potential spills of hazardous materials, and attraction of avian predators. The potential impacts of these operational elements are described in section 4.1.5.2, and would be similar for federally listed fish. However, species-specific responses are presented below for some elements.

As discussed in section 4.1.5, within the terminal area, artificial lighting resulting from construction or operation would likely only penetrate the upper few feet of the Columbia River. This penetration would vary based on the level of turbidity and suspended sediment, as well as the direction of the light source with respect to the water's surface.

Artificial lighting would affect the salmonid critical habitat PCE for estuarine migration by potentially increasing predation or altering salmonid behavior. Juvenile salmonids move vertically in the water column to maintain a constant light environment that maximizes foraging efficiency while minimizing detection by predators (Nightingale and Simenstad, 2001). Localized changes in light regime have been shown to affect fish species behavior in a variety of ways. However, much is still unknown about salmonid responses to light pollution and how they vary with the intensity, duration, and spectrum of light and also by species and developmental stage.

Increased predation on salmonids from shading would be unlikely because of the low abundance of large predatory fish in the lower Columbia River estuary, the height of the pier above the water, the overcast climate (which causes shadows to be less intense and more diffuse), the use of grated metal decking, the orientation of the trestle, and the location of the platform in deepwater habitat where densities of small juvenile salmonids would not be expected to be high. Because of the large amount of available habitat near the terminal, juvenile salmonids would not be restricted in their movements and, therefore, should be able to easily avoid shadows cast by the platform and access trestle without significantly altering individual movement, migration, or feeding behaviors. We conclude that only minor degradation of existing conditions with respect to shading would occur. Further, salmonid critical

habitat PCEs would be largely unaffected, with a small chance for effects on estuarine migration habitat through increased predation (although, as stated previously, increased predation would be very small).

Given the existing depths of the terminal location, it is likely that foraging sturgeon, if present during periods of operation or construction when lights are used, would be at depths greater than those affected by over-water lighting. Sturgeon that may be migrating near the surface may be prone to dive deeper; however, researchers have not reported any correlation between green sturgeon activities and the amount of ambient light (Kelly et al., 2007). Given the apparent diversity of depths that green sturgeon are known to occupy, it is unlikely that sturgeon would be affected to a level that would result in negative effects on individual fish.

Oregon LNG's proposed over-water operational lighting would likely result in effects on eulachon that are similar to those described above for salmonids. Although spawning would not occur in the vicinity of the terminal, migrating adults and outmigrating larvae may be subjected to increased levels of light during operations. Adults may alter their migratory pathway and swim deeper to avoid lights to avoid predation in the upper portion of the water column. Lighting may make larvae more susceptible to predation if present in illuminated areas, though studies conducted upstream of the terminal have shown that larvae are most dense in the middle and bottom portion of the water column (Howell et al., 2002). Therefore, we conclude that negative effects on eulachon due to lighting would be minor.

To minimize stormwater runoff from the terminal, Oregon LNG would limit the impervious surfaces to the maximum degree through conscientious site design. Conservation measures for the stormwater and fire suppression testing water include implementation of the SWPPP. Prior to any discharges, Oregon LNG would be required to obtain a NPDES stormwater discharge permit, which would include protective measures for federally listed fish species.

To prevent and mitigate spills of hazardous materials stored at the terminal, Oregon LNG would prepare a spill plan for operation of the terminal that would meet state and federal agency requirements. The risk of an LNG spill at the terminal is low due to secondary containment and other precautionary measures. Federally listed fish could be affected in the unlikely event of a LNG spill at the terminal if the spill reached the Columbia River or otherwise impacted habitat. However, these effects would be minor, localized, and short term.

Oregon LNG would implement measures described in section 4.1.5.2 to minimize potential for predation on juvenile salmonids and eulachon from avian predators. As such, we conclude that no individual federally listed or proposed fish or critical habitat PCEs are likely to be affected by increased avian predation.

Pipeline Construction

The effects on federally listed fish and their critical aquatic habitat from pipeline construction and operation are primarily related to waterbody crossings and associated construction activities necessary to bury the pipeline under and next to waterbodies. The effects described in section 4.1.5.2 would directly apply to listed fish and their habitat. Oregon LNG would construct the pipeline in several waterbodies that may contain federally listed fish, or within 0.1 mile of suitable habitat (see table 4.1.8-7). The distance of 0.1 mile is an estimate of the maximum distance that effects on listed fish would potentially occur downstream of crossing sites based on the proposed crossing methods.

Oregon LNG would cross all waterbodies that are flowing at the time of construction using either the flume or HDD method. The flume technique uses upstream and downstream dams to isolate the crossing area, and a flume (pipe or trough) is used to bypass the flowing water around the construction

area. A pump would be used in most cases to dry the work area between the dams following work area isolation, which would last for up to three days (maximum crossing time). HDD has the lowest potential for negative effect because this technique would not involve actions within the waterbody channel and near-channel riparian zone. The only significant effects associated with the HDD crossings would be those associated with an inadvertent release of drilling mud to the waterbody (see section 4.1.5.2 *Sedimentation and Turbidity*).

Table 4.1.8-7

Waterbody Crossings Where Federally Listed Fish May Be Present and Associated In-Water Work Periods

Milepost	Waterbody	ESA-Fish Present	Proposed Crossing Method	In-Water Work Period [a,b]	
				Start Date	End Date
Youngs Bay and Lower Columbia River Basins (Oregon)					
1.0	Adair Slough [c]	Coho	HDD	November 1	February 28
1.5	Vera Creek [d]	Coho	Flume	November 1	February 28
3.1	Lewis and Clark River [d]	Fall Chinook, winter steelhead, coho	HDD	November 1	February 28
4.5	Barrett Slough [d]	Coho	Flume	November 1	February 28
5.2	Lewis and Clark River [d]	Fall Chinook, winter steelhead, coho	HDD	November 1	February 28
5.7	Lewis and Clark River [d]	Fall Chinook, winter steelhead, coho	HDD	November 1	February 28
7.9	Heckard Creek	Coho	Flume	July 1	September 15
11.0	Lewis and Clark River	Fall Chinook, winter steelhead, coho	HDD	July 15	September 15
70.7	Clatskanie River	Chinook, coho	Flume	July 15	August 31
71.8	Little Clatskanie River	Coho	Flume	July 15	August 31
76.4	Merrill Creek	Coho	Flume	July 15	September 15
78.4	Tributary to Merrill Creek	Coho	Flume	July 15	September 15
81.6	Deep Island Slough	Chinook, coho	Flume	July 15	September 15
82.3	Columbia River	Fall, summer, spring Chinook, steelhead, coho, sockeye, chum	HDD	November 1	February 28
Northern Oregon Coastal Basin Rivers (Oregon)					
31.4	Alder Creek	Coho	Flume	July 1	September 15
33.5	Nehalem River	Spring and fall Chinook salmon, coho salmon, winter steelhead	HDD	July 1	August 31
41.0	Rock Creek	Coho and winter steelhead	HDD	July 1	August 31
43.1	South Fork Rock Creek	Coho	HDD	July 1	August 31
43.4	Bear Creek	Coho	HDD	July 1	August 31
47.6	North Fork Wolf Creek	Spring Chinook, coho, winter steelhead	Flume	July 1	August 31
50.5	Clear Creek	Coho	Flume	July 1	August 31
55.7	Cedar Creek	Coho	Flume	July 1	August 31
57.7	Rock Creek	Spring Chinook, winter steelhead, coho	HDD	July 1	August 31
63.8	Nehalem River	Spring and fall Chinook salmon, coho salmon, winter steelhead	HDD	July 1	August 31
Willamette Basin Rivers (Scappoose Creek Watershed, Oregon)					
73.0	Milton Creek	Winter steelhead, coho	Flume	July 15	September 15
74.9	Milton Creek	Winter steelhead, coho	Flume	July 15	September 15

Table 4.1.8-7

Waterbody Crossings Where Federally Listed Fish May Be Present and Associated In-Water Work Periods

Milepost	Waterbody	ESA-Fish Present	Proposed Crossing Method	In-Water Work Period [a,b] Start Date	End Date
Lower Columbia River (Washington)					
83.3	Burris Creek [e]	Winter steelhead, coho–Burris Creek connection to Columbia River blocked by pump station, ESA fish presence unlikely	Flume	August 1	August 31

[a] ODFW, 2008a.

[b] WDFW lists a general in-water work period of July 1 through September 30 for Cowlitz County (USACE, undated). WDFW's windows appear to be for ESA/salmon. Burris Creek is not listed. WSDOT lists the general Cowlitz County in-water work period as July 16 through September 30 and Burris Creek as August 1 through August 31 (WSDOT, 2010a). Oregon LNG would use the most restrictive dates, August 1 through 31, unless other dates were approved by WDFW.

[c] Oregon LNG would coordinate with ODFW to request an alternative in-water work period at this crossing.

[d] ODFW indicated in comments to earlier submittals that these streams and rivers are tidally influenced and, therefore, should be considered estuarine waters for the purposes of in-water work, hence the November 1 to February 28 work period. Were they not to be considered estuarine, the in-water work period would be July 15 to September 15.

[e] Several unnamed tributaries to Burris Creek are also reported to contain salmonids (Chinook and coho) (CH2M HILL 2013e).

Effects on Listed Salmonids

The pipeline would cross the Columbia River, which is occupied seasonally by multiple ESUs and DPSs of federally listed salmon and steelhead trout. However, because the crossing would be conducted using HDD methods, it should not negatively affect federally listed salmonids or salmonid habitat. At other pipeline crossings, the following construction-related activities and changes to existing conditions would potentially result in effects on lower Columbia River Chinook, upper Willamette River Chinook, lower Columbia River coho, OC coho, lower Columbia River steelhead, and upper Willamette River steelhead:

- fish salvage activities at waterbody crossings;
- physical habitat alteration;
- increases in turbidity and suspended sediments;
- impediments to fish passage;
- water withdrawals and discharges;
- contamination of surface waters as a result of hazardous materials releases; and
- cross contamination between waterbodies by fish or amphibian pathogens or by invasive species.

These activities and anticipated effects on aquatic species are described in section 4.1.5.2, and effects on listed salmonids would be similar. During the in-water work periods, salmonid eggs are not expected to be present in streams crossed by the pipeline. Likewise, during summer work windows no adult salmonids are expected in the pipeline areas to be crossed using the flume methods, except for possibly a few adult lower Columbia River and OC coho. Early migrating adult lower Columbia River coho occur in tributaries to Youngs Bay that would be crossed by the pipeline including Barrett Slough, Heckard Creek, Clatskanie River, Little Clatskanie River, Merrill Creek, and Milton Creek. Oregon Coast coho occur in Alder, Rock, North Fork Wolf, Clear and Cedar Creeks. If adult coho are present at

these locations, flumed waterbody crossings would temporarily interfere with upstream, and, to a lesser extent, downstream fish passage. Oregon LNG would provide upstream passage if construction is expected to last more than 3 days, which is unlikely. Therefore, we expect that direct effects would be restricted primarily to rearing juvenile salmonids. Conservation measures protective of rearing juveniles (described below) would also be protective of any adult salmonids, should they happen to be present. Because the duration of any given waterbody crossing would be so brief, and because the timing of the crossings would not coincide with major migrations (either upstream migrations of adults, or downstream migrations of juveniles), instream passage delays would be minimal.

Oregon LNG would install temporary dams at the upstream and downstream ends of each construction zone in preparation for dry-ditch waterbody crossings. Following construction of the dams, any fish remaining in the isolated in-water work areas would be salvaged prior to excavation. Oregon LNG would employ fish salvage techniques, including seining and/or electrofishing, until no additional fish are evident for three electrofishing or seine passes. Oregon LNG would obtain appropriate fish handling permits from the ODFW, WDFW, and NMFS before fish salvage begins, and immediately relocate all collected fish to an appropriate area within the same waterbody.

Oregon LNG would avoid increased turbidity from construction at many crossings through use of the HDD method. Turbidity would be further minimized through the use of dry crossing techniques (i.e., flume method) of waterbodies that may contain threatened or endangered species. This would limit turbidity to the time of installing and removal of the dams. Before construction begins, Oregon LNG would survey the crossing area to ensure that no spawning is occurring within 500 feet downstream. If spawning is occurring, construction would be postponed until fry have had adequate time to leave the redds as determined through consultation with ODFW, WDFW, and NMFS. Oregon LNG would follow its Procedures to limit water quality effects on waterbodies during construction. BMPs and erosion and sediment control measures also would be implemented, as described in Oregon LNG's SWPPP (see appendix F1). In addition, Oregon LNG would obtain an NPDES 1200-C construction stormwater discharge permit before construction of the project.

In summary, negative effects on federally listed salmonids would be temporary and occur during active construction. The most significant include effects on individual salmonids due to fish salvage and increased turbidity downstream of waterbody crossings. There are a limited number of the flume crossings where salvage and turbidity increases would occur, and any one ESU/DPS would not be affected by more than four such crossings. We conclude that implementation of the conservation measures described below and in section 4.1.5.2 would minimize the negative effects on individual fish.

Effects on Green Sturgeon

While it is possible that some small number of green sturgeon would occur in the tidal portions of the Lewis and Clark River and its tributaries (namely, Barrett Slough), green sturgeon are not likely to be present during the estuarine in-water work window (November 1 through February 28). The locations most likely to be occupied by green sturgeon include the Lewis and Clark River and the Columbia River, both of which would be crossed using the HDD method. For these reasons, pipeline construction in estuarine waterbodies (including tidally-influenced tributaries) would not affect green sturgeon. Oregon LNG intends to request alternative work windows for several tidally-influenced tributary pipeline crossings; however, the crossings would either occur in the dry, or via HDD. As such, direct effects on green sturgeon during any of pipeline-related construction are unlikely. Because the riparian corridors of estuarine crossing locations are currently degraded, there would be very little project-related riparian effects. Further, the streambeds that would be crossed using flume methods are expected to be largely

recovered by the following summer when green sturgeon would be present in the lower Columbia River estuary.

Effects on Eulachon

Adult and larval eulachon may be present from December through May in the lower Columbia River. Although use of lower Columbia River tributaries to be crossed by the pipeline appears to be infrequent, any potential occurrence in freshwater portions of the tributaries would be limited to the winter/early spring spawning and incubation period. Therefore, pipeline crossings of freshwater tributaries to the Columbia River are unlikely to have any effect on eulachon because crossings would be conducted during the ODFW- and WDFW-recommended summer work windows. Outmigrating larvae may be present in tidally influenced portions of tributaries to be crossed by the pipeline. The ODFW has indicated that such waterbodies should be considered estuarine waters for the purposes of in-water work window (i.e., November 1 to February 28). However, Oregon LNG would request a variance to perform in-water construction during the summer. This would avoid any effect on outmigrating larvae, or upstream migrating adults.

Effects on Critical Habitat

Construction of the proposed pipeline in waterbodies containing critical habitat would result in effects that were described in section 4.1.5.2. The physical disturbance of critical habitat has the potential to affect the substrate and natural cover PCEs of critical habitat as well as numerous existing conditions, including substrate, LWD, water quality, natural cover, forage species and habitat, and width-depth ratios. While minor amounts of critical habitat for green sturgeon and eulachon would be temporarily affected, the majority of effects would be on salmonid critical habitat PCEs. The potential pipeline effects on salmonid critical habitat and existing conditions are summarized in table 4.1.8-8. Changes to instream habitat would be mitigated by the proposed conservation measures (see next section).

Table 4.1.8-8

Potential Oregon LNG Pipeline Effects on Salmonid Critical Habitat

Habitat	Essential Physical and Biological Features	Potential Project Effects	Conservation Measures
Freshwater spawning	Water quality, water quantity, and substrate	Small potential for increased siltation of spawning beds downstream of project area.	Construction BMPs, flume and HDD crossing methods, streambank restoration.
Freshwater rearing	Water quantity and floodplain connectivity	No effect. Water withdrawals for hydrostatic testing should not reduce water quantity sufficiently to affect salmonids.	N/A
	Water quality and forage	Would decrease water quality (increase turbidity) and decrease forage (by eliminating some benthic invertebrates) over the short term.	Construction timing, Construction BMPs, flume and HDD crossing methods, and streambank restoration.
	Natural cover	Short-term negative effect by shifting some LWD and possibly boulders during construction.	Construction timing, construction BMPs, HDD, and streambank restoration. Long-term positive effect through the placement of LWD and other mitigation measures.
Freshwater migration	Free of artificial obstructions and excessive predation, with adequate water quality and quantity and natural cover.	Would have no effect on predation. Juvenile upstream migration would be hindered in the short term during dry crossings. See responses related to water quality/quantity, and cover, above.	Construction timing, construction BMPs, turbidity monitoring, flume and HDD crossing methods, streambank restoration.

Conservation Measures for Pipeline Construction

Conservation measures and compensatory mitigation measures for pipeline construction are discussed in section 4.1.5.2. Oregon LNG would schedule in-water work during the ODFW- and WDFW-recommended in-water work windows as the initial conservation measure to avoid direct project effects on listed fish. This would minimize the number of fish present in waterbodies that would be crossed by the pipeline. Oregon LNG would install temporary dams at the upstream and downstream ends of each construction zone in preparation for dry-ditch waterbody crossings. Following construction of the dams, any fish remaining in the isolated in-water work areas would be salvaged prior to pipeline installation. Oregon LNG would employ fish salvage techniques according to NMFS protocols, and would obtain handling permits from WDFW and ODFW before salvage begins. At flumed crossings, Oregon LNG would not cross streams known to support anadromous fish during periods of adult upstream migration; downstream juvenile salmonid migrations would be available via bypass flume or culvert. The exception to this would be lower Columbia River and OC coho, if early adult migrants are present at crossing locations.

Oregon LNG would construct all waterbody crossings in compliance with its Procedures, including hydrostatic testing of the pipeline. For HDD and hydrostatic test water withdrawals (see table 4.1.3-7), Oregon LNG would use NMFS-compliant screens on intakes. The crossings would be monitored after construction to ensure that the bank stabilization methods employed were effective in abating increased sedimentation. Oregon LNG would restore stream habitat as closely as possible to preconstruction condition. Native materials (including large wood, native vegetation, weed-free topsoil, and native channel materials [gravel, cobble, and boulders]) disturbed during site preparation would be conserved on-site for restoration. Oregon LNG addresses restoration of waterbody crossings in its Conceptual Mitigation Plan (see appendix F3).

Oregon LNG proposes remediation to replace the LWD lost to pipeline construction, resulting in no net loss of LWD. Where existing LWD would be removed from the waterbody crossing site, it would either be put back in place after construction or replaced with better quality LWD. At waterbody crossings where LWD is lacking, LWD would be installed at appropriate locations within the channel to improve habitat quality. Installation of LWD would be done in coordination with state (ODFW, WDFW) and federal (USFWS, NMFS, USACE) agencies.

Pipeline Operation

As discussed in section 4.1.5.2, the potential effects from ongoing pipeline operations that would affect lower Columbia River Chinook, upper Willamette River Chinook, lower Columbia River coho, OC coho, lower Columbia River steelhead, or upper Willamette River steelhead include:

- long-term adverse effects from instream habitat alteration, including scour and channel migration;
- long-term effects from clearing of and construction in the riparian zone, including increased sediment inputs, increased water temperatures, reduction in LWD recruitment, and increased potential for mass failures;
- effects from pipeline maintenance and inspection activities; and
- effects associated with increased access (due to the presence of the right-of-way or new/improved access roads).

Other long term impacts on federally listed fish may include the cumulative effect of multiple stream crossings of the same waterbody or on different waterbodies but in close proximity where the

overall effect would be greater than the individual effects (see section 4.1.5.2). For instance, if increased solar radiation from one cleared right-of-way raised water temperatures slightly, and a second crossing occurred before water temperatures had the opportunity to equilibrate, the effects of the individual waterbody crossings would be compounded (Poole et al., 2001). The pipeline portion of the project would result in the clearing of a maximum of 0.09 percent of the entire riparian length in any of the river basins crossed (see table 4.1.8-9). These estimates assume that all existing areas have fully functional riparian zones, which would not be the case.

Table 4.1.8-9

Length of Riparian Effect Within Basins

4th Field Hydrologic Unit Code (HUC)	Number of Crossings	Total Length of Riparian Area Cleared (miles)	Total Length of Rivers in the Basin (miles)	Fraction of Total Cleared (percent)
Lower Columbia	77	1.85	2,098.84	0.088
Lower Columbia-Clatskanie	29	1.33	5,307.59	0.025
Lower Willamette	7	0.13	1,670.33	0.008
Nehalem	101	2.06	3,664.33	0.056

Within individual watersheds, the waterbody crossings would be sufficiently far apart so as to have little to no potential additive effects. Different individual fish would be present within the separate waterbody crossing areas, and the cumulative effects on the population level would be no greater than if the crossings were present on different waterbodies or in different watersheds. In conclusion, the cumulative effects of multiple waterbody crossings on the population level of federally listed species would be insignificant. Although there are a significant number of waterbody crossings associated with the project, the number of these that affect any one population or ESU/DPS is small.

Effect Determination

Table 4.1.8-10 summarizes the recommended effect determinations for federally listed fish species and critical habitat that may be present in the project area based on the potential effects described in this section and section 4.1.5.2. Although the proposed project would adversely affect federally listed species, we do not conclude that these potential effects would cause adverse, long-term effects that would affect the survival and/or recovery of the species or their critical habitat.

The proposed project would not significantly "hinder the attainment of relevant functioning indicators" as defined in *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (NMFS, 1996a). No significant direct, indirect, cumulative, interrelated, or interdependent effects on federally listed salmonids or their critical habitats were identified for the proposed project.

Table 4.1.8-10

Federally Listed Fish Species and Critical Habitat Potentially Occurring in Project Area and Effect Determination

Species [a]	Determination of Effect [b]		Justification
	Species	Critical Habitat	
Chinook Salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River ESU	LAA	LAA	Juveniles of this species routinely forage and reside near the terminal site year round. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low); pile driving would adversely affect individuals, if present during in-water work. Designated critical habitat would be modified during dredging.
Upper Columbia River Spring-run ESU	LAA	LAA	This species migrates past the terminal site and dredged material disposal locations. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Designated critical habitat would be modified during dredging and dredged material disposal.
Snake River Spring/Summer-run ESU	LAA	LAA	This species migrates past the terminal site and dredged material disposal locations. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Pile driving would potentially affect juveniles if present in zone of disturbance. Designated critical habitat would be modified at the terminal location and during dredging and dredged material disposal.
Snake River Fall-run ESU	LAA	LAA	Sub-yearling fish of this species forage and migrate through areas of the estuary that would be affected by the project. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Designated critical habitat would be modified at the terminal location during dredging and dredged material disposal.
Upper Willamette River ESU	LAA	LAA	Juvenile life stages of this species are present in the vicinity of the terminal site and dredged material disposal sites throughout the year. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Pile driving would potentially affect juveniles if present in zone of disturbance or injury. Designated critical habitat would be modified during dredging and dredged material disposal.
Sockeye Salmon (*O. nerka*)			
Snake River ESU	LAA	LAA	Larger juveniles of this species migrate past the terminal site. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Critical habitat would be adversely affected by project activities as a result of modifications at the terminal and dredged material disposal locations.
Steelhead (*O. mykiss*)			
Lower Columbia River DPS	LAA	LAA	Although steelhead smolts migrating past the terminal would be larger and, therefore, less susceptible to adverse effects, they would be present in the lower river throughout the year. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Designated critical habitat for this species would be affected by project activities.
Upper Willamette River DPS	LAA	LAA	Juvenile and adult life stages of this DPS migrate past the terminal site. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Dredged material disposal and dredging and construction of the ship berthing and maneuvering area would occur in designated critical habitat.
Snake River Basin DPS	LAA	LAA	Individuals of this DPS migrate past the LNG terminal and dredged material disposal locations. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Project activities would adversely affect its critical habitat.

Table 4.1.8-10

Federally Listed Fish Species and Critical Habitat Potentially Occurring in Project Area and Effect Determination

Species [a]	Determination of Effect [b]		Justification
	Species	Critical Habitat	
Upper Columbia River DPS	LAA	LAA	Juvenile and adult life stages of this DPS migrate past the terminal site. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Dredging and construction of the ship berthing and maneuvering area would occur in designated critical habitat.
Middle Columbia River DPS	LAA	LAA	Individuals of this DPS migrate past the terminal site year round. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Dredging and construction of the ship berthing and maneuvering area would occur in designated critical habitat.
Chum Salmon (*O. keta*)			
Columbia River ESU	LAA	LAA	This species has been observed rearing in the vicinity of the terminal site and may be exposed to in-water work activities. Juvenile chum would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Designated critical habitat would be modified during dredging and dredged material disposal.
Coho Salmon (*O. kisutch*)			
Lower Columbia River ESU	LAA	LDAM	This species occurs within the project area year-round, including areas affected by terminal construction, dredged material disposal and pipeline installation. Juveniles would be susceptible to entrainment during ballast and cooling water operations (though potential is extremely low). Dredging and construction of the ship berthing and maneuvering area would occur in proposed critical habitat and critical habitat would be temporarily adversely modified during pipeline installation.
Oregon Coast ESU	LAA	LAA	This species occurs within the pipeline portions of the project area and may be affected by installation of the pipeline. Critical habitat would be temporarily adversely modified during pipeline installation.
Bull Trout (*Salvelinus confluentus*)			
Columbia River DPS	No Effect	NLAA	There are no documented amphidromous runs of bull trout currently known to occur in the lower Columbia River. Dredged material placement, dredging and construction of the ship berthing and maneuvering area, and cooling water operations would occur in designated critical habitat in the Mainstem Lower Columbia River CHU; however, adverse effects on critical habitat are unlikely because of the minor amount of habitat affected compared to what is available in the CHU.
Eulachon (*Thaleichthys pacificus*)			
Southern DPS	LAA	NLAA	Adults and larvae migrate past the terminal location and the dredged material disposal sites. LNG ballast and cooling water exchanges would entrain larvae. Dredging and construction of the ship berthing and maneuvering area would occur in designated critical habitat, but adverse effects would not occur.
North American Green Sturgeon (*Acipenser medirostris*)			
Southern DPS	NLAA	NLAA	Adults and subadults would be present during the proposed summer to early fall dredging period. Dredging and construction of the ship berthing and maneuvering area would occur in designated critical habitat

[a] Table does not include fish that are present only in the Pacific Ocean because marine transit would not adversely affect these species.

[b] LAA = likely to adversely affect; LDAM = likely to destroy or adversely modify (provisional); NLAA = not likely to adversely affect

Invertebrate—Oregon Silverspot Butterfly

The Oregon silverspot butterfly is federally listed as threatened throughout its entire range which extends from Grays Harbor County, Washington, south to Del Norte County, California. The butterfly is currently endemic to coastal Oregon where it occurs in three types of grassland habitat, including coastal salt spray meadows, stabilized dunes, and mountain meadows (WSDOT, 2014; FWS, 2005). The Oregon silverspot butterfly requires the early blue violet (*Violet adunca*) as a host plant to complete its development. As an adult, the Oregon silverspot generally moves out of the meadows and into the fringes of conifers or brush. Current threats to the species include habitat alteration, invasion of nonnative plants, off-road vehicle use, and vegetation change due to fire suppression (FWS, 2001).

Records for the Oregon silverspot butterfly indicate one occurrence about 1.8 miles west of the pipeline (ORNHIC, 2009; ORBIC, 2011). Three populations have been documented about 2.7 to 2.8 miles west of the pipeline and one other population has been documented about 2.8 miles south of the terminal (ORNHIC, 2009). No early blue violets have been documented within 2 miles of the pipeline or terminal (ORNHIC, 2009). In addition, no Oregon silverspot butterflies or early blue violets were observed during the field investigation.

Suitable habitat for Oregon silverspot butterfly is limited to coastal meadows, dunes, and montane meadows within a few miles of the coast that support populations of early blue violet. These habitat types are absent from the terminal site and the pipeline construction right-of-way. However, dispersal habitat for this species may be present in the project area. The nearest critical habitat for Oregon silverspot butterflies is about 115 miles south of the project.

Oregon silverspot butterflies would be directly affected by the proposed action if individuals or occupied host plants are present within the pipeline construction corridor during construction. Impacts would include noise and visual disturbance as well as crushing of eggs, larvae, or adult butterflies. Herbicide application during operation could also impact this species if present.

Oregon LNG would implement the following conservation measures to avoid or minimize effects on the Oregon silverspot butterfly:

- survey areas of potentially suitable habitat for associated larval host species and nectar plants on properties where access was denied prior to construction;
- limit removal of host or nectar plants to the minimum necessary for construction;
- restore cleared areas to preconstruction condition; and
- if larval host plants are identified during construction, possible avoidance and mitigation measures could include pipeline micrositing (as feasible), or removal and conservation of plants for replanting following construction.

Suitable habitat for the larval host plant does not occur at the terminal or along the pipeline, and neither Oregon silverspot butterfly nor its larval host plant have been documented within the project area. Therefore, we conclude the project would have ***no effect*** on the Oregon silverspot butterfly.

Because no critical habitat is present in the project area, the proposed action would have ***no effect*** on designated critical habitat for this species.

Plants

We received a comment that surveys for listed plants should be conducted during the appropriate flowering times for listed plants.

Plant Species

Oregon LNG conducted rare plant surveys along the pipeline to identify the presence of rare plants within the project area. Target species include all plant taxa listed by the FWS as endangered or threatened species, or as candidates for listing, or identified as endangered or threatened or candidate species under the Oregon Endangered Species Act (ORBIC, 2011) or by the Washington Natural Heritage Program (WNHP, 2013a) or Washington PHS Mapping. The surveys methods followed guidelines of the Bureau of Land Management's (BLM) *Survey Protocols for Survey and Manage Strategy 2 Vascular Plants* (Whiteaker et al., 1998).

Prior to field work, Oregon LNG reviewed recent aerial photography of the project areas to identify areas likely to contain suitable habitat to support rare plants and exclude other areas that obviously lacked, such as agricultural areas. Field surveys were not conducted in some areas due to access issues.

Oregon LNG's rare plant surveys during the 2007 and 2008 and 2013 flowering season did not find any federal or state listed rare plants in the project area. For those areas not surveyed due to access restrictions, Oregon LNG proposes an adaptive management plan with a set of minimization and avoidance measures for rare plants that could be found in the pipeline corridor, along with mitigation measures to offset potential impacts on habitat and species (discussed below).

Bradshaw's Lomatium

Bradshaw's lomatium was listed as federally endangered on September 30, 1988 (U.S. Department of the Interior [USDI], 1988). It was listed endangered by the state in 1990 (ODA, 1990). Critical habitat has not been proposed. Once endemic to and widespread in the wet, open areas of the Willamette Valley of western Oregon, Bradshaw's lomatium is limited now to a few sites in Lane, Marion, and Benton Counties with a recently discovered population in Clark County, Washington (FWS, 2010). The majority of known Bradshaw's lomatium populations occur on seasonally flooded native grass prairies and mixed grasslands in the Willamette Valley.

The ORNHIC/ORBIC and PHS has no record of Bradshaw's lomatium within a 2-mile radius of the project area. Within the project area, historical wet prairies generally have been converted to agricultural land or developed for residential and urban uses; however, small remnant wet prairie habitat may remain in some areas (FWS, 1993; ODFW, 2008b).

Potentially suitable habitat for Bradshaw's lomatium occurs in the grassy areas along roadsides and fencerows, areas that are not disturbed by continual plowing and use of herbicides. These areas provide marginal suitable habitat, as they are heavily degraded. Nonnative grasses and shrubs are often dominant in these roadside habitats and compete with native plants for nutrients and space. Plants are also at risk of trampling from foot or road traffic. Surveys for Bradshaw's lomatium were conducted in locations of potentially suitable habitat in 2008 and 2013. No plants were observed. Potential suitable habitat may be present between MP 80.2 and MP 81.8 in Columbia County, Oregon, and between MP 83 and MP 85.6 in Cowlitz County, Washington. Marginally suitable habitat may exist on properties where survey crews were denied access. There are no native wetland prairies within the project area.

Nelson's Checkermallow

Nelson's checkermallow is listed as threatened federally and by the state of Oregon (FWS, 1993). A recovery plan was developed in 1998 (FWS, 1998). Between 75 and 80 percent of the total population is in the Willamette Valley (ORNHIC, 2009). Historical and recent accounts of Nelson's checker-mallow include Benton, Clackamas, Clatsop, Columbia, Linn, Marion, Polk, Tillamook, Washington, and Yamhill Counties (FWS, 2010).

Nelson's checkermallow is a perennial herb that typically occupies wetland prairies and streamsides, roadsides, and fallow fields. It often occurs in areas where prairie merges with deciduous woodland, and it flowers from May to July. Most known sites have been densely colonized by invasive weeds, especially introduced forage grasses. Throughout its range, Nelson's checkermallow habitat is threatened by reduction in native prairie and grassland habitat caused by fire suppression, the associated invasion of woody species, and because of residential, agricultural, and commercial development in otherwise suitable habitat (FWS, 1998).

Within the project area, potential habitat for Nelson's checkermallow exists along roadside ditches, fences, and wetland habitats. These habitats have been heavily disturbed and altered by human activities. In the Coast Range, forestry practices have fragmented habitat and the construction of logging roads has led to an increase in sediment in streams and wetlands. Vegetation observed along logging roads is often coated in a thick layer of dust. While cleared forests may favor Nelson's checkermallow colonization initially, harvested areas are often invaded and dominated by fast-growing, nonnative woody species, including Himalayan blackberry, evergreen blackberry, and Scot's broom. These species can suppress Nelson's checkermallow, which is sensitive to shading (FWS, 1998). Finally, any Nelson's checkermallow populations in cleared forest likely are not sustainable. Plants in cleared forest are at risk from future shading effects following coniferous replanting, and from herbicide spraying prior to replanting (FWS, 1998). Nelson's checkermallow was not observed during rare plant surveys conducted in 2008 and 2013.

Water Howellia

Water howellia is a small water annual of the bellflower family that is federally listed as threatened but has no state status (FWS, 1994). It is found in slow-moving sloughs and ponds that grows submerged, with roots set in the substrate (Oregon Flora Project, 2013; WNHP, 2013b) and it grows in the shallower waters of sloughs, oxbows, and ponds of Montana, Washington, Idaho, and historically Oregon. It grows in consolidated soils associated with glacial potholes.

There have been historical sightings of water howellia in Clackamas, Marion, and Multnomah Counties (FWS, 1996); but all of these populations were subsequently lost due to development. According to current FWS (FWS, 1996) and ODFW (ODFW, 2008c) websites, water howellia is thought to be extirpated in Oregon. However, an ORNHIC website (ORNHIC, 2009) lists an extant population in western Benton County, Oregon. No critical habitat has been designated for water howellia. No project components are proposed in western Benton County. In Washington, water howellia is known from Thurston, Pierce, northern Clark, and Spokane Counties. Historically, much of the lowland areas of northern Columbia and Cowlitz Counties were seasonally inundated. Most of these habitats have been diked, drained, and developed for agricultural, residential, or urban uses. Wetlands in the Coast Range have been disturbed by logging activities. Nonnative species have invaded many of these wetlands. Whereas most of the remaining known populations of water howellia are found on federal lands, the pipeline would pass through private lands and a small portion of state land.

The ORNHIC/ORBIC and PHS has no record of water howellia within a 2-mile radius of the project area. Oregon LNG surveyed the terminal site during the flowering season in 2007 and did not encounter water howellia. This is consistent with the observation that suitable habitat for howellia would be unlikely to occur on the Skipanon peninsula, because it is constructed of dredge spoils.

Impacts

Rare plant surveys were conducted during the spring and summer of 2008 and 2013. No specimens of Bradshaw's lomatium, Nelson's checkermallow, or water howellia were observed. In addition, no wetland prairie habitat was observed within the project area. However, because surveys did not cover all potential areas due to access restrictions and to changes to the pipeline alignment following the conclusion of the plant surveys, it is possible that remnant rare plants may be present in the pipeline corridor. Direct and indirect effects on rare plants include disturbances to nonnative grasslands and agricultural lands within their historical range. Additionally, development of the pipeline corridor may prevent any plants or prairie habitat from colonization or establishment in the project area. The pipeline route would act as a conduit for the spread of nonnative species, further degrading the remaining patches of potentially suitable habitat. However, this impact would be minimized by Oregon LNG's control of noxious weeds and invasive plant species as described in section 4.1.6.2.

Mitigation and Conservation Measures

Oregon LNG plans to conduct additional rare plant surveys at the sites where property owners did not grant access permission for previous surveys. Additional surveys may also need to be conducted to accommodate any changes to the pipeline alignment or facilities sites that may occur prior to final design. The additional surveys would be conducted in the year prior to pipeline construction to encompass the complete range of bloom times for the identified species.

Despite completion of all recommended surveys, it is still possible that individuals or populations of rare plant species may be encountered in the course of pipeline construction. Adaptive management procedures would be implemented in the event that rare plants are observed within the construction corridor during project construction. In the event of such a discovery, the following procedures would be implemented.

- Work in the vicinity of the rare plant(s) would cease immediately.
- A qualified botanist would verify identity and delineate the extent of the plant(s).
- FWS would be notified of the discovery. All efforts would be made to avoid disturbance to such species. These efforts include implementation of micrositing where practicable.

If disturbance cannot be avoided, efforts would be employed to minimize disturbance to the maximum extent practicable. Possible avoidance measures may include the following:

- clearly delineate and fence rare plant populations;
- retain a qualified botanist to provide monitoring during construction; and
- implement site restoration measures immediately upon completion of any work in the vicinity of rare plants.

If, during preconstruction surveys, federally listed plants are discovered, then additional compensatory mitigation would be provided at a ratio of 2 to 1 with a 1-acre minimum. The rationale for the 2 to 1 ratio is associated with the uncertainty that salvage and restoration would be successful. Also see appendix F3.

Effect Determination

No Bradshaw's lomatium or Nelson's checkermallow plants were observed during surveys conducted by Oregon LNG, no existing populations are known to occur within the project area, and the pipeline would not cross wetland prairie habitat. Although comprehensive surveys have not yet been conducted throughout the entire proposed project area (due to limits on access to some private properties and to changes to the pipeline alignment following the conclusion of the plant surveys), it is highly unlikely that remnant wetland prairie habitat that could support Bradshaw's lomatium or Nelson's checkermallow exists along the proposed pipeline route. Oregon LNG has committed to completing preconstruction surveys, as described above, to verify that no rare plants occur in the construction right-of-way. Therefore, we conclude the proposed project would ***not likely adversely affect*** Bradshaw's lomatium and Nelson's checkermallow.

Water howellia is thought to be extirpated in Oregon. Suitable habitat to support water howellia is present in the Coast Range, and it is present within the survey corridor of the project area. Because surveys have not yet been completed, it is possible that suitable habitat, individuals, or populations of water howellia may be present in the pipeline project area. But, because this species is thought to be extirpated from Oregon, and this plant would not be likely to occur along the pipeline corridor, even in unsurveyed areas, we conclude the project would ***not likely adversely affect*** water howellia.

4.1.8.2 State Listed Threatened and Endangered Species

In addition to species that may occur in the project area and are federally listed as threatened or endangered, Oregon and Washington have designated 14 species as threatened, endangered, or candidates under state ESA laws. These species are shown in table 4.1.8-11 and include one marine mammal, four birds, one reptile, and eight plants.

Table 4.1.8-11

State Listed or Candidate Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status	Project Component of Potential Occurrence			Preferred Habitat
		Marine Transit Route	Terminal	Pipeline	
Marine Mammals					
Gray whale *(Eschrichtius robustus)*	OR–E WA-SS	X			Near shore waters between their breeding grounds in Baja, California, and their summer feeding grounds in the Gulf of Alaska.
Birds					
Aleutian Canada goose *(Branta canadensis leucopareia)*	OR–E	X	X		Forage in wetland and upland habitats, including meadows, pastures, agricultural, and fallow fields.
Brown Pelican *(Pelecanus occidentalis)*	OR-T	X	X		Near-shore habitat found in large bays and river mouths. Roost on sandy shores and offshore rocks.
Purple Martin *(Coccyzus americanus)*	OR-NL WA-C		X	X	Riparian forests, particularly woodlands with cottonwoods and willows.
Vesper sparrow *(Pooecetes gramineus affinis)*	OR-SC WA-C			X	Prairie, sagebrush steppe, meadows, pastures, and roadsides.

Table 4.1.8-11

State Listed or Candidate Species Potentially Occurring in the Vicinity of the Oregon LNG Project

Species	Status	Project Component of Potential Occurrence			Preferred Habitat
		Marine Transit Route	Terminal	Pipeline	
Reptiles					
Northwestern pond turtle (*Acttinemys marmorata marmorata)*	OR-SC WA-E			X	Ponds, lakes, sloughs, backwaters, roadside ditches with upland access for nesting.
Plants					
Pink sand verbena *(Abronia umbellate)*	OR–E		X		Restricted to coastal soft sandy beaches, coastal dunes and scrub. Typically at or below the zone of driftwood accumulation and away from European beachgrass areas.
Saddle Mountain bittercress *(Cardamine pattersonii)*	OR-C WA-NL			X	Steep gravelly and rocky slopes.
Tall bugbane *(Cimicifuga elata var. elata)*	OR-C WA-NL				Moist shady woodlands at lower elevations.
Howell's montia *(Montia howellia)*	OR-C WA-NL			X	Meadows and vernal-pools.
Saddle Mountain saxifrage *(Saxifraga hitchcockiana)*	OR-C WA-NL			X	Rocky crevices, grassy balds, meadows, and roadsides.
White top aster *(Seriocarpus rigidus)*	OR-T WA-SS			X	Moist native prairies and on well-drained upland soils in oak savannah.
Bristly-stemmed sidalcea *(Sidalcea hirtipes)*	OR-C WA-E			X	Prairie remnants, meadows, and coastal headlands.
Oregon sullivantia *(Sullivantis oregano)*	OR-C WA-E			X	Moist basalt cliffs, seepy rock faces, and spray zones of waterfalls.

NL = Not Listed, SC = Species of Concern, E = Endangered, T = Threatened, C = Candidate, SS = State Sensitive, SC = State Critical

Marine Mammal – Gray Whale

The gray whale was delisted from the federal ESA status in 1994 (Angliss and Outlaw, 2008), it remains listed as endangered by the state of Oregon and is considered a sensitive species in Washington. Gray whales migrate in nearshore waters between their breeding grounds in Baja, California, and their summer feeding grounds in the Gulf of Alaska. Some gray whales do not make the full migration and are known to feed off the coasts of Oregon and Washington in the summer months (Angliss and Outlaw, 2008). These whales are referred to as the Pacific Coast Feeding Aggregation (Calambokidis et al., 2002).

Gray whales have recovered to reach an estimated population of 19,448 in 2000–2001 and 18,178 in 2001–2002 (Rugh et al., 2008). They are estimated to be between 71 percent and 102 percent of carrying capacity (Angliss and Outlaw, 2008). Delisting is recognition that there are no immediate threats to maintaining a viable population. Gray whales continue to be protected under the MMPA. However, this species remains listed as endangered by the state of Oregon and is listed as state sensitive in Washington.

Gray whales occur off the coasts of Oregon and Washington during their northern migration between March and June and their southern migration, beginning in November and December. Potential impacts on gray whales as a result of LNG marine carrier traffic associated with the project are similar to those discussed above for federally listed whales.

Birds

Aleutian Canada Goose

The Aleutian Canada goose was formerly federally listed; it was delisted in 2001 (Warren, 2006), but it is still listed as endangered by the state of Oregon. A unique population of Aleutian Canada geese breeds in the Semidi Islands, southwest of Kodiak Island, and winter only at Nestucca Bay, near Pacific City, Oregon. This population consists of fewer than 150 individuals. Aleutian Canada geese forage in wetland and upland habitats, including meadows, pastures, agricultural, and fallow fields. Wintering habitats include short-grass fields in agricultural areas, wetlands, fallow fields, and even residential and urban areas (Csuti et al., 2001).

Aleutian Canada geese are rarely found along the lower Columbia River and more likely to be found along the Washington and Oregon coast (Warren, 2006) but Aleutian Canada geese may occasionally use the Columbia River as a stop-over during migration. The small footprint of dredging would not likely interfere with migratory behavior and LNG marine carrier traffic should not impact this species. The Columbia River estuary is not a critical winter ground or nesting area.

No species-specific mitigation is proposed but minimization measures related to the MBTA would also benefit Aleutian Canada Goose (see section 4.1.7.5 for specific measures related to the MBTA). Therefore, we conclude impacts on Aleutian Canada goose would be negligible due to their rare occurrence in the project area and Oregon LNG's proposed measures related to MBTA.

Brown Pelican

Brown pelicans are listed as threatened by the state of Oregon. They are commonly observed near the terminal site in the spring, summer, and fall. Brown pelicans prefer near-shore habitat found in large bays and river mouths, like the Columbia River. They tend to roost on sandy shores and offshore rocks and feed exclusively on fish taken from the surface. Currently, East Sand Island in the Columbia River (about 7.3 miles northwest of the terminal) is the largest (1,375 birds) post-breeding roost site for brown pelicans north of San Francisco Bay (Pacific Biological Institute, 2002).

The northern tip of the East Skipanon Peninsula is not known as a preferred roosting area. Brown pelicans have the potential to fly over, but there is no recent recorded documentation of their presence or use of the terminal site. Therefore, we conclude construction and operation of the terminal would not affect on this brown pelican. Plus, Oregon LNG's proposed minimization measures related to MBTA would also benefit brown pelican.

Purple Martin

Purple martins are a candidate species for listing under Washington's ESA. ODFW also considers purple martin as a sensitive species. Purple martins are migratory birds that winter in South America and nest in Mexico, United States, and the southern part of Canada. In the Pacific Northwest, purple martins typically nest near the coast. Suitable habitat for purple martins exists in areas that provide both nesting cavities and open areas for foraging. Meadows, lakeshores, rivers, and open woodlands are often used (Brown, 1997). The population of purple martins is declining throughout their range due to loss of nesting cavities and increased competition for existing cavities with introduced European starlings

and house sparrows. Artificial nest box programs have helped compensate for the loss of burned trees and snags.

Potential habitat for purple martins exists in open woody areas in the project area. Two adult purple martins were observed at the Skipanon Peninsula in 2005, perched on pilings in the Skipanon River. The area was resurveyed during the nesting season of 2007 and no purple martins were observed. Abandoned pilings appear to provide the only habitat for nest cavities, as there are no nest boxes, snags, or trees with cavities at the terminal site. We conclude that neither the terminal nor pipeline would have an adverse affect on this species.

Vesper Sparrow

Vesper sparrow is a candidate for listing by the State of Washington and has critical status in Oregon. Vesper sparrows are found in various open habitats with grass, including prairie, sagebrush steppe, meadows, pastures, and roadsides. Most sightings of vesper sparrow in Oregon and Washington are from remnant prairie areas of the Willamette Valley and Puget Sound, but vesper sparrow have been observed on the Skipanon Peninsula (eBird, 2014). The pipeline would not cross native grasslands or oak savannah habitat that vesper sparrow prefer. Therefore, we conclude the project is unlikely to affect this species.

Reptile—Northwestern Pond Turtle

Northwestern pond turtle is found in slow moving aquatic sites (i.e., pond, lake, slough, backwaters, roadside ditches) with ample basking sites and access to upland areas for nesting. These turtles are listed as endangered by the State of Washington and have critical status in Oregon. Oregon LNG conducted an amphibian and reptile survey at the terminal in 2006 and did not observed pond turtles. The pipeline would cross wetlands (PEM, ES) with potential to provide suitable habitat for northwestern pond turtle but implementation of Oregon LNG's Plan and Procedures would minimize the impact on wetlands. In general, wetlands would return to preconstruction condition within 3 years. Oregon LNG would cross sensitive waterbodies using the HDD method which would also avoid potential impacts on pond turtles. Northwest pond turtles could be crushed by equipment if they are present in the construction work area at wetland crossings, but the risk of this occurring would be low.

Plants

Pink Sand Verbena

Pink sand verbena *(Abronia umbellate)* inhabits only the littoral sandy beach areas and unstabilized sand dunes of coastal beaches. There are only 12 known populations of pink sand verbena in Oregon, most of which are fewer than 50 individual plants. No suitable habitat is present in the terminal area. There are no known populations of pink sand verbena within 2 miles of the project. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline and state-listed plants were not observed. Therefore, we expect no impacts on pink sand verbena.

Saddle Mountain Bittercress

Saddle Mountain bittercress (*Cardamine pattersonii*) can be either an annual or perennial herb that grows on mossy mats on bedrock, in gravel along small streams, and on grassy balds. It grows in high-elevation Coast Range peaks and coastal river systems, and it flowers from late April through June. The pipeline route in the Coast Range primarily traverses managed industrial forest where habitat suitable for Saddle Mountain bittercress may occur. However, no grassy balds are present along the pipeline route. ORBIC has a record (Clatsop County, 2005) of Saddle Mountain bittercress occurring about

2 miles from the pipeline route. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

Tall Bugbane

Tall bugbane (*Cimicifuga elata*) is a woodland perennial that occurs in or at the margins of moist coniferous, and mixed conifer-deciduous forests, from low to middle elevations. It flowers from late May through early August. Potential habitat for tall bugbane may occur along the pipeline route in the Coast Range and in lowland areas adjacent to the Columbia River. Neither ORBIC nor PHS lists any occurrences of tall bugbane within 2 miles of the pipeline. In Cowlitz County, PHS lists Oak Woodland habitat, which may support tall bugbane, as occurring within about 2 miles of the pipeline. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

Howell's Montia

Howell's montia (*Montia howellii*) is a low annual that occurs in moist lowland areas west of the Cascade Mountains, typically in freshwater wetlands, riparian wetlands, wet meadows, or vernal pools. It blooms April through May. Potential habitat for Howell's montia may be present along the pipeline route in lowland areas adjacent to the Columbia River. Neither ORBIC nor the PHS databases lists any occurrences of Howell's montia within 2 miles of the pipeline route. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

Saddle Mountain Saxifrage

Saddle Mountain saxifrage (*Saxifraga hitchcockiana*) is a perennial herb that grows in rocky crevices, grassy balds, meadows, and roadsides. It is endemic to the northwest Coast Range and flowers from late May to July. Suitable habitat is likely to occur in some areas of the pipeline route. ORBIC has a record (ORBIC, 2011) of Saddle Mountain saxifrage occurring within about 3 miles of the pipeline route. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

White Top Aster

White top aster (*Seriocarpus rigidus*) is a perennial herb typically found in colonies of 50 to 200 or more shoots. This species occurs in open grassland habitats in lowlands of the Willamette-Puget Trough. It occurs in moist native prairies and on well-drained upland soils in oak savannah. It blooms from July through early September. Potential habitat for white top aster may be present along the pipeline route in lowland areas adjacent to the Columbia River. Neither ORBIC nor the PHS lists any occurrences of white top aster within 2 miles of the pipeline route. The PHS lists Oak Woodland habitat within about 2 miles of the pipeline route. This habitat may support white top aster. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

Hairy Stemmed Checkermallow

Hairy stemmed checkermallow (*Sidalcea hirtipes*) is a perennial herb that grows in meadows, remnant prairie fragments, coastal bluffs, and mountain peaks. It flowers from June to mid-July. Suitable habitat for this species may be present over some portions of the pipeline route. ORBIC has a record (Clatsop County, 2005) of hairy stemmed checkermallow occurring within about 3 miles of the pipeline route. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

Oregon Sullivantia

Oregon sullivantia (*Sullivantia oregana*) is a delicate perennial that occurs on moist, shaded cliffs, especially near waterfalls. This species has been observed in bloom from May through August. Potential habitat for Oregon sullivantia may be present along the pipeline route in the Coast Range and in lowland areas adjacent to the Columbia River. ORBIC and the PHS databases do not list any occurrences of Oregon sullivantia within 2 miles of the pipeline route. Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline, state-listed plants were not observed.

4.1.8.3 Other Special Status Species

In addition to the federal and state threatened and endangered or candidate species described above, there are 27 additional species that have been given special status designation by federal or state agencies that may occur in the project area. These include eight mammals, two birds, eight amphibian and reptile species, three fish, three invertebrates, and three plants (see appendix H). The FWS and NMFS maintains a list of federal species of concern, which are species that may be listed as threatened or endangered in the future pending further research or status information. The ODFW also assigns special status to species in Oregon that are considered to be at risk of extinction. The state special status designations include critical, vulnerable, peripheral or naturally rate, and undetermined. Critical status refers to species with pending threatened or endangered status if immediate conservation actions are not taken. Vulnerable species are not considered to be at immediate risk and further populations declines can be avoided by continued or expanded use of protective measures. Peripheral species refer to species that are at the edge of their natural range in Oregon. Undetermined species have an unclear status, and more information is needed to clarify their current population status.

The OCS is a broad framework for long-term conservation of Oregon's native fish and wildlife, as well as various invertebrates and native plants (ODFW, 2006a). The Conservation Strategy emphasizes proactive conservation of declining species and habitats to reduce the possibility of future federal or state endangered species listings. The Conservation Strategy identifies priority issues, landscapes, habitats, and species based on conservation needs and opportunities.

The Washington State Priority Habitats and Species database contains records of special-status species, including bald eagles. According to the database, there are no recorded occurrences or potential suitable habitat for any priority species in the vicinity of the pipeline in Cowlitz County. Appendix H describes the likely presence of the Oregon and Washington special status species within the project area, possible impacts, and any mitigation measures for impacts on these habitats and species. The mitigation measures proposed by Oregon LNG (as detailed in appendix H) would meet the PHS Management Recommendations with the following exceptions, which are not applicable to the project: limit or eliminate livestock grazing, construct power lines using latest Avian Power Line Interaction Committee standards to avoid electrocution of birds, and remove unused fencing.

4.1.9 Land Use, Recreation, and Visual Resources

4.1.9.1 Terminal and Waterway

The waterway for LNG marine traffic extends from the outer limits of the U.S. territorial waters, about 12 nautical miles off the coast of Oregon, and up the Columbia River about 11.5 miles to the proposed location of the Oregon LNG terminal. The waterway leading to the terminal is an existing, federal navigational channel maintained at a depth of about 42 feet by the USACE. The channel is greater than 2,000 feet wide near the mouth of the river but narrows to 600 feet wide beginning at RM 4.0. The berth at the terminal would be about 1,800 feet from the existing federal navigation channel. The Coast Guard has determined the waterway is suitable for LNG marine traffic provided certain conditions are met by Oregon LNG[5]. As discussed in section 1.1, the waterway for LNG marine traffic is a FERC nonjurisdictional facility for this project. The Coast Guard has evaluated the proposed use of the waterway relative to safety and security but not for environmental aspects, and therefore, we address environmental impacts in this EIS.

The lower Columbia River is mostly rural with the exception of the urban areas of Ilwaco in Washington, and Warrenton and Astoria in Oregon. Outside urban areas and along the shore of the waterway are scattered residences and commercial/industrial facilities. On the northern shoreline of the Columbia River, in Pacific County, Washington, from the Long Beach peninsula eastward to RM 11.5, are the sparsely populated unincorporated communities of Chinook and McGowan. Along the southern shoreline in Clatsop County, Oregon, to RM 11.5, are the community of Hammond and City of Warrenton. The lower Columbia River is used for a variety of activities, including commercial shipping, boating, fishing, and recreational activities.

As described in section 2.1.1.1, the terminal would be at the northern portion of the East Skipanon Peninsula at RM 11.5. The East Skipanon Peninsula was created beginning in the early 1900s through the deposition of dredged material. The peninsula has not been developed; however, concrete block remnants on a small area suggest there may have been a concrete batch plant at some point, though no record of such has been found. Currently the property is used as an informal recreation area for motor bike riding, walking, and running.

Land Use

The terminal would be on a 96-acre parcel of land on the East Skipanon Peninsula near the confluence of the Skipanon and Columbia Rivers at Warrenton, Oregon. Table 4.1.9-1 provides a summary of the acres of land affected by construction and operation of terminal facilities. This table includes onshore and offshore impacts. About 229.4 acres would be affected by the construction of the LNG terminal facilities and access road. About 221.7 acres of these impacts would be permanent and necessary for the operation of the Oregon LNG Project.

Construction of the onshore terminal facilities would affect about 71.3 acres within the 96-acre parcel, and about 69.0 acres would be needed for the permanent operation of the onshore facilities. Construction of the access road to the terminal would affect 6.2 acres and about 4.6 acres of the affected area would be needed for operation. The remainder of the parcel subleased by Oregon LNG would be kept in its current state as open space or wetlands.

[5] Coast Guard recommendations on the suitability of the waterway are included in the LOR issued by the Coast Guard on April 24, 2009. More detailed information regarding the Coast Guard's LOR and the safety and security recommendations that the Coast Guard has developed for the Oregon LNG project, and our recommendations for adopting and incorporating the Coast Guard's recommendations into the design and operation of the Oregon LNG Project, can be found in section 4.1.13.

Aquatic areas that would be affected include a 152.3-acre area of the Columbia River that would be used for construction of a ship berth, turning basin, and pier. About 148.2 acres of the affected area would be needed for the permanent operation of the marine facilities (see figure 2.1.1-1). Within the 152.3-acre marine construction area, Oregon LNG would dredge about 1.2 million cubic yards of sediment from about 83 acres of the river bottom (see figure 2.1.3-2). The dredged material would be placed at the EPA Deepwater Site as described in 2.1.1.1. Maintenance dredging of the turning basin and berth would also be required during operation.

Impacts on each land use type as a result of terminal construction and operation are summarized in table 4.1.9-1. Following construction, Oregon LNG would restore the terminal site as described in section 2.1.4.1.

Table 4.1.9-1

Land Use Impacts Associated with the Terminal (Acres)

Facility Component	Open Space		Wetlands		Right-of-way		Residential		Commercial/ Industrial		Open Water	
	Const	Oper	Const	Oper	Const	Oper	Const	Oper	Const	Oper	Const	Oper
Terminal Onshore Facility	35.9	35.3	34.8	33.3	0.3	0.1	0.0	0.0	0.3	0.3	0.0	0.0
Permanent Access Road	0.2	0.0	1.7	1.0	4.2	3.6	0.1	0.0	0.0	0.0	0.0	0.0
Berth Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	13.5
Turning Basin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.2	134.7
Pier	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	< 0.1	< 0.1
Total	36.1	35.3	36.5	34.3	4.5	3.7	0.1	0.0	0.3	0.3	152.3	148.2

Actual numbers may vary slightly because of rounding. Construction acres include the temporary footprint for construction and the permanent footprint for terminal operation.

Const = Construction

Oper = Operation

Open Space

Construction of the terminal and access road would temporarily affect 36.1 acres of open space. Operation of the Oregon LNG Project would result in a permanent loss of about 35.3 acres of open space for the terminal and access road. Vegetation would be cleared from the construction corridor as a necessary part of construction. Following construction, temporary construction workspace outside of the permanent terminal footprint would be allowed to revert to preconstruction conditions. The disturbed areas would be recontoured and revegetated to control soil erosion and replace habitat. Oregon LNG would use seed mixtures approved by state and federal resource agencies. Section 4.1.6.1 provides more information on impacts, restoration, and revegetation of open space.

Wetlands

Oregon LNG designed the terminal layout to minimize temporary and permanent disturbances of existing wetland areas. However, some wetland impacts would occur and include impacts on both estuarine and palustrine wetlands. Overall, the construction of the terminal and access road would impact about 36.5 acres of wetlands (about 47 percent of the total terminal land construction impacts). Operation of Oregon LNG Project would result in a permanent loss of about 34.3 acres of wetlands for the terminal and access road.

As discussed in section 4.1.4.1, following construction Oregon LNG would rehabilitate temporary freshwater wetland disturbance areas. Rehabilitation would initially involve seedbed preparation and control of noxious weeds. Some vegetation would regenerate naturally from the seedbank and vegetative propagules. For permanent, unavoidable wetland impacts, Oregon LNG would implement off-site compensatory mitigation. Accordingly, Oregon LNG proposes to offset unavoidable permanent impacts as a result of terminal construction by restoring estuarine wetland habitat near the mouth of the Youngs River. Section 4.1.4.1 provides more information on terminal wetland impacts and mitigation.

Right-of-way

Construction of the terminal and access road would impact about 4.5 acres of land within an existing right-of-way. Terminal operation would permanently impact about 3.7 acres of right-of-way for the terminal and access road.

Open Water

For the turning basin, 135.2 acres of open water would be needed for construction, and 134.7 acres would be permanently impacted during operation. For the berth, 17.1 acres would be impacted during construction and 13.5 acres would be permanently impacted. However, Oregon LNG has indicated that the dredged footprint for the turning basin and berth area is 83.0 acres, as a large area of the turning basin would not be dredged because it is already at the required depth of 45 feet or greater. The area permanently dredged for the berth and turning basin would result in a permanent impact on open water.

Oregon LNG would follow its Procedures to minimize temporary impacts on open water during construction. Construction timing constraints required by federal and state agencies would be incorporated into the construction schedule. Waterbody impacts, mitigation, and crossings are discussed in section 4.1.3.2.

Residential Land

Construction of the access road would temporarily affect about 0.1 acre of residential land. Operation of the terminal would not permanently impact any residential land. There is no residential land within the terminal site.

Zoning

Development at the terminal site is regulated by the City of Warrenton Comprehensive Plan and Development Code. In 2005, the City of Warrenton approved a Comprehensive Plan map amendment and rezone of the East Skipanon Peninsula and surrounding areas specifically to allow development of an LNG terminal. The Comprehensive Plan was updated in 2011.

The current Comprehensive Plan designation of the onshore terminal area is Especially Suited for Water Dependent Shorelands, and the terminal estuarine-marine facilities are designated as Aquatic Development. Especially Suited for Water Dependent Shorelands are defined as "managed for water-dependent industrial, commercial, and recreational uses." Aquatic Development areas include "areas suitable for deep-draft or shallow-draft navigation, including shipping, channels, access channels and turning basins; dredged material disposal sites and mining/mineral extraction areas; and areas adjacent to developed or developable shorelines which may need to be altered to provide navigational access or to create new land areas for water-dependent uses." The terminal and marine facilities would be consistent with the applicable policies for Aquatic Development areas.

The terminal would be within the City of Warrenton's Water Dependent Industrial Shorelands (I-2) zone, which allows for water-dependent industrial development or port uses, and specifically for "industrial docks, piers, moorage facilities" and "marine cargo transfer facilities," such as an LNG terminal. The terminal facilities would be consistent with the purpose of the I-2 zone and are described as a permitted use.

The terminal estuarine-marine facilities would be within the Aquatic Development (A-1) zone. "Water-dependent commercial or industrial uses" and "dredging and filling" are allowed to occur in the A-1 zone. The marine facilities proposed with the terminal and the proposed dredging for the ship berth and turning basin would be consistent with the purpose of the A-1 zone and are listed as permitted uses.

While dredging for the turning basin and ship berth is allowed in the A-1 zone, dredging within a "Development" management unit (i.e., the A-1 zone) would trigger Oregon Statewide Planning Goal 16 (Estuarine Resources) requirements outlined in the Lower Columbia River Estuary Program (LCREP) Comprehensive Conservation and Management Plan (LCREP, 2011). Project dredging would require further City of Warrenton review as well as ongoing coordination with agencies to develop a comprehensive final dredged material management plan.

Coastal Zone Management

The coastal zone for the state of Oregon extends from the Washington border on the north to the California border on the south; seaward to the extent of state jurisdiction as recognized by federal law (i.e., the territorial sea, extending 3 nautical miles offshore); and inland to the crest of the Coast Range.

Management of the coastal zone in Oregon is addressed in the OCMP which combines the state laws for managing Oregon's coastal lands and waters into a single, coordinated program management plan. Procedures for ODLCD coastal zone reviews are specified in federal regulations (15 CFR 930) and state regulations (OAR 660-035). As the state's designated coastal management agency, the ODLCD is responsible for reviewing projects for consistency with the OCMP and issuing coastal management decisions. The ODLCD's reviews involve consultation with local governments, state agencies, federal agencies, and other interested parties in determining project consistency with the OCMP.

The Oregon LNG Project (the terminal and portions of the pipeline) would be within the Oregon coastal zone in Clatsop and Tillamook Counties. Oregon LNG must demonstrate that the portion of the Oregon LNG Project in the Oregon coastal zone would be consistent with the statewide planning goals, applicable local comprehensive plans and land use regulations, and selected state authorities (e.g., those governing removal-fill, leases of submerged and submersible lands, water quality, water rights, and fish and wildlife protections) as part of the federal consistency review under the CZMA. Oregon LNG submitted its CZMA consistency certification to the ODLCD on July 3, 2013. In an October 16, 2013 letter, the ODLCD responded that it cannot concur that the Oregon LNG Project is consistent with the CZMA until the following authorizations are obtained:

- ODEQ Air Contaminant Discharge Permit, NPDES Individual and 1200-C permits, and 401 Water Quality Certification;
- ODSL Removal-Fill Permit, Proprietary Approval;
- OWRD Use Permit and Certificate (Water Right), Limited License; and
- Clatsop County, Tillamook County, and the City of Warrenton land use approvals.

The status of Oregon LNG's permits and approvals is summarized in table 1.5.4-1 (see section 1.5). If the Oregon LNG Project is authorized by the Commission, Oregon LNG would need to demonstrate that its project is consistent with the CZMA before FERC would allow any construction activities to begin. Therefore, **we recommend that:**

- **Prior to construction of the Oregon LNG Project, Oregon LNG should file with the Secretary documentation of concurrence from the ODLCD that the Oregon LNG Project is consistent with the CZMA.**

Land Ownership

The terminal site would be on a 96-acre parcel of land, which is owned by the State of Oregon and leased to the Port of Astoria by the ODSL. LNG Development Company, LLC, holds a long-term sublease for the parcel. We received a letter alleging that ODSL did not own the entire 96-acre parcel and that Pinnacle Long, LLC owns land within ODSL lands. However, ODSL confirmed in a letter dated October 6, 2008, that the State of Oregon does own the land, including the existing access road, and therefore the right to lease it. County records indicate that Pinnacle Long, LLC owns two properties (tax lot 100 and tax lot 1900) to the south of the ODSL lands. Tax lot 1900 is adjacent to the ODSL land on the southern side. Tax lot 100 is farther south near the Skipanon River.

The USACE is currently in litigation (quiet title action) with LNG Development Company, LLC in the U.S. District Court for the District of Oregon, Portland Division. At issue is which party has superior title to the terminal site: the USACE, by virtue of its 1957 dredged material disposal easement; or LNG Development Company, LLC, pursuant to its sublease over the area. As of April 20, 2015, the USACE's Amended Motion to Dismiss LNG Development Company, LLC's Amended Complaint (for lack of jurisdiction) is pending, for which oral arguments are yet to be scheduled.

Schools

No schools would be within 1.0 mile of the terminal. Impacts on schools are not anticipated during construction and operation of the terminal, aside from increased construction traffic on local roads in the vicinity, which would be temporary and short term. Information on measures Oregon LNG would implement to reduce impacts associated with increased traffic is presented in section 4.1.10. Safety is addressed in section 4.1.13.

Existing Residences and Commercial Areas

The closest communities to the terminal would be Warrenton and Astoria in Clatsop County, Oregon, and Chinook and McGowan in Pacific County, Washington. The closest residential areas would be in Warrenton, about 0.5 mile south and 0.6 mile west of the terminal site. In addition, there are residential areas along the shoreline between the Tansy Point and Hammond Marina, about 1.7 miles west. Other residences are scattered in the sparsely populated, unincorporated communities elsewhere along the waterway.

During construction and operation of the terminal, impacts on nearby residential and commercial areas would occur from increased traffic on local roads, dust, odors, and noise. In general, as the distance from the terminal increases, the severity of the impacts would decrease. Most of the impacts on nearby residential communities related to traffic, dust, and odors would be minor, temporary and short term. Information on measures Oregon LNG would implement to reduce impacts associated with increased traffic, dust, and noise is presented in section 4.1.10.

Dredging activities can sometimes result in odors, primarily due to hydrogen sulfides released from decaying organic material (e.g., plants) that occur in the dredged sediments. Generally, the greatest potential for odors is shortly after the dredged materials are brought to the surface and when the material is still wet (particularly when temperatures are warm). The sediments to be dredged from the turning basin site generally do not contain a high percentage of organic material and no upland disposal of the dredged sediments would occur. Additionally, the issue of odors associated with dredged material has not been particularly problematic for other dredging operations on the Columbia River. Therefore, we conclude dredging associated with the Oregon LNG Project would not cause, or contribute to, objectionable odors at nearby residential and commercial areas.

Planned Developments

There are 53 City of Warrenton 2014-2019 capital improvement projects planned in the area of the terminal and waterway including park, trail, street, utility, and marina improvements. There are no active private development proposals within 0.25 mile of the terminal. No impacts are expected on planned developments during the construction of the terminal facilities.

During operation of the terminal, the effects of LNG marine traffic on planned residential and commercial developments along the waterway would primarily be visual. Observers would see an LNG marine carrier for only a few minutes at any given location as it passes by. Large vessels in the Columbia River are already a common sight within the viewshed for the residential and commercial developments.

Recreation and Public Interest Areas

The terminal and waterway would not affect national parks or forests; Indian reservations; national wilderness areas; national wildlife refuges; waterfowl production areas; federally designated natural, recreational or scenic areas; registered natural landmarks; or national wild and scenic rivers. Several designated recreation and public interest areas would be in the general vicinity of the waterway for LNG marine traffic and the terminal. A number of local parks, campgrounds, recreational areas and trails would be within 2 miles of the waterway for LNG marine traffic and the terminal. The only existing recreational or public interest areas that would be within 0.25 mile of the terminal are the Lower Columbia River Water Trail and the Lewis and Clark National Historic Trail (LCNHT). These areas are described below, and safety related to the Zones of Concern is addressed in section 4.1.13.6.

Lower Columbia River Water Trail

The Lower Columbia River Water Trail stretches 146 miles in length from Bonneville Dam to the Pacific Ocean. The water trail is intended for use by people in nonmotorized boats, to travel for daily or overnight excursions along the free-flowing portion of the lower Columbia River. There are multiple launches, landings, and campsites along this segment of the river. Impacts on users of the water trail and proposed mitigation are described below under the *Recreational River Users* section.

The water trail is administered through the Lower Columbia River Water Trail Committee of the LCREP, a nonprofit corporation, whose goals include protecting the ecosystem, improving habitat, reducing river pollution, and educating the public. The NPS has provided community assistance to this water trail under the Outdoor Recreation Act of 1963. These grants have enabled the Water Trail Committee to inventory more than 70 waypoints along the trail and develop an interactive website to provide paddlers with trail information. The partnership owns no land or facilities along the trail. Instead, the water trail utilizes existing recreational facilities owned and operated by various city, county, or state government agencies in both Oregon and Washington.

Warrenton/Astoria Parks and Trails

The Warrenton Waterfront Trail is a 4.5-mile trail that extends from Seafarers Park to Skipanon River Park. Seafarers Park has open space, picnicking, links to trails, and wildlife viewing. Carruthers Park has a picnic area, walking trails, restroom, and dog park. Fisherman's Memorial Lighthouse Park is a memorial to sailors and contains a lighthouse and historic objects. Skipanon River Park has picnic tables, links to trails, and a nonmotorized boat dock. Warrenton City Park contains a playground and sports field and the Warrenton Soccer Complex has soccer fields. The Airport Dike is a 2-mile-long trail on the north side of the Port of Astoria Airport.

Tapiola Park in Astoria was established in 1941 by members of the Finnish Brotherhood and includes a skate park in a former swimming pool and an educational playground. A restored 1913 trolley runs for about 3 miles between Basin and 39th Streets in Astoria. Because all of the Warrenton/Astoria parks and trails would be over 1 mile away from the terminal, construction and operation impacts are not anticipated.

Lewis and Clark National Historic Trail

The LCNHT traces the journey of the "Corps of Discovery" expedition of 1804-1806 led by Meriwether Lewis and William Clark, and was authorized by the National Trails System Act of 1978. The trail extends about 3,700 miles, crossing 11 states from Wood River, Illinois to the mouth of the Columbia River. The LCNHT is administered by the NPS, but includes lands in federal, tribal, state, county, local, and private jurisdictions. Trail infrastructure in the area is a mixture of motor routes, land trails, water trails, waysides, visitor centers, parks, and overlooks. There are 11 official interpretive centers along the LCNHT, and many other unofficial partnering centers operated by various entities. The mission of the NPS is to preserve remnants of the LCNHT, and to provide a comprehensive interpretation of its history, to allow for better visitor understanding and appreciation of its significance (NPS, 2006). The portion of the waterway for LNG marine traffic from the mouth of the Columbia River to Young's Bay overlaps the LCNHT. The LCNHT is further addressed in section 4.1.11.

Lewis and Clark National Historic Park

The Lewis and Clark National Historic Park (LCNHP) is at the western terminus of the LCNHT. The LCNHP was created by Congress in 2004, expanding the Fort Clatsop National Memorial, originally established in 1958, by adding other sites at the mouth of the Columbia River related to the Lewis and Clark expedition. The purpose of the LCNHP is to preserve and interpret resources associated with the Corps of Discovery's 1805-1806 winter encampment near the Pacific Ocean at Fort Clatsop. The legislation directed the NPS to work with Oregon and Washington State Parks to promote visitor use and cooperative management (Applegate et al., 2005).

Under the umbrella of the NPS, the LCNHP is made up of 12 park sites along the Pacific Coast from Long Beach, Washington to Cannon Beach, Oregon. Two state parks, Fort Stevens State Park and Cape Disappointment State Park, would be within 2 miles of the waterway. In addition, the terminal would be visible from Fort Columbia State Park and the Dismal Nitch and Station Camps. The terminal may cause visual impacts for recreational visitors of the LCNHP. Visual impacts are addressed in section 4.1.9.1.

Fort Stevens State Park

Fort Stevens is an Oregon State Park covering about 3,700 acres at the mouth of the Columbia River, west of Hammond, Oregon, between the Pacific Ocean and Trestle Bay. A former federal military installation, the park includes the remains of gun batteries and the commander's station as well as a military museum. Also part of Fort Stevens State Park, are the remains of the Peter Iredale shipwreck,

Coffenbury and Swash lakes, wildlife viewing platforms, bike paths, and hiking trails, including the northern trailhead for the Oregon Coast Trail. Fort Stevens State Park has the largest public campground of any state park in Oregon.

Cape Disappointment State Park

Cape Disappointment is a Washington State Park. It encompasses 1,882 acres on the Long Beach peninsula, between the Pacific Ocean and the Columbia River, in Pacific County, Washington. This park is associated with the LCNHP and provides access to the Lower Columbia River Water Trail. Cape Disappointment State Park includes the historic location of Fort Canby, two historic lighthouses (North Head Lighthouse on the Pacific Coast and Cape Disappointment Lighthouse on the Columbia River), the Lewis and Clark Interpretive Center, Thomas Jefferson Memorial, Colbert House Museum, amphitheater, ball fields, boat ramp and dock, picnic area, campsites and cabins, and hiking trails.

Fort Columbia State Park

Fort Columbia, a Washington State Park, is a 593-acre day-use historical park. The park includes an interpretive center with information on the Chinook Native American culture and fort history, an observation station, 12 historic wood-frame fort buildings, hiking trails, and picnic tables.

Dismal Nitch and Station Camps

The Dismal Nitch and Station Camps were used by Lewis and Clark on their route to the Pacific Ocean. Dismal Nitch Camp is adjacent to the Megler Rest Area along the north shore of the Columbia River and Washington State Route 401. Station Camp is also on the Washington shore of the Columbia River, 4 miles downstream of Dismal Nitch Camp. Both sites include interpretive signs.

Clatsop State Forest

The Clatsop State Forest, comprising over 154,000 acres, is the only public forest in Northwestern Oregon and is administered by the Astoria District of the ODF. According to the ODF (2010), the Clatsop State Forest is 98 percent Board of Forestry Lands. These lands were privately owned and logged between 1910 and 1940, and when Clatsop and Columbia Counties foreclosed due to landowners not paying their taxes, the counties deeded these cutover and unmanaged forest lands to the Board of Forestry to manage as a state forest. The remaining 2 percent of the Clatsop State Forest is Common School Fund Lands. The *Clatsop State Forest Astoria District Recreation Management Plan* (ODF, 2000) outlines the implementation of recreation management in the state forest through objectives and actions, activity zoning, and the type of facilities the ODF would develop and manage.

Recreational uses in the Clatsop State Forest occur along roads and waterbodies. Recreational activities include hunting, fishing, dispersed or campground camping, off-road vehicle (ORV) use, horseback riding, mountain biking, hiking, and scenic viewing (at viewpoints), and some interpretation.

Portions of Clatsop State Forest are just south and east of the City of Astoria. The only effect the terminal may have on recreational visitors to the Clatsop State Forest would be visual impacts for viewers using the forest. Visual impacts are addressed in section 4.1.9.1.

Marinas and Boat Launches

Marinas and boat launches along the LNG waterway are listed in table 4.1.9-2 and discussed in this section.

Table 4.1.9-2

Marinas and Boat Launches along the LNG Waterway

Marina or Boat Launch	County, State
Hammond Marina and Boat Launch	Clatsop, OR
Warrenton Marina and Boat Launch	Clatsop, OR
Skipanon Marina and Boat Launch	Clatsop, OR
Port of Astoria West Mooring Basin Marina	Clatsop, OR
Cape Disappointment Boat Launch	Pacific, WA

The Hammond Marina, at about RM 8.6, includes a four-lane boat ramp, 220 slips, and overnight moorage for both commercial and recreational vessels. Two Columbia River Pilot cutters operate out of this marina. The entrance to the Hammond Boat Basin is 1,410 feet from the federal navigation channel.

The Warrenton Marina has a two-lane boat ramp and 370 slips. There are an additional 133 slips at the Skipanon Marina. The Warrenton Marina is up the Skipanon River from the Columbia River. The ship berth on East Skipanon Peninsula would extend into the Columbia River near the federal navigation channel leading towards the Warrenton Marina on the Skipanon River. LNG marine carriers docking or undocking would hinder boat movement in and out of the Skipanon River for the 10 to 20 minutes it would take the LNG marine carriers to travel between the berth and the federal navigation channel. We conclude this would be a minor impact given the twice weekly frequency of LNG marine carrier visits.

The Port of Astoria West Mooring Basin marina for recreational boaters contains 335 slips and has moorings for craft up to 100 feet long. The West Mooring Basin is near RM 14.0. Construction and operation of the terminal would not impact these marinas and or commercial and recreational boats when moored in the marinas.

The Cape Disappointment boat launch includes a boat ramp and 135-foot dock in Cape Disappointment State Park.

Recreational River Uses

Recreational river activities include fishing, boating, water-skiing, kayaking, windsurfing, kite surfing, kayaking, canoeing, personal watercraft, sunbathing, sightseeing, wildlife viewing, hiking, camping, picnicking, and beach combing.

Recreational fishing occurs most frequently during the summer months (averaging about 300 private fishing boats in the waters of the Columbia River estuary per day between June and August). A popular recreational Chinook and coho salmon fishery, referred to as the "Buoy 10" fishery, occurs during late summer in the lower Columbia River estuary from about RM 2 upstream to about RM 18.3. The proposed terminal is in the mid-region of the Buoy 10 fishing area (RM 11). In addition, the white sturgeon fishery has become a popular fishery in the lower Columbia River. There is a small recreational smelt fishery, and surf smelt are targeted by dipnet fishers during their spawning period (WDFW, 2013a). The recreational fishery for Dungeness and red rock crab is popular in the lower Columbia River estuary and occurs primarily in the marine zone, with some crabbing in the brackish water of the LNG marine carrier transit route in the vicinity of the proposed terminal. According to ODFW (2008d), the estimated average annual recreational crab boat count in the Columbia River downstream of the Astoria-Megler Bridge is 4,055 boats, with the peak month being October (850 trips) and the peak season from June to January. Section 4.1.10.1 provides additional discussion on recreational fisheries in the lower Columbia River.

Recreational boaters can reach the lower Columbia River from upstream boat ramps and marinas. Additionally, along the waterway to be used by LNG marine carriers there are Columbia River accesses for recreational boaters. In Pacific County, Washington, there are boat launches at Cape Disappointment State Park, Ilwaco, and Chinook. In Clatsop County, Oregon, there are boat launches at Hammond, Warrenton, Youngs Bay, and Astoria.

Recreational boat operators may have to move to a prescribed distance while an LNG marine carrier passes by. However, this inconvenience would only last for a few minutes, as the LNG marine carriers would travel at speeds between about 4 and 12 knots. Operators of personal watercraft such as jet-skis, and kayakers, canoers, and windsurfers typically stay in shallow waters outside of the federal navigation channel, but they may be affected by wakes from LNG marine carriers. Large commercial ships that currently travel through the lower Columbia River already create wakes of similar size to those that would be generated by LNG marine carriers, and jet-skiers, kayakers, and canoers should be familiar with how to deal with wakes from large ships.

Little, if any, windsurfing occurs in the waterway that would be used by LNG marine carriers. These activities typically take place in the shallow areas of the river, away from the federal navigation channel. Therefore, the Oregon LNG Project would not be expected to have any direct impacts on windsurfing or kite surfing activities.

LNG marine carriers should not have significant negative impacts on sunbathing, beachcombing, sightseeing, wildlife viewing, hiking, swimming, camping, and picnicking. There are no developed recreational beaches immediately adjacent to the waterway to be used by LNG marine carriers.

The public raised concerns regarding the possibility of the ship berth impeding use of the federal navigation channel. However, no facilities constructed as part of the ship berth would be within the federal navigation channel. Navigational marking and operation of the structures would be conducted in accordance with applicable Coast Guard and USACE regulations. The Coast Guard's LOR outlines a number of safety and security recommendations for LNG marine carrier operation within the federal navigation channel that have the potential to affect other river users. The Coast Guard has recommended measures to make the waterway suitable for the type and frequency of marine traffic associated with the Oregon LNG Project, as described below.

- Use a moving safety/security zone to be established around LNG marine carriers, and extending 500 yards around the vessel (but ending at the shoreline) while in transit. No vessel would be able to enter the safety/security zone without first obtaining permission from the Coast Guard. The expectation is that the Coast Guard's representative would work with the pilots and patrol vessels to control river traffic, and would allow vessels to transit the safety/security zone on a case-by-case assessment conducted on scene.
- Establish a 200-yard security zone around the LNG marine carrier while the carrier is moored at the facility and 50-yard security zone around the LNG terminal when an LNG marine carrier is not present at the dock.
- Prior to the first transit of an LNG marine carrier, develop a Transit Management Plan in coordination with river pilots, bar pilots, escort tug operators, and the Coast Guard.
- Do not overtake an LNG marine carrier without prior Coast Guard approval.
- Prearrange all meetings of LNG marine carriers with commercial vessels via radio communications, and restrict meetings to certain areas under certain conditions.

- Coordinate vessel transits and bar crossings so as to minimize conflicts with other deep draft vessels, recreational boaters, seasonal fisheries, and other marine events. Oregon LNG has also indicated it would schedule LNG marine carriers to travel at night or when the number of fishermen has decreased during the Buoy 10 fishing season (about August 1 to Labor Day).

More detailed information regarding the Coast Guard's safety and security recommendations for the Oregon LNG Project, and our recommendations for adopting and incorporating the Coast Guard's recommendations into the design and operation of the Oregon LNG Project, can be found in section 4.1.13.

We received comments regarding recreational use restrictions in the Columbia River as a result of the Oregon LNG Project. Operational activities of the terminal itself would not affect recreational uses of the Columbia River. Additionally, the distance of the proposed berth location from the Skipanon River is sufficient so that the 200-yard security zone would not cross the Skipanon River shipping channel when LNG marine carriers are at the berth. LNG marine carriers docking or undocking would only hinder boat movement in and out of the Skipanon River for the approximately 10 to 20 minutes it takes the LNG marine carriers to travel between the berth and federal navigation channel. The terminal would be restricted and public access would not be allowed. Recreational use in the terminal area would be limited to designated areas, such as the Lower Columbia River Water Trail.

Dredging and other terminal construction activities would not affect ship traffic within the federal navigation channel. Recreational vessels would be restricted from the construction area during construction and from the security zones at the terminal during operation. However, the restrictions during construction would be temporary and the security zones would present a minor inconvenience relative to the size of the river at this location.

Commercial River Uses

Commercial activities along the lower Columbia River include shipping, commercial fishing, charter boat services, cruises, ship piloting (both along the river and at the bar), tugboat operations and long-shoring, and miscellaneous shore-based activities in the Astoria area. Construction of the terminal is not anticipated to affect commercial river uses in the federal navigation channel.

Commercial fisheries in the lower Columbia River include those for salmon, smelt, sturgeon, shad, and anchovy. The primary method of commercial harvest is gill netting, and the largest fishery is Pacific salmon. A select-area fishery exists in Youngs Bay, in which juvenile Chinook and coho salmon are reared in net pens and released as smolts into estuarine waters. The Youngs Bay net pens are at the mouth of the Youngs River about 4 miles east of the proposed terminal. The commercial fishing area does not include the proposed terminal location, but instead encompasses an area to the east, including those waters of Youngs Bay (North et al., 2004). Gillnet fishing also occurs for white sturgeon and shad. Northern anchovy and Pacific sardine are harvested with purse seines. Commercially important invertebrates include Dungeness crab and ghost and mud shrimp. Section 4.1.10.1 provides additional discussion on commercial fishing in the lower Columbia River.

The average number of ships crossing the Columbia River bar each month has been declining since the late 1990s, from 321 a month from 1998 through 2002 to about 276 from 2003 through 2011 (Columbia River Bar Pilots, 2012). Most of these ships are traveling to or from ports upriver of the terminal. In addition to ships passing by the terminal area, cargo ships are frequently seen docked at berths or waiting offshore in the general terminal area at Tansy Point, Astoria, and the Hampton Affiliates (formerly Weyerhaeuser) facility. The project would add about 125 LNG marine carriers per year to the

existing marine traffic. The use of the federal navigation channel by LNG marine carriers would be consistent with its current use by other commercial ships. The increase of 125 vessels per year from the Oregon LNG Project represents an increase in large vessel traffic by about 3 to 4 percent over the average levels between 2003 and 2011. The LNG marine carriers would be limited to movement within the federal navigation channel and proposed turning basin at the terminal.

The Port of Astoria receives ship calls from a number of river-based cruise vessels (riverboats) and ocean-going cruise ships. These ships would pass the terminal during arrivals and departures. The riverboats vary in size, with the larger vessels carrying 200 to 250 passengers. The cruises begin in Portland, Oregon, with stops along the Columbia, including Astoria. The riverboats moor at the Astoria Maritime Museum dock upriver of the Astoria-Megler Bridge; however, a small number of riverboats pass the Astoria-Megler Bridge and approach the Columbia River Bar. The riverboat cruising season is year-round, though the majority of the river cruise boat visits in Astoria occur from spring through fall. The combined number of cruise ship and river cruise calls at the Port of Astoria has decreased while the number of passengers has increased, from about 134 vessel calls and 20,000 passengers in 2000 to about 97 vessel calls and 27,500 passengers in 2007.

In 2013, 21 cruise ships were scheduled to call at the Port of Astoria. Oregon LNG coordination with the Port of Astoria and cruise ship representatives indicated that their only concern was that the LNG marine carriers not affect the arrival and departure schedules of the cruise ships. The cruise ships typically arrive at about 8:00 AM and depart around 5:00 PM, which allows passengers limited time to disembark and visit Astoria and the surrounding attractions. If the LNG marine carriers arrived during the arrival or departure of the cruise ships, cruise ship operation would be affected. The Coast Guard's recommendations in its LOR Analysis (see section 4.1.13.8) include coordination of inbound and outbound transit details between the Coast Guard, Federal Bureau of Investigation, bar and river pilots, escort tug masters, and other escort assets 24 hours prior to arrival. Subsequent coordination meetings or phone call confirmation would be required 4 hours prior to arrival and 1 hour prior to arrival. This provision would avoid conflicts between LNG marine carrier and cruise ship schedules.

About two to three tug or tug/barge combinations currently transit past the terminal site each day. There is an average of 40 monthly (20 inbound and outbound) tug and barge transits passing the terminal site. These transits can be anytime during the day or night except for the Tidewater tugs, which normally conduct their work at the Warrenton Fiber Plant on Tansy Point between 3:00 a.m. and 12:00 p.m. on Monday, Wednesday, and Friday. Representatives of the tug companies indicated that their primary concern was that the tugs must be able to transit past the terminal and LNG vessels moored at the facility while remaining in the channel. The moored LNG marine carrier and 200-yard security zone around the LNG marine carrier while the carrier is moored at the facility would not impact the movement of vessels in the shipping channel nor would it limit movement in and out of the Skipanon Waterway.

Special Land Use Areas

Hazardous Waste Sites

No landfills or hazardous waste sites are in the waterway or within 0.25 mile of the terminal (EPA, 2013a).

Military Installations

The Tongue Point Naval Air Station was established in 1940 on the east side of Astoria, Oregon. In 1964 the Coast Guard Astoria Air Station was at the Tongue Point Naval Air Station. It was relocated to the Astoria Regional Airport southeast of Warrenton in 1966. The Coast Guard maintains an Aid to

Navigation Team at Tongue Point and has docking facilities for cutters along the Astoria waterfront. The Coast Guard also operates a life boat station at Cape Disappointment in Ilwaco, Washington. Terminal construction and operation activities would not impact the Coast Guard facilities.

Astoria Regional Airport

The Astoria Regional Airport, owned and operated by the Port of Astoria, is a general aviation airport in Warrenton. Terminal construction would not impact the Astoria Regional Airport.

The LNG storage tanks at the terminal would extend 25.5 feet into airspace of the Astoria Regional Airport. We received several comments that relayed concern about the potential for a collision of an airplane with the terminal facilities, specifically the LNG storage tanks.

The FAA reviewed the location of the LNG storage tanks on the East Skipanon Peninsula in relation to flight operations at the Astoria Regional Airport and determined the storage tanks pose no hazard to air navigation (FAA, 2011). For each of the two LNG storage tanks, the FAA conducted an aeronautical study on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules. They issued a "Determination of No Hazard to Air Navigation" in November 2008.

Under the terms and conditions of the FAA determination, Oregon LNG would minimize the overall height of the tanks by mounting any ladders, walkways, valves, and vent lines on the side of the storage tanks instead of on the top as in typical configuration for LNG storage tanks. Oregon LNG would also place navigation lights on the tanks per FAA guidance. In addition, Oregon LNG would upgrade the conventional very high frequency omni-directional radio navigational signal at the Astoria Regional Airport to a new Doppler very high frequency omni-directional radio to mitigate the impact of the two LNG storage tanks on the existing navigation signals. These measures would allow for the intrusion of the LNG storage tanks into the navigation airspace without disrupting visual or instrument flight paths.

Visual Resources

Oregon LNG conducted a visual impact assessment to determine the potential impacts on the visual resources associated with the terminal and waterway. The assessment was based on methodology in the Federal Highway Administration's (FHWA) *Visual Impact Assessment for Highway Projects* (FHWA, 1989). FHWA's methodology begins by establishing the Oregon LNG Project's viewshed, which is generally defined as the overall project setting.

Visual impacts are then described using Key Observation Points (KOPs) which are selected to depict existing visual conditions and visual quality from representative areas within the Oregon LNG Project area and to illustrate changes to the viewed landscape and how those changes would affect visual quality. Six KOPs were analyzed by Oregon LNG. Table 4.1.9-3 describes these points and the following sections describe the potential impacts of the terminal and waterway. The locations of the six KOPs are shown in figure 4.1.13-12.

We received comments about visual impacts from the Astoria Column and Fort Clatsop. Oregon LNG analyzed the Astoria Column KOP as indicated in table 4.1.9-3. Fort Clatsop, which is about 3 miles southeast and inland of the terminal site, was not analyzed as a KOP because intermediate vegetation and land features preclude a view of the Columbia River and proposed terminal site from Fort Clatsop.

The following sections provide a description of the viewshed and the KOPs in terms of existing conditions and potential impacts.

Table 4.1.9-3

Key Observation Points

Key Observation Point (KOP)	Description
Tansy Point KOP 1	Tansy Point is at the end of NE 13th Street Circle near Tansy Point, immediately south of the Warrenton Fiber facility. The distance to the LNG storage tanks is about 0.9 mile, and the distance to the unloading platform is about 1.1 miles. The viewpoint offers expansive views that include the Columbia River, Astoria, and the heavily forested West Skipanon Peninsula. While this location offers the best public view of the terminal, it is not well marked, does not have many facilities, and is not used by a large number of people. Tansy Point consists of a traffic circle and informal parking and is mostly used by nearby employees of the Warrenton Fiber facility and local residents who drive there to enjoy the view. The view has a largely undisturbed natural character, although some human-made elements (the Youngs Bay Bridge and parts of Astoria) can be seen in the background distance zone.
Warrenton Boat Basin KOP 2	The Warrenton Boat Basin is at the south end of the East Skipanon Peninsula on an unpaved access road that branches off of Northeast Harbor Place. The road is used to access a public ramp and floating boat dock. Views are generally restricted to the boat basin area but also extend beyond the basin to the forested part of the East Skipanon Peninsula.
East Skipanon Peninsula, Western Dike Road KOP 3	The East Skipanon Peninsula Western Dike Road is at the end of NE Heron Avenue, at the access gate to the dike road, which extends north to south next to the Skipanon River. Situated at the south end of the East Skipanon Peninsula, views of the terminal would be to the north. The Warrenton harbor is directly adjacent to the west. The area is mostly used by local residents who utilize the dike road and unofficial trails for riding motorcycles and ORVs. The area is also used by recreationists such as hikers and photographers.
East Bank Skipanon Peninsula, Eastern Dike Road KOP 4	The Eastern Dike Road is northwest of the Youngs Bay Bridge (SR 26 and U.S. Highway 101 on the far eastern side of the East Skipanon Peninsula. This location affords expansive views of the Columbia River and the State of Washington along the north bank of the river. Viewers include those driving west from Astoria towards Warrenton and points beyond.
Youngs Bay Bridge KOP 5	The Youngs Bay Bridge crosses Youngs Bay at U.S. Highway 101. Views of the bay and the East Skipanon Peninsula are visible from this location. Viewers are mostly local residents and tourists who drive across the bridge between Warrenton and Astoria.
Astoria Column KOP 6	The 125-foot-high Astoria Column is on Coxcomb Hill and offers panoramic 360-degree views from a viewing platform. From this location looking west, residential areas situated above the main portion of Astoria are visible, as is the Youngs Bay Bridge, the Skipanon Peninsula, Warrenton, the Warrenton Fiber and Hampton Affiliates facilities, the mouth of the Columbia River, and the Pacific Ocean beyond. The column is a popular regional attraction and receives heavy visitation from visitors and residents.

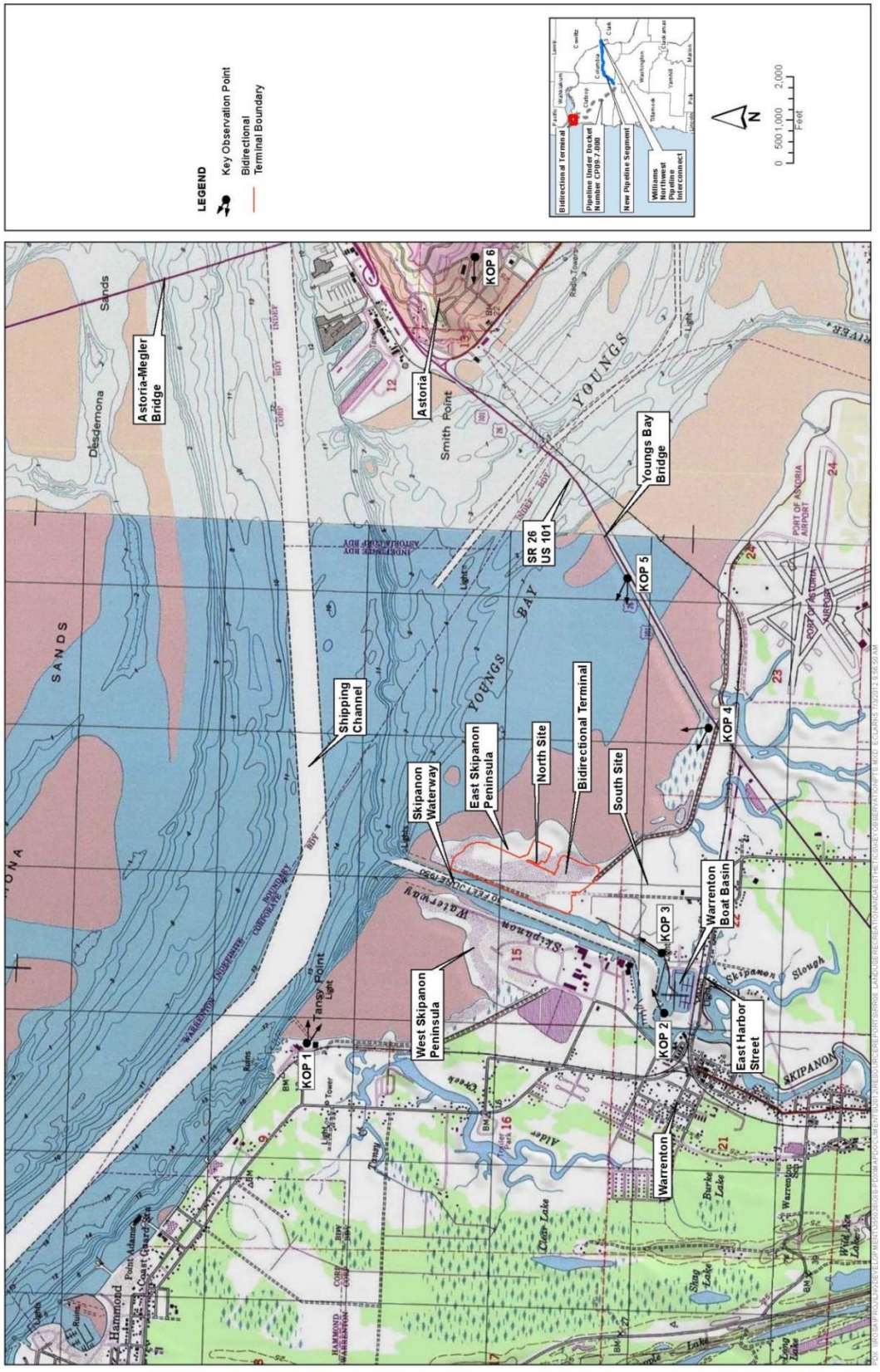


Figure 4.1.9-1: Key Observation Points

Warrenton Area Viewshed

The terminal would be within the City of Warrenton. The terrain is generally flat in the portion of Warrenton near the terminal area and nearby waterway viewshed. Due to the fairly flat terrain, areas of heavy vegetation block views towards the terminal site from the west side of the waterway between the Hampton Affiliates facility and Tansy Point, and areas immediately north of East Harbor Street between its intersection with Highway 26 and the Warrenton Boat Basin. Much of the area west of the waterway is privately owned and industrial in use. The Hampton Affiliates lumber mill is the largest business in the area.

Land uses around the Warrenton Boat Basin south of the waterway consist primarily of marine-related businesses and facilities for commercial fishing, although a multifamily residential development is at the north end of the basin. Access roads branch off of East Harbor Street providing the public access to the area, which has the character of a working harbor. Viewers consist of the owners and employees of marine-related businesses and fishing boats, recreationists, residents, and people moving through the area.

The south and southwest portion of the viewshed is mostly flat and undeveloped, except for the southeastern-most portion area, which contains retail shopping centers. It contains a mixture of plant communities and vegetation types, numerous ORV user created trails, and areas with dumped debris. Viewers are mainly recreationists such as ORV enthusiasts, wildlife viewers, or those working or shopping at the shopping centers.

The terminal's components would have an insignificant impact on the visual quality of the Warrenton area, with the exception of the very far eastern part of Warrenton next to Youngs Bay. At the east end of NE 13th Street Circle near Tansy Point, the terminal components would be clearly visible to the general public. The presence of the LNG storage tanks and the offshore facilities would be noticeable and would change the visual quality of the area.

Most of the terminal would not be visible from the Warrenton Boat Basin area. The most visible components would be the tops of the LNG storage tanks and the Oregon LNG Project's 230-kV power line (a nonjurisdictional facility). The tops of the tanks would be seen from areas within and near the boat basin, but would not dominate views. The LNG storage tanks would be more visible from the waterway than from the boat basin. However, the area already includes industrial uses such as the Warrenton Hampton Affiliates facility (and other commercial buildings) on the west side of the waterway and therefore would not significantly change the visual quality of views from the waterway. The power line would be seen beyond the dike that forms the east side of the boat basin and waterway. However, it would be similar in character to other nearby power lines that can be seen in the vicinity of the boat basin and would have negligible effects on the visual quality of the area.

The terminal's components would be closer to the southern part of the East Skipanon Peninsula than to most of Warrenton. Views from along the dike road that forms the east side of the East Skipanon Peninsula would include the storage tanks, associated buildings, pier, and berthed vessels. Although Oregon LNG has proposed to include a color scheme on the storage tanks that would blend in with the surroundings, a landscaped buffer along the southern side of the terminal, and measures to minimize lighting impacts; the presence of the facility would be noticeable and the visual quality of the area would change.

Tansy Point – KOP 1

The distance from KOP 1 to the LNG storage tanks would be about 0.9 mile and the distance to the loading/unloading platform is about 1.1 mile. The two LNG storage tanks would be clearly seen from

this location, as would the access pier. The loading/unloading platform and arms would also be seen. The tanks would introduce two large, cylindrical, human-made elements to the viewed landscape. The tanks would contrast in scale, form (shape), and color with their surroundings, although the potential effects from color would be reduced by using a bluish-gray color scheme to help visually break up the mass (form) of the tanks relative to the other structures that would be visible from this location. A muted green color scheme for these other structures would be similar to nearby vegetation, blending with the natural surroundings, and preventing them from appearing more prominently in the view.

Terminal lights would add to the lights in the background distance zone that can currently be seen from this location that include parts of Astoria, the Astoria-Megler Bridge, and lights on the Washington side of the Columbia River. Lights from the Warrenton Fiber facility to the immediate north can also be seen from this location. Aviation lights on top of the two LNG storage tanks would be seen as would navigation and safety lights on the access pier, loading/unloading dock, and dolphins (only navigation lights).

The pier would interfere with some of the view up the Columbia River. Moored LNG marine carriers would also be seen from this location and would temporarily block some of the view up the Columbia River. Berthed LNG marine carriers would also be seen at the end of the access pier and would require lights for the same reasons as the access pier and loading/unloading dock. The addition of the lights to the existing lights seen from this location would somewhat intrude on night views, but would not be expected to affect many viewers.

The existing view from Tansy Point is provided in figure 4.1.9-2. A simulated view of the terminal with an LNG marine carrier at berth is shown in the same figure.

Warrenton Boat Basin – KOP 2

The terminal and LNG storage tanks would be about 1 mile away from the boat basin. Although the tops of the tanks would be seen above the horizon when viewed from this location, the presence of the commercial fishing boats' rigging in front of the tanks and the many other objects in this visually busy area would distract the viewer so that the tanks would not be very noticeable. The red aviation lights on top of the tanks would be seen from this location, but would have little to not effect on nighttime views. The existing view from the Warrenton Boat Basin is provided in figure 4.1.9-3. A simulated view of the terminal and storage tanks is shown in the same figure.

East Bank Skipanon Peninsula, Western Dike Road – KOP 3

The LNG storage tanks would be about 0.6 mile away from this location. The storage tanks, along with the flare, stacks, liquefaction process enclosures, and ancillary structures, would be noticeable from this location, but would not dominate the view. Oregon LNG proposes to screen views by planting a landscaped buffer along the southern side of the terminal site to screen views. Red aviation lights on top of the tanks would also be seen from this location, but given the presence of the lights associated with the Warrenton Boat Basin and the Hampton Affiliates facility, the addition of the red aviation lights would have little to no effect on nighttime views from this location. The existing view from the Western Dike Road is provided in figure 4.1.9-4. A simulated view of the terminal and landscaped buffer is provided in the same figure.



Existing Conditions



Proposed Conditions

Figure 4.1.9-2: Key Observation Point 1 – Tansy Point



Existing Conditions



Proposed Conditions

Figure 4.1.9-3: Key Observation Point 2 – Warrenton Boat Basin



Existing Conditions



Proposed Conditions

Figure 4.1.9-4: Key Observation Point 3 – East Bank Skipanon Peninsula, Western Dike Road

East Bank Skipanon Peninsula, Eastern Dike Road – KOP 4

The LNG storage tanks would be about 1 mile away from this location, and the loading/unloading platform would be about 1.3 miles away. The LNG storage tanks and liquefaction process enclosures would be clearly seen against the horizon from this location, as would the flare, main column heat exchanger stacks, and ancillary structures. The access pier, loading/unloading platform, and loading/unloading arms would also be seen low on the horizon. Similar to KOP 1, the tanks would introduce large, cylindrical, human-made elements in the landscape. The tanks and other visible structures would contrast in scale, form (shape), and color with their surroundings, although the potential effects from color would be reduced by the color scheme of blush-gray and muted greens and browns, which would help visually break up the mass of the tanks and buildings by reducing color contrast with nearby vegetation.

The pier would be less visible, but would intrude on views towards the mouth of the Columbia River. Berthed LNG marine carriers would also be seen from this location and would temporarily block some of the view towards the mouth of the Columbia River area. Several buildings and facilities would also be visible from this area, but would likely be somewhat hard to see in many conditions due to their colors.

Lights associated with the terminal would be seen from this location, but their potential effects would be tempered by the nearby lights associated with the commercial developments along SR 26 and East Harbor Street. The aviation lights on top of the storage tanks would be seen, as would navigation lights on the access pier, loading/unloading dock, and dolphins. Lights for berthed LNG marine carriers would be seen at the end of the access pier.

The existing view from the East Skipanon Peninsula Eastern Dike Road is provided in figure 4.1.9-5. A simulated view of the terminal and LNG marine carrier at berth from the roadway is provided in the same figure.

Astoria Area Viewshed

The City of Astoria is on a peninsula surrounded by the Columbia River to the north and west, and Youngs Bay/Youngs River to the south. The East Skipanon Peninsula forms the west side of Youngs Bay and is generally south of Astoria. Therefore, the majority of the views from Astoria are oriented into the Columbia River to the north and west, away from the terminal site. In addition, the majority of the City of Astoria, including the downtown district, sits east of the Astoria-Megler Bridge in an area sloped directly north away from the terminal site. Therefore, the terminal would not be visible from much of this area. In addition, areas of heavy vegetation, buildings, and structures block many views of the terminal site in the northern and western sections of Astoria.

The northwestern portion of Astoria is north of the Pacific Coast Highway (Highway 101) and would be nearest to the terminal site. The Port of Astoria and several industrial businesses are in this area. Views of the terminal site in this area are often blocked by industrial buildings. Most viewers in the area closest to the terminal site are employees of the industries in the area.

Land uses farther south along the east side of Youngs Bay are mainly residential with some commercial use directly adjacent to Business Route 101. However, Business Route 101 and the Youngs Bay Bridge (Highway 101), which spans Youngs Bay, are between this portion of Astoria and the terminal site. Views towards the terminal site in this area would be blocked by elevated portions of the highway and the bridge.

The distance of the terminal from the parts of Astoria that are within the Oregon LNG Project's viewshed would range from 1 to 2 miles away at the Youngs Bay Bridge to over 5 miles farther inland. Due to the distance and lack of available viewing areas, the terminal would have little effect on the visual quality of most of the Astoria area. The storage tanks, offshore facilities, and berthed carriers would be seen to varying degrees from within the viewshed, but would have negligible effects on views. At night, FAA-required lights on the two LNG storage tanks would potentially be seen, as would navigation lights on the offshore facilities and berthed carriers. Operational lighting associated with the liquefaction facilities and cooling towers would also be directly visible from the Astoria area, except for views from the East Bank Peninsula, in which vegetation would partially to completely block these structures. The terminal would not be visible from the LCNHP/Fort Clatsop Interpretive Center. The portion of the viewshed that would be most affected by the terminal would be the Youngs Bay Bridge. The storage tanks, pier, and berthed carriers would be very visible from the bridge. However, views from the bridge would be from moving vehicles and of short duration.

Youngs Bay Bridge – KOP 5

The LNG storage tanks and liquefaction process enclosures would be about 1.5 miles away from the Youngs Bay Bridge and the loading/unloading platform about 1.4 miles away. The storage tanks would be clearly seen against the horizon from this location, adding large human-made elements to the view. However, as discussed previously, the potential effects would be reduced by coloring the tanks to blend with the surrounding environment, visually breaking up the mass (form) of the tanks. The terminal buildings would also be seen from this location, but the color scheme would make them less noticeable.

The flare, main column heat exchanger stacks, access pier, loading/unloading platform, and loading/unloading arms would also be seen, but to a lesser degree. Similar to the view from Tansy Point, moored LNG marine carriers would also be seen from this location and would temporarily block some of the view towards the mouth of the Columbia River area.

People driving west of the Youngs Bay Bridge would see the red aviation lights of the two tanks as well as navigation lights on the access pier, loading/unloading dock, dolphins, and berthed LNG marine carriers. The addition of the lights seen from this location would somewhat intrude on night views, but would not be expected to affect many viewers, because of the existing presence of lights seen in the general area of the bridge (e.g., the Astoria Regional Airport and the large retail establishments and their associated parking lots along SR 26). The existing view and a simulated view of the terminal and LNG marine carrier at berth from the Youngs Bay Bridge are shown in figure 4.1.9-6.

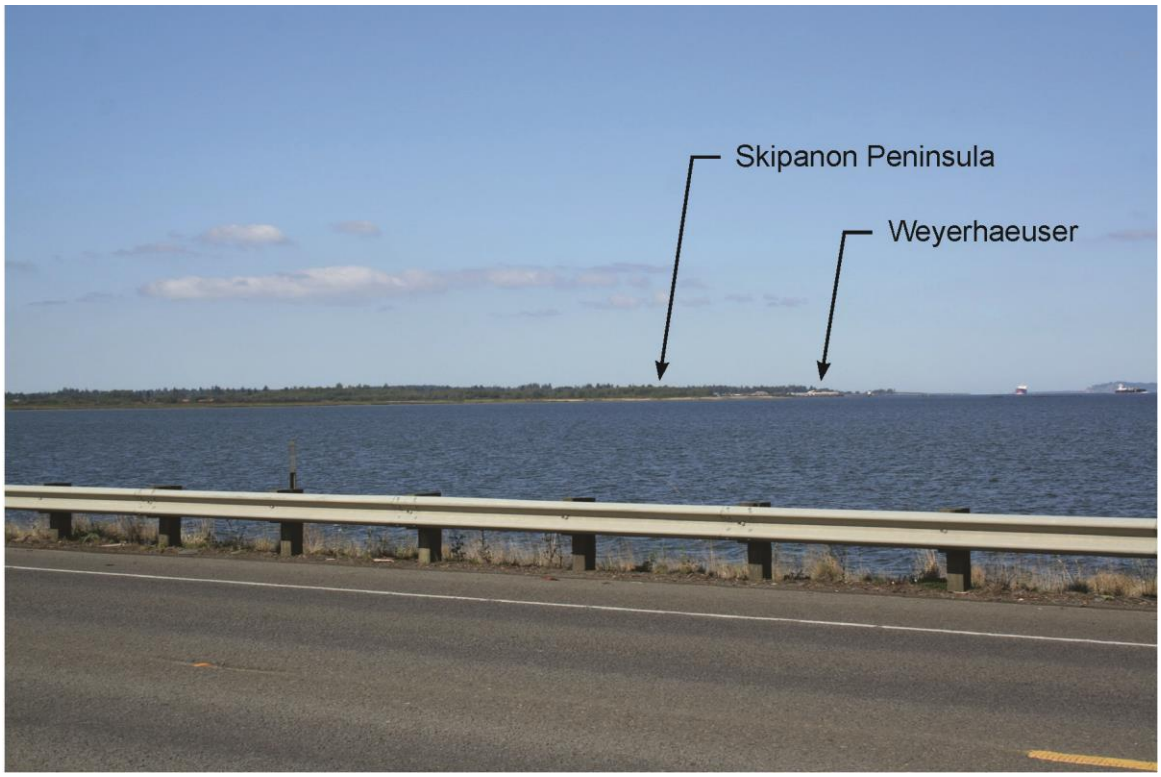


Existing Conditions



Proposed Conditions

Figure 4.1.9-5: Key Observation Point 4 – East Bank Skipanon Peninsula, Eastern Dike Road



Existing Conditions



Proposed Conditions

Figure 4.1.9-6: Key Observation Point 5 – Youngs Bay Bridge

Astoria Column – KOP 6

Oregon LNG analyzed the Astoria Column KOP to address concerns raised in comments. The Astoria Column, a monument dedicated in 1926, is 125 feet high and within a 780-acre wooded park on Coxcomb Hill. Visitors can climb to the top of the column for scenic views of the surrounding area.

The terminal area would be about 4.3 miles away from the Astoria Column. The two LNG storage tanks would be seen along the shoreline as would the access pier, loading/unloading platform, and loading/unloading arms, and berthed LNG marine carriers. Terminal buildings would be difficult to see from this location. As discussed previously, the storage tanks, liquefaction process enclosures, pier, and berthed LNG marine carriers would contribute additional human-made elements to the view that would contrast in scale, shape, and color with the natural surroundings. However, when viewed from this angle and distance, the terminal facilities would not be greatly out of character with the other industrial facilities that can be seen to the south. Further, during certain lighting conditions, the color scheme applied to the structures would help visually break up the mass (form) of the tanks and help the other structures blend in visually with the surrounding environment.

The red aviation lights of the tanks as well as navigation lights on the access pier, loading/unloading dock, dolphins, and berthed LNG marine carriers would be seen, but would not be expected to affect many viewers because of the existing lights in the general area (e.g., Youngs Bay Bridge, Astoria Regional Airport, and industrial facilities).

The existing view from the Astoria Column is shown in figure 4.1.9-7 along with a simulated view of the terminal and LNG marine carrier at berth.



Existing Conditions



Proposed Conditions

Figure 4.1.9-7: Key Observation Point 6 – Astoria Column

Areas Outside of Warrenton and Astoria

On the north shore of the Columbia River across from the terminal the terrain is steep, rising from the river's edge up to the Bear River Ridge to the north. The terminal site is about 4 to 5 miles away from this area, which includes Fort Columbia State Park and the Dismal Nitch and Station Camps. Viewers in this area would include residents from several scattered residential areas, recreationists, and people driving along Highway 101. The terminal facilities would be visible in the distance, but would not appear out of character with the existing facilities that are also visible along the shoreline in this area.

The terminal would not be visible from most areas to the south between Youngs River and the coast because of flat terrain that does not offer vantage points from which to look down to the terminal site. Heavy vegetation would also block views from these generally flat areas. Heavily forested areas are between the Youngs and Lewis and Clark Rivers and LCNHP, which is situated along the west bank of the Lewis and Clark River. Viewers in the area would include residents and recreationists.

The terrain northwest of Warrenton is relatively flat and similar in elevation to the terminal site. This area also contains heavily forested areas that would block views of the terminal site. Much of this area is comprised of the Fort Stevens State Park with a few residential areas such as Hammond. Most viewers would be residents or recreationists.

Views of the terminal site from boats and ships on the Columbia River and Youngs Bay would vary depending on the viewing angle, distance to the peninsula, and foggy conditions. When viewed from some parts of Youngs Bay, the profile of the end of the peninsula can be readily seen against the background sky. Viewers from farther out in the Columbia River looking in a generally southerly direction see a less distinctive peninsula because the vegetation and hillsides in the background can visually blend in with the peninsula. Views towards the peninsula can include views of the Skipanon Waterway and the Warrenton Hampton Affiliates facility. Viewers would include workers (e.g., commercial fishers, crew on container ships, and other commercial vessels), recreationists, sport anglers, and sightseers on the water.

The terminal would have negligible effects on the visual quality from land areas within the terminal's viewshed that are beyond Warrenton and Astoria. Factors combining to reduce visual impacts include the distance, generally flat terrain, and presence of vertical elements such as trees, buildings, and structures that would block views of terminal components. The impact of the terminal on views from the Columbia River and Youngs Bay would vary, depending on the angle of view and viewing distance. When viewed from parts of Youngs Bay, the profile of the end of the peninsula, the storage tanks, the pier, and berthed carrier would be seen against the background of the Columbia River or sky. Viewers from farther out in the Columbia River looking in a generally southerly direction would also see terminal components, but to a lesser degree because vegetation and hillsides in the background would help to visually blend the components with the background.

Visual Impact Mitigation

Oregon LNG has proposed mitigation measures to help reduce the visual impacts of the terminal components including: coloring the tanks and other structures to mimic nearby colors in the landscape, screening facilities from views outside of the terminal area, and controlling potential impacts associated with lighting. The same measures described in section 4.1.5.2 and section 4.1.7.1 to minimize the potential for lighting effects on fish and wildlife, respectively, would also mitigate the visual impacts of terminal lighting. In addition, as described in section 2.1.1.1, the LNG storage tanks would use a dual lighting system to meet FAA lighting requirements. The dual lighting system is designed to reduce visual impacts of the flashing aviation lighting at night.

We conclude that the terminal would change the visual character of the East Skipanon Peninsula. Although the terminal facilities would introduce a new element into the viewshed, it would not appear out of character with the existing industrial facilities that are also visible along the shoreline in this area.

4.1.9.2 Pipeline and Associated Facilities

Land Use

The 86.8-mile pipeline would cross a variety of land use categories, including forested areas, agricultural lands, wetlands, existing rights-of-way, open space, open water, commercial/industrial lands, and residential lands. In selecting the pipeline route, Oregon LNG minimized impacts on the environment and landowners by paralleling other linear features, such as existing power lines, railroads, and road rights-of-way to the greatest extent practicable. About 9.9 miles of the route would be collocated with existing linear features.

The pipeline would cross about 70.2 miles (80.9 percent) of forest land, including upland and industrial deciduous, evergreen, and mixed forests. About 1.1 mile (1.2 percent) of agricultural land would be crossed, including cultivated fields/crop lands, grass seed fields, pasture, and hayfields. The pipeline would cross about 9.7 miles (11.1 percent) of wetlands, including agricultural, scrub-shrub, emergent, forested, and estuarine. The pipeline would cross about 2.0 miles (2.3 percent) of existing right-of-way for roads, railroads, and utility corridors. About 1.3 mile (1.4 percent) of open space would be crossed, including nonagricultural or abandoned fields, parks, recreational areas, and native grassland. About 1.1 mile (1.3 percent) of open water would be crossed, which consists of perennial waterbodies greater than 100 feet wide. The pipeline would cross about 1.0 mile (1.2 percent) of commercial/industrial land, which includes electric power or gas utility stations, manufacturing or industrial plants, landfills, mines, quarries, and commercial or retail facilities. About 1.4 mile (0.5 percent) of residential land would be crossed, including residential yards, residential subdivisions, and planned new residential developments.

Land use impacts associated with the pipeline would include the disturbance of existing land uses within the construction right-of-way during construction and retention of a new permanent right-of-way for operation. Oregon LNG proposes to use a 100-foot-wide construction right-of-way for the majority of the pipeline route. When crossing wetlands, Oregon LNG would reduce the construction right-of-way to a width of 75 feet in accordance with its Procedures. The 75-foot limitation on the construction right-of-way width would not apply to wetlands in actively cultivated or rotated cropland. Following construction, a 50-foot-wide permanent right-of-way would be maintained for operation and maintenance of the pipeline. The pipeline and route is shown in figure 1.1-1. Typical right-of-way cross sections for the pipeline route are provided in appendix E2.

Aboveground facilities that would be constructed in association with the pipeline include a compressor station, meter stations, MLV sites, and pig launcher and receiver stations. Section 2.1.1.2 provides a description and location of the aboveground facilities.

In addition to the construction right-of-way, Oregon LNG would require ATWS outside the standard construction right-of-way at locations where additional space is necessary for excavation, soil placement, or equipment management and staging. These areas would include road and railroad crossings, wetland and waterbody crossings, areas with steep side slopes, areas requiring topsoil segregation, tie-ins to existing pipelines, areas where special construction techniques would be used (e.g., HDD, flume, and boring), and foreign pipeline and utility crossings. The size and configuration of each ATWS is unique and dependent on existing site conditions (e.g., available or accessible space, the

presence of buildings and other structures, crossing angle, crossing depth, length of crossing, terrain, the presence of trees or sensitive habitat) at each work location. Construction of the pipeline would require 370 ATWS, which would temporarily impact about 143.4 acres of land. ATWS for the pipeline are listed in appendix E4.

Oregon LNG's construction contractor would need construction staging and storage yards located outside of the construction right-of-way for the storage of pipe and equipment, as well as to provide areas for temporary contractor office space. Oregon LNG identified six construction staging and storage yards for use during the construction of the pipeline. Location maps are provided in appendix E1. The sites were selected because of their proximity to the pipeline route, existing railroad accessibility, and access to the sites during construction activities. Oregon LNG made an effort to identify and select yards that have been previously disturbed but do not have an ongoing land use that would preclude the storage of construction-related materials.

Oregon LNG would access the construction and operation right-of-way and aboveground facilities via existing public and private roads that intersect the right-of-way. To access the pipeline right-of-way and aboveground facilities, 113 existing roads would be used temporarily during construction. Seven additional existing roads would be used permanently during operation. About 2.5 acres of land would be temporarily impacted for modification (extensions) of existing access roads. Maps and a table of the pipeline access roads are provided in appendix E5. When modifying existing access roads, Oregon LNG would follow the impact minimization measures in its Plan and Procedures. Existing drainage patterns and culverts would be maintained during construction. Erosion and sedimentation controls would be installed at the limits of the access roads where necessary. Oregon LNG does not propose improvements to access roads with adjacent wetlands or waterbody crossings.

Land use impacts as a result of temporary and permanent rights-of-way, aboveground facilities, temporary workspaces, construction staging and storage yards, and access roads would include about 1,197.9 acres of land during construction and about 532.8 acres (about 44 percent) of these areas would be retained permanently during operation of the Oregon LNG Project. These impacts are listed in table 4.1.9-4 and table 4.1.9-5 and discussed in the following sections. Measures to mitigate impacts are also discussed.

Table 4.1.9-4

Land Use Associated with the Proposed Oregon LNG Pipeline Facilities Construction (Acres)

Facility		Forest [b]	Agricultural [c]	Wetland [d]	Right-of-way [e]	Open Space [f]	Open Water [g]	Commercial/ Industrial [h]	Residential [i]	Total
Pipeline [a]										
Clatsop County	Pipeline	404.2	9.4	68.7	9.5	4.0	2.7	0.8	0.3	499.6
	ATWS	57.3	2.7	20.4	0.3	1.2			<0.1	82.0
Tillamook County	Pipeline	39.2		0.3						39.5
	ATWS	1.7								1.7
Columbia County	Pipeline	376.9		9.6	3.6	4.2	2.9	5.9		403.1
	ATWS	43.8		2.8	0.1	0.4		0.7		47.7
Cowlitz County	Pipeline	3.6	23.1	10.1	0.9	6.3	1.8	1.4	2.5	49.7
	ATWS	0.1	2.2	1.7	0.2	1.3			0.3	5.8
Pipeline Total		*926.8*	*37.4*	*113.6*	*14.6*	*17.4*	*7.4*	*8.8*	*3.1*	*1129.1*
Aboveground Facilities										
Meter Station (Terminal) [j]										N/A
Compressor Station [k]		1.9				16.8				18.7
Meter Station (Woodland)		0.5								0.5
Mainline Valves [l]										N/A
Pig Launchers/Receivers [l]										N/A
Aboveground Facilities Total		*2.4*				*16.8*				*19.2*
Access Roads		2.5								2.5
Construction Staging and Storage Yards										
Area 1 (Tongue Point)						28.3				28.3
Area 2 (Hwy 26 & NW Timber Rd)						0.8				0.8
Area 3 (off Pittsburg Rd)								1.9		1.9
Area 4 (off Pittsburg Rd)						1.2				1.2
Area 5 (Hwy 30 & Dike Rd)						9.5				9.5
Area 6 (off Port Rd)			5.4							5.4
Construction Staging and Storage Yards Total			*5.4*			*39.8*		*1.9*		*47.1*
Total Construction Land Requirements		**948.5**	**42.8**	**113.6**	**14.6**	**57.2**	**7.4**	**10.7**	**3.1**	**1197.9**

Table 4.1.9-4

Land Use Associated with the Proposed Oregon LNG Pipeline Facilities Construction (Acres)

Facility	Forest [b]	Agricultural [c]	Wetland [d]	Right-of-way [e]	Open Space [f]	Open Water [g]	Commercial/ Industrial [h]	Residential [i]	Total

Actual numbers may vary slightly because of rounding.

[a] Construction impacts include permanent right-of-way, temporary right-of-way, and ATWS associated with the pipeline construction corridor. Assumes a 100-foot-wide construction right-of-way in upland areas and a 75-foot-wide right-of-way in wetlands for the pipeline. Assumes a 50-foot-wide operational right-of-way for the pipeline.

[b] Forest land includes deciduous, evergreen, and mixed forests.

[c] Agricultural land includes cultivated fields/crop lands, grass seed fields, pastureland, hayfields, and other agricultural land.

[d] Wetland includes agricultural, scrub-shrub, emergent, forested, and estuarine wetlands.

[e] Right-of-way includes roads, railroads, and utility corridors perpendicularly crossed by the pipeline.

[f] Open space includes nonagricultural land or abandoned fields, parks, recreational areas, and native grasslands.

[g] Open water includes perennial waterbodies greater than 100 feet wide.

[h] Commercial/industrial land includes electric power or gas utility stations, manufacturing or industrial plants, landfills, mines, quarries, and commercial or retail facilities.

[i] Residential land includes residential yards, residential subdivisions, and planned new residential developments.

[j] Included in table 4.1.9-1 with the terminal land requirements.

[k] Acreage estimated from aerial photos.

[l] Occurs within the permanent right-of-way or existing/proposed aboveground facility limits.

Table 4.1.9-5

Land Use Associated with the Proposed Oregon LNG Pipeline Facilities Operation (Acres)

Facility	Forest [a]	Agricultural [b]	Wetland [c]	Right-of-way [d]	Open Space [e]	Open Water [f]	Commercial/ Industrial [g]	Residential [h]	Total
Pipeline									
Clatsop County	210.5	5.3	42.8	2.1	2.6	2.7	0.5	0.3	266.8
Tillamook County	19.9		0.3						20.2
Columbia County	195.0		5.6	2.0	2.7	2.6	3.0		210.9
Cowlitz County	1.5	11.9	5.8	0.7	3.7	1.8	0.7	1.3	27.4
Pipeline Total	*426.9*	*17.2*	*54.3*	*4.8*	*9.0*	*7.1*	*4.2*	*1.6*	*525.3*
Aboveground Facilities									
Meter Station (Terminal) [i]									N/A
Compressor Station [j]	0.7				6.3				7.0
Meter Station (Woodland)	0.5								0.5
Mainline Valves [k]									N/A
Pig Launchers/Receivers [k]									N/A
Aboveground Facilities Total	*7.5*								*7.5*
Access Roads									0.0
Total Operation Land Requirements	**434.4**	**17.2**	**54.3**	**4.8**	**9.0**	**7.1**	**4.2**	**1.6**	**532.8**

Actual numbers may vary slightly because of rounding.

[a] Forest land includes deciduous, evergreen, and mixed forests.

[b] Agricultural land includes cultivated fields/crop lands, grass seed fields, pastureland, hayfields, and other agricultural land.

[c] Wetland includes agricultural, scrub-shrub, emergent, forested, and estuarine wetlands.

[d] Right-of-way includes roads, railroads, and utility corridors perpendicularly crossed by the pipeline.

[e] Open space includes nonagricultural land or abandoned fields, parks, recreational areas, and native grasslands.

[f] Open water includes perennial waterbodies greater than 100 feet wide.

[g] Commercial/industrial land includes electric power or gas utility stations, manufacturing or industrial plants, landfills, mines, quarries, and commercial or retail facilities.

[h] Residential land includes residential yards, residential subdivisions, and planned new residential developments.

[i] Included in table 4.1.9-1 with the terminal land requirements.

[j] Acreage estimated from aerial photos.

[k] Occurs within the permanent right-of-way or existing/proposed aboveground facility limits.

Forest Lands

Construction of the pipeline, aboveground facilities, and access road improvements would require the clearing of trees, affecting about 948.5 acres of forest land within the construction right-of-way. About 434.4 acres would be permanently impacted during operation of the pipeline and facilities.

About 855.0 acres of merchantable timber would need to be cleared during construction activities. Merchantable trees would be cut and stacked in designated areas outside of riparian and floodplain corridors for commercial sale (see section 4.1.6.2 and the section on Clatsop and Tillamook State Forests below for more detail on merchantable timber).

Following construction, areas outside the maintained portion of the permanent pipeline right-of-way, would be restored through plantings directed by site-specific restoration and revegetation plans and by natural recolonization of the area, but each would require many years to reestablish their woody canopy. Section 4.1.6.2 provides more information on impacts, restoration, and revegetation of forest lands.

Agricultural Lands

Construction of the pipeline, ATWS areas, and construction staging and storage yards would affect about 42.8 acres of agricultural lands. Construction impacts would be temporary and short-term, and Oregon LNG would restore lands in accordance with its Plan. About 17.2 acres would be permanently impacted during operation.

No existing specialty crops have been identified in the agricultural land crossed by the pipeline. Impacts on soils designated as Prime, Unique, or Important Farmlands are discussed in section 4.1.2. On completion of construction, cropland areas would be restored to preconstruction conditions. However, some permanent impacts would result due to the need to maintain access areas. Oregon LNG would work with each landowner during the land acquisition process to develop a mutually agreeable plan to address crop damage or loss caused during construction and operation. The plan may include replanting, financial compensation, or specialized construction procedures. Additionally, Oregon LNG has prepared an Agricultural Impact Mitigation Plan (see appendix F2), which addresses the potential impacts on agricultural operations. This plan supplements its Plan and would serve as the basis for discussions with affected agricultural land owners.

Mitigation measures in agricultural areas include increased pipeline burial depth, topsoil segregation, and repair of any damaged irrigation systems and drain tiles. Agricultural production of herbaceous (nonwoody) crops can resume on the construction area, including the permanent pipeline right-of-way, following construction. Woody and deep-rooted crops, including trees, shrubs, cane berries, vines, and crops requiring trellising, may be restricted within the permanent pipeline right-of-way. Oregon LNG may negotiate with landowners, on an individual basis, to allow production of certain specialty crops within its exclusive right-of-way, as long as the activities do not interfere with the safe operation of the pipeline, or Oregon LNG's ability to maintain its exclusive right-of-way.

Oregon LNG would minimize disturbance to existing fences and other improvements on pasturelands by constructing temporary gates and fencing and promptly repairing fences or cattle guards to their original state as soon as practical. Functional use of the pasturelands would be maintained and Oregon LNG would contact the owners of fences prior to disturbing them.

We received several comments about the potential loss of income due to construction and operation of the pipeline and the temporary and long-term impacts associated with economic loss of

agricultural land. Route variations were made based on field surveys and communications with local landowners. The pipeline route was shifted in locations to avoid impacts on farm buildings and drainage ditches and minimize impacts on high-value agricultural lands. Oregon LNG has committed to specific measures to minimize and mitigate potential impacts on all agricultural areas beyond the minimum requirements established in its Plan. Oregon LNG has proposed the following measures in the Agricultural Impact Mitigation Plan (see appendix F2) beyond FERC's minimum requirements:

- Standard tillage operations disturbing ground less than 2-foot deep would be allowed within the 50-foot permanent right-of-way. Any other ground-disturbing activity within the 50-foot permanent right-of-way must be cleared with Oregon LNG.
- Approved crops, including annual crops and perennial herbaceous crops would be allowed within the 30-foot pipeline center strip. However, woody vegetation and stakes or posts would not be allowed over the pipeline.
- Approved crops, including nursery stock, orchard, Christmas trees, field and specialty crops, and landscape and native vegetation up to 15 feet tall would be allowed beyond the 30-foot center strip. Trees over 15 feet tall would not be allowed.
- All crops, including trees greater than 15 feet tall, would be allowed beyond the 50-foot center strip.
- Except for piping facilities such as mainline block valves, tap valves, meter stations, etc., and except as otherwise stated in the Agricultural Impact Mitigation Plan, the pipeline would be buried with a minimum of 5 feet of cover where it crosses agricultural land. This additional cover sets the pipeline well below the depth of any normal tillage practice and allows for reduced conflicts with future installations of buried irrigation and/or drainage facilities.
- In agricultural land, Oregon LNG would strip and segregate topsoil not only from over the trench and spoil storage area, but also over portions of the construction area where grading or cut and fill would occur or where excavations are made beyond the typical trench width.
- Oregon LNG would strip and segregate topsoil down to the lower limit of the "A" horizon or to 24 inches in depth, whichever is less. This additional topsoil stripping depth has been included at the request of agricultural stakeholders to provide additional protection against long-term impacts on soil productivity.

Wetlands

Construction of the pipeline and ATWS areas would affect about 113.6 acres of wetlands. At wetland crossings along the pipeline, the construction right-of-way would be limited to 75 feet wide. About 54.3 acres would be permanently impacted during operation.

The impacts of project-related construction and operation activities on wetlands would vary depending on the timing of construction, construction techniques used, sensitivity of the resources disturbed, and length of time required for wetlands to be restored. In general, Oregon LNG would minimize wetland impacts by avoidance, mitigation of impacts, and compensation in accordance with federal, state, and local regulations. Oregon LNG intends to restore wetlands impacted by the Oregon LNG Project as described in its Procedures. Section 4.1.4 provides more information on wetland impacts and mitigation.

Existing Rights-of-way

Construction of the pipeline and ATWS areas would affect about 14.6 acres of existing right-of-way. About 4.8 acres would be permanently retained for operation.

No long-term construction effects are expected on existing right-of-way lands following construction, as the right-of-way would be restored to preconstruction conditions. Generally, where the pipeline would traverse public roads, the pipeline would be installed by boring underneath the roadway, thereby minimizing disturbance to the public. In the event that a public road is open cut, at least one traffic lane would be maintained, except for brief periods essential to laying the new pipeline. Additionally, attempts would be made to avoid peak traffic time periods during construction that temporarily closes roads. For crossing of roads that provide access to private residences or businesses with no alternate entrance, measures would be taken to maintain passage for landowners during construction. To maintain safe conditions, Oregon LNG would keep roads free of mud from crossing construction equipment. Track-driven equipment would cross paved roads on tires or equipment pads to minimize damage to the road surface. Oregon LNG would enforce local weight limitations and restrictions to minimize road damage. Roadways damaged during construction would be repaired to preconstruction conditions. Road and utility crossings are discussed in section 2.1.4.2.

Open Space

Construction of the pipeline, ATWS areas, and construction staging and storage yards would impact about 57.2 acres of open space and about 9.0 acres would be permanently impacted during operation. Oregon LNG would clear open space of herbaceous growth before construction during grading operations. After final construction clean-up, these areas would be re-seeded and mulched according to recommendations from state agencies and the NRCS. These areas are expected to revert to preconstruction land uses after the vegetation is established. No long-term construction impacts are expected on open land dominated by herbaceous vegetation. Section 4.1.6.2 provides more information on vegetation impacts and restoration.

Open Water

Construction of the pipeline would impact about 7.4 acres of open space and operation would permanently impact about 7.1 acres. To minimize impacts, Oregon LNG would cross significant areas of open water using the HDD method. At waterbodies not crossed by the HDD method, Oregon LNG would follow its Procedures to minimize short-term impacts on open water during construction. Efforts would be made before, during, and after construction to minimize the extent and duration of project-related disturbances to water resources. Oregon LNG would incorporate recommended construction timing constraints requested by federal and state agencies into the construction schedule. Waterbody impacts, mitigation, and crossings are discussed in section 4.1.3.2.

Commercial/Industrial/Residential Lands

Construction of the pipeline, ATWS areas, and construction staging and storage yards would impact about 10.7 acres of commercial/industrial lands. About 4.2 acres of commercial/industrial would be permanently impacted during operation. Construction of the pipeline and ATWS areas would impact about 3.1 acres of residential land. About 1.6 acres of residential land would be permanently impacted during operation.

Residential land uses impacted by construction and operation of the pipeline right-of-way and aboveground facilities, can be generally characterized as small, single-family farm homes with associated outbuildings. The level of impact on adjacent residential lands would generally be moderate and short-

term, resulting primarily from construction activities. Mitigation measures for construction activities in residential areas are discussed below under Residences and Commercial Buildings.

Zoning

Local land use approvals for portions of the Oregon LNG Project within the designated Oregon coastal zone are necessary to obtain a determination of CZMA consistency by the ODLCD (see Coastal Zone Management in section 4.1.9.1). Oregon LNG submitted land use applications to the City of Warrenton and Clatsop and Tillamook Counties because a portion of the pipeline within these areas would be within the designated coastal zone and these jurisdictions have comprehensive plans and land use regulations that have been approved as part of the OCMP. About 47.4 miles of the pipeline are within the coastal zone of those three jurisdictions. Applicable comprehensive plan designations and zoning districts in these jurisdictions are discussed below. Oregon LNG has not requested that any of the land crossed by the pipeline in these jurisdictions be rezoned. Cowlitz County, the only county affected by the Oregon LNG Project in Washington, is not part of the state's Coastal Zone Management area and local land use approvals are therefore not required.

City of Warrenton, Oregon

The Oregon LNG pipeline would begin at the terminal in Warrenton, extending across about 2.7 miles within the city limits. The pipeline alignment would cross three *City of Warrenton Comprehensive Plan* (City of Warrenton, 2011) designations and five separate zoning districts within Warrenton. Table 4.1.9-6 lists the comprehensive plan designations, zoning districts, and the length of each crossed by the Oregon LNG Project. The pipeline is a permitted use within four of the crossed zoning districts and a conditionally-permitted use in one zoning district (Aquatic Natural) within the City of Warrenton. A consolidated land use application was submitted to the City of Warrenton on June 13, 2014, and is pending approval.

Table 4.1.9-6

Comprehensive Plan Designations and Zoning Districts Crossed, City of Warrenton

Comprehensive Plan Designation [a]	Zoning District [b]	Zoning Abbreviation [b]	Length of Zone Crossed (miles)
Natural Areas	Lake and Freshwater Wetlands	A-5	<0.1
Natural Areas	Aquatic Natural	A-3	0.5
Other Urban Shorelands	General Commercial	C-1	<0.1
Other Urban Shorelands	General Industrial	I-1	1.6
Especially Suited for Water Dependent Shorelands	Water-Dependent Industrial Shorelands	I-2	0.4

[a] City of Warrenton, 2011
[b] City of Warrenton, 2013

Clatsop County, Oregon

The proposed pipeline would enter the Clatsop County zoning jurisdiction at about MP 3.0 after crossing the City of Warrenton border. It would extend about 41.4 miles across Clatsop County; this portion equals about 87 percent of the pipeline in the coastal zone. The pipeline would cross six Clatsop County Comprehensive Plan (Clatsop County, 2012) designations and seven separate zoning districts within Clatsop County. Table 4.1.9-7 lists the comprehensive plan designations, zoning districts, and the length of each crossed by the Oregon LNG Project. The pipeline would be a permitted use across all of

the crossed zoning districts in Clatsop County. The consolidated land use application for Clatsop County was initially approved and then approval was withdrawn.

Table 4.1.9-7

Comprehensive Plan Designations and Zoning Districts Crossed, Clatsop County

Comprehensive Plan Designation [a]	Zoning District [b]	Zoning Abbreviation [b]	Length of Zone Crossed (miles)
Conservation Other Resources	Aquatic Conservation 2	AC-2	0.3
Development	Aquatic Development	AD	<0.1
Conservation Forest Lands	Agricultural Forest	AF	1.6
Natural	Aquatic Natural	AN	<0.1
Rural Agricultural Lands	Exclusive Farm Use	EFU	4.2
Conservation Forest Lands	Forest 80	F-80	34.9
Rural Lands	Residential Agricultural 5	RA-5	0.3

[a] Clatsop County, 2012
[b] Clatsop County, 2013a

Tillamook County, Oregon

The pipeline route would enter Tillamook County at about MP 44.1 after crossing Clatsop County. It would extend about 3.3 miles across Tillamook County, all within the *Tillamook County Comprehensive Plan* (Tillamook County, 2004) Forest designation and the Forest zoning district (Tillamook County, 2002). The pipeline would be a permitted use in the Forest zoning district. A consolidated land use application was submitted to Tillamook County on July 15, 2010, and approval granted on April 30, 2010.

Washington Growth Management Act

The Washington GMA requires county and city governments to designate and protect critical areas and natural resource lands. Each of the local government jurisdictions crossed by the proposed loops has implemented a comprehensive plan and has critical areas ordinances in place.

Comprehensive Plans

A comprehensive plan is a land use document that provides the framework and policy direction for land use decisions. In general, no conflicts with county or city comprehensive plans are anticipated. A detailed discussion of land uses affected by the Oregon LNG Project facilities in Cowlitz County, including recreation uses, is presented above. Section 4.1.10 contains information about impacts associated with the Oregon LNG Project on population, economy, housing, public services, and transportation.

Critical Areas Ordinances

As required by the GMA, all of the local government jurisdictions affected by the project have critical areas ordinances. There are five critical areas identified in the GMA: geologically hazardous areas (including erosion hazard areas), areas with a critical recharging effect on aquifers used for potable water, frequently flooded areas, wetlands, and fish and wildlife habitat conservation areas (Washington State Department of Community, Trade, and Economic Development, 2003). Designated critical areas that would be affected by the Oregon LNG Project are identified and discussed in the applicable resource sections in section 4.1.

Land Ownership and Easements

The pipeline would cross public and private lands as summarized in table 4.1.9-8. Land ownership along the pipeline route is about 15.0 percent state land (14.6 percent Oregon and 0.4 percent Washington) and 85.0 percent private.

Table 4.1.9-8

Land Ownership Crossed by the Oregon LNG Pipeline

County, State	State Land (miles)	Private Land (miles)	Total (miles)
Clatsop, Oregon	6.9	37.2	44.1
Tillamook, Oregon	2.9	0.5	3.4
Columbia, Oregon	2.9	31.9	34.8
Cowlitz, Washington	0.3	4.2	4.5
Total	13.0	73.8	86.8

We received comments expressing concerns about how Oregon LNG would acquire new right-of-way for the pipeline and the potential use of eminent domain in this context.

Oregon LNG would secure easements to convey both temporary (for construction) and permanent (for operation) rights-of-way on private lands. The easement acquisition process is designed to provide fair compensation to the landowners for the pipeline company's right to use the property for pipeline construction and operation. Oregon LNG would compensate landowners for loss of value to specific parcels. The easement agreement between the company and landowner typically specifies compensation for loss of use during construction (e.g., crops), loss of nonrenewable or other resources, damage to property during construction, and limits on use of the permanent right-of-way after construction. Landowners have the opportunity to request that site-specific factors and/or development plans for their property be considered during easement negotiations, and that specific measures be taken into account. Other than the easement, construction of the pipeline would not place any restrictions on a landowner's ability to sell or transfer ownership of a property during or after construction.

If authorized, Oregon LNG could use the right of eminent domain granted to it under Section 7(h) of the NGA to obtain right-of-way and temporary work areas in the event that an easement could not be negotiated and the Oregon LNG Project is certificated by the FERC. In this case, Oregon LNG still would be required to compensate the landowner for the right-of-way and for any damages incurred during construction; however, the level of compensation would be determined by a court. Eminent domain does not apply to land under federal ownership or management.

Schools

Six existing schools would be within about 1.0 mile of the pipeline, including South Jetty High School in Warrenton; Lewis and Clark Elementary School in Astoria; Woodland Elementary School, Middle School, and High School; and Woodland Intermediate School. All of these schools would be more than 0.5 mile from the pipeline with the exception of Woodland Intermediate School, which would be about 0.4 mile away. A new Woodland high school currently under construction would be about 0.5 mile from the pipeline.

Impacts on schools are not anticipated during construction and operation of the terminal, aside from increased construction traffic on local roads in the vicinity, which would be temporary and short

term. Information on measures Oregon LNG would implement to reduce impacts associated with increased traffic is presented in section 4.1.10.2.

Existing Residences and Commercial Buildings

One pole barn, one shed, four unknown structures, and two residences would be within 50 feet of the pipeline construction right-of-way (see table 4.1.9-9). Site-specific residential construction plans for the two residences are provided in appendix E6.

We received a number of comments from landowners who would be affected by the pipeline. Concerns expressed included potential impact on private landowner rights, use of eminent domain to acquire rights-of-way, allowed future land uses, construction disturbance, potential impacts on wells and septic systems, and potential loss of trees and fencing. Several comments also suggested possible route variations that would avoid or minimize impacts on specific properties. Pipeline route variations that have occurred as a result of working with landowners are discussed in section 3.4.1.

We also received comments regarding potential property devaluation caused by construction and operation of pipeline. The effect that a pipeline right-of-way may have on property values is a damage-related issue and should be negotiated between the parties during the easement acquisition process, or would be determined during condemnation proceedings. The easement negotiation process would occur between Oregon LNG and landowners and would not involve FERC. Property values in relation to the Oregon LNG Project are further discussed in section 4.1.10.2.

In residential areas, impacts associated with installation of an underground natural gas pipeline include disturbance during construction and encumbrance for future uses (e.g., the limitation on future permanent structures within the permanent right-of-way). In general, as the distance from the construction work area increases, the impacts on residences decrease.

Table 4.1.9-9

Structures Within 50 Feet of the Oregon LNG Pipeline Construction Work Areas

County	Milepost	Type of Structure	Distance from Construction Right-of-way (feet)
Clatsop	11.2	Residence	7
Clatsop	11.2	Pole Barn	42
Clatsop	11.2	Shed	39
Clatsop	36.2	Shed	36
Cowlitz	84.5	Unknown Structure (nonresidential)	17
Cowlitz	84.5	Unknown Structure (nonresidential)	18
Cowlitz	86.0	Unknown Structure (nonresidential)	38
Cowlitz	86.0	Unknown Structure (nonresidential)	46
Cowlitz	86.6	Residence	5

Impacts on adjacent residential lands from construction activities would be moderate and short-term and would stem primarily from construction activities. Temporary construction impacts on residential areas would include inconvenience caused by construction related traffic; blocking of roads and driveways; noise and dust generated by construction equipment; ground disturbance of lawns and removal of trees, landscaped shrubs, or other vegetative screening between residences and/or adjacent

rights-of-way; potential damage to existing septic systems or wells; and removal of aboveground structures such as sheds or trailers from within the right-of-way.

Although the route would require clearing of wooded areas along the right-of-way, several methods for mitigating the long-term effects of a cleared right-of-way would be utilized. Prior to construction, Oregon LNG would meet with landowners to identify trees, other vegetation, and objects that landowners want protected during construction. During construction, precautions would be taken to protect the identified vegetation and trees located outside the specified construction right-of-way. In addition, landowners would be compensated for the trees removed during construction. If the new right-of-way would be visible from an adjacent thoroughfare or residential area, mitigation measures such as screen plantings to reduce line-of-sight visibility could be utilized to the extent practicable.

After completion of pipeline construction, the landowners would be able to use the permanent right-of-way provided they did not interfere with the rights granted to Oregon LNG. No trees or bushes greater than 15 feet tall would be permitted within the permanent right-of-way (see section 4.1.9.2 for right-of-way requirements on agricultural land) because they impair access to the pipeline, and roots can damage the coating or positioning of the pipeline. No temporary or permanent structures, including houses, tool sheds, garages, guy wires, catch basins, swimming pools, trailers, leach fields, septic tanks, would be permitted within the permanent right-of-way.

Oregon LNG has proposed the following measures to reduce impacts on existing residential lands.

- Landowners would be notified prior to construction. Access to residences and traffic flow would be maintained during construction activities for landowners and fire and emergency vehicles. At least one lane of traffic would be kept open when constructing on or across residential streets. During the brief period when a road is completely cut, steel plates would be available on-site to cover the open area to permit travel by emergency vehicles.
- Appropriate DOT caution and safety signs, as well as safety personnel as needed, would be installed and maintained during construction along roadways and crossing points to alert the public and approaching traffic of the construction activities, congestion, and reduced speeds.
- Construction would proceed quickly through residential areas, thus minimizing exposure to nuisance effects such as noise and dust and limiting the hours during which construction activities with high decibel noise levels (i.e., drilling and boring) would be conducted.
- Dust from construction would be limited through prearranged work hours and by utilizing dust minimization techniques, such as watering, during construction to reduce generation of fugitive dust due to surface disturbance.
- Landowner identified vegetation, mature trees, and landscaping would be preserved to the extent possible while ensuring the safe operation of construction equipment. Immediately after backfilling the trench, lawn areas and landscaping within the construction work area would be restored consistent with the requirements of its Plan and Procedures.

- The edge of the construction work area adjacent to a residence would be fenced for a distance of 100 feet on either side of the residence to ensure that construction equipment and materials, including the spoil pile, remain within the construction work area.
- Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Oregon LNG would also limit the period of time the trench remains open prior to backfilling. If the pipeline centerline is within 25 feet of a residence, Oregon LNG would ensure that the trench would not be excavated until the pipeline is ready for installation. Open trenches would be secured during nonconstruction activities.
- Oregon LNG would employ specialized construction techniques in residential areas and in areas with residences within 50 feet of the construction workspace to ensure construction is quick and cleanup is thorough. Such techniques would include reduced construction area, stovepipe construction, drag section construction, or other construction techniques depending on specific conditions at each site. Drag section and stovepipe construction techniques would be considered to reduce working space requirements.
- Oregon LNG would notify the landowners or tenants prior to removal of private property features such as gates or fences.
- For areas where residences and structures are within 50 feet of the construction workspace limit, Oregon LNG has developed, and would finalize, site-specific construction plans depicting the pipeline alignment, permanent rights-of-way, temporary workspaces, ATWS, the location of structures, and distance of structures from the alignment and construction areas.

Oregon LNG has developed site-specific construction plans for residences identified within 50 feet of the construction right-of-way (see appendix E6). We have reviewed these preliminary plans and find them acceptable. Because the entire pipeline route has not yet been surveyed, there is the potential that other residences and structures that would be affected by the pipeline could be identified after FERC issues a Certificate and Oregon LNG gains access to property previously denied. Therefore, **we recommend that:**

- **<u>Prior to pipeline construction</u>, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP:**

  a. the results of a survey of previously unsurveyed areas along the pipeline route and an updated list of residences and commercial structures within 50 feet of the construction right-of-way;

  b. for all residences identified within 25 feet of a construction work area, a final site-specific construction plan that includes all of the following:

    (1) a dimensioned site plan that clearly shows:

      i. the location of the residence in relation to the pipeline;

      ii. the boundaries of all construction work areas;

      iii. the distance between the edge of construction work areas and the residence and other permanent structures;

      iv. equipment travel lanes;

v. location of topsoil and subsoil storage;

vi. safety fencing and other safety features;

vii. other nearby structures and residential features (including decks, fences, driveways, etc.), indicating which would be removed and any areas with restrictions after construction;

viii. trees and other landscaping, indicating which would be removed and where trees would not be allowed after construction;

ix. nearby utilities including wells, water and sewer lines, and septic systems;

x. nearby roads or waterbodies; and

xi. the edge of the new permanent right-of-way;

(2) a detailed description of construction techniques that would be used (such as reduced pipeline separation, centerline adjustment, use of stove-pipe or drag section techniques, working over existing pipelines, pipeline crossover, bore, etc.);

(3) an estimate of the amount of time required for construction;

(4) a description of how Oregon LNG would ensure the trench would not be excavated until the pipeline is ready for installation and the trench is backfilled immediately after pipeline installation; and

(5) a description of restoration and revegetation measures and procedures for the property;

c. a description of how and when landowners would be notified of construction activities; and

d. documentation of landowner concurrence if the construction work areas would be within 10 feet of a residence.

Planned Developments

We received comments regarding planned developments and concern about the pipeline impacting the ability to develop, access, and market the sites for the planned use. Oregon LNG has contacted jurisdictions and landowners to identify planned or future developments within 0.25 mile of the pipeline right-of-way. Jurisdictions contacted include the City of Warrenton and Clatsop, Tillamook, Columbia, and Cowlitz Counties. There are 11 known planned developments along the pipeline right-of-way (see table 4.1.9-10). No known future planned residential or commercial developments are in close proximity to the pipeline route in Clatsop, Tillamook, or Columbia Counties. There are three residential subdivisions proposed in Warrenton that would not be crossed by the pipeline and would not be affected. A proposed public boat launch facility at Lions Day Park in the Woodland Martin's Bar area would be crossed via HDD. Therefore, physical and visual impacts on the site would be avoided. However, no

temporary or permanent structures would be permitted within the permanent pipeline right-of-way. There are four planned developments in the City of Woodland that would not be crossed by the pipeline and would not be affected. Oregon LNG would work with the City and the property owner to minimize adverse impacts on an industrial expansion and new recreational vehicle storage facility in the City of Woodland.

We received comments from the City of Woodland regarding the proposed City of Woodland Scott Hill Park and Sports Complex development, which would be crossed by the pipeline. Oregon LNG would work with the City to minimize adverse impacts on the proposed park and sports complex. Scott Hill Park and Sports Complex is further discussed below in the *Recreation and Public Interest Areas* section.

Oregon LNG would continue to consult and coordinate with the applicable jurisdictions and affected landowners to minimize conflicts with the pipeline route to the extent feasible during the easement application process.

Table 4.1.9-10

Planned Developments within 0.25 Mile of the Oregon LNG Pipeline Construction Right-of-way

Planned Development	Jurisdiction	Milepost	Tax Lot	Distance from Centerline (feet)	Direction from Centerline	Development Time Frame	Proposed Mitigation
Pacific Ridge Estates Phase 2 (14 lot residential subdivision)	City of Warrenton	NA	Multiple	NA	NA	Under construction	None – construction right-of-way would not cross parcels.
Pacific Ridge Estates Phase 3 (16 lot residential subdivision)	City of Warrenton	NA	Multiple	NA	NA	Unknown	None – construction right-of-way would not cross parcels.
Gramson Estates (17 lot residential subdivision)	City of Warrenton	NA	Multiple	NA	NA	Unknown	None – construction right-of-way would not cross parcels.
Public Boat Launch (including trailer parking area and associated facilities) at Port of Woodland Martin's Bar/ Lions Day Park	Cowlitz County	82.7	WB1502002	0	—	Unknown	We have recommended that Oregon LNG work with the County to minimize adverse impacts on Lions Day Park facilities.
American Paper Converting (industrial expansion)	City of Woodland	84.2-84.3	508760101	0	North	Unknown	Oregon LNG to work with the City and the property owner to minimize adverse impacts on the proposed facility expansion.
AIMMCO Expansion (addition onto existing building)	City of Woodland	84.7	507810112	500	South	Unknown	None – construction right-of-way would not cross parcel.
Recreational Vehicle Storage Facility	City of Woodland	84.6-84.8	507810105 507810106	0	South	Fall 2015	Oregon LNG to work with the City and the property owner to minimize adverse impacts on the proposed storage facility.
Chilton Logging (new building)	City of Woodland	85.4	506800181	160	East	Fall 2015	None – construction right-of-way would not cross parcel.
Scott Hill Park and Sports Complex	City of Woodland	86.3-86.7	50876 508800100 508990100	0	—	Unknown	Oregon LNG to work with the City to minimize adverse impacts on the proposed park.
Residential Subdivision and Park	City of Woodland	86.7	Multiple	10	South	Unknown	None – construction right-of-way would not cross parcels.

National or State Scenic Highways

National or state scenic highways that would be crossed by the pipeline are listed in table 4.1.9-11 and discussed below.

Table 4.1.9-11

National or State Scenic Highways Crossed by the Oregon LNG Pipeline

National or State Scenic Highways/Roads	Milepost
Highway 101-Pacific Coast Highway (National Scenic Byway, All American Road, Oregon Scenic Byway, FPA-Scenic Highway)	0.8; 3.0
Highway 26 (FPA-Scenic Highway)	41.1; 43.5
U.S. Route 30 (FPA-Scenic Highway)	80.8
I-5 (Washington Scenic Byway)	85.7

Pacific Coast Highway (Highway 101)

Oregon LNG intends to use the HDD method to cross the Pacific Coast Highway (Highway 101), a designated National and Oregon Scenic Byway, to minimize visual impacts and construction impacts on this scenic byway. The HDD segment would be a sufficient length to avoid impacts on the highway itself and areas directly adjacent to the highway. Although construction activities may be visible to auto travelers in this area, workspaces would be located away from the highway and would be temporary in nature. The permanent right-of-way along the HDD segment would not be cleared during construction or maintained during operation; therefore, impacts on the visually-sensitive corridor would not occur on either side of Highway 101 at the pipeline crossings.

Oregon Forest Practices Act Scenic Highways

The FPA, administered by the ODF, and ORS 527.755 designate Scenic Highways to provide a tool to protect roadside trees for the motoring public to enjoy. The scenic highway provision restricts commercial tree cutting in the "visually sensitive corridor" defined as forestland extending outward 150 feet from the edge of the roadway along both sides of a scenic highway [ORS 527.620(18)]. ODF and ODOT coordinate their review of projects proposed within the visually sensitive corridor.

In an effort to minimize impacts on state forests, environment, and landowners, Oregon LNG would collocate the pipeline with existing right-of-way corridors to the extent practicable. By collocating the pipeline with existing corridors to minimize impacts in these areas, segments of scenic highways would be crossed or adjacent to the pipeline route. These include State Highways 101, 26, and 30. Oregon LNG met with staff from ODF and ODOT to identify potential visual impacts on these scenic highways and mitigation where necessary. The impacts of the Oregon LNG Project on FPA-designated Scenic Highways and measures to mitigate these impacts are detailed below.

Highway 101

As indicated above, Highway 101 would be crossed with a perpendicular HDD at MPs 0.8 and 3.0. The HDD would be a sufficient length to avoid impacts on the highway and areas directly adjacent, including a restrictive 150-foot visually sensitive corridor. In addition, no trees occur on either side of Highway 101; therefore, the visually sensitive corridor, as defined by the FPA, is minimal to nonexistent at the crossings. The permanent right-of-way for the HDD segment would not be cleared during

construction or maintained during operation. Therefore, impacts on the visually sensitive corridor would not occur on either side of the crossings.

Highway 26

In addition to the pipeline alignment crossing Highway 26 twice at MPs 41.1 and 43.5, it also includes segments that are parallel and within 150 feet of Highway 26. The highway would be crossed by HDD with the entrance and exit points set more than 150 feet from the highway. The permanent right-of-way for the HDD would not be cleared during construction or maintained during operation and therefore, no impacts on the visually sensitive corridor would occur.

Oregon LNG met with staff from ODF and ODOT at each of the close proximity segments to identify potential visual impacts and mitigation where necessary. In general, the temporary impacts would be minimal for a number of reasons, including but not limited to the following.

- Existing clear-cut areas already exist within 150 feet of the pipeline; therefore, construction and operation of the pipeline would not cause visual impacts on these areas.
- An existing Western Oregon Electric Cooperative 34.3-kilovolt-ampere (kVA) transmission line corridor running parallel to and within the 150-foot corridor. In the majority of the locations where the pipeline would be within 150 feet of Highway 26, it would be parallel to the existing transmission line corridor and on the north side away from Highway 26; therefore, the 150-foot-wide corridor has been previously disturbed and currently maintained in these colocation areas.
- Existing topography places the 150-foot-wide corridor significantly higher and lower than Highway 26 in many areas, thus minimizing views of the corridor.
- Oregon LNG would incorporate the following ODF and ODOT recommended mitigation measures between MPs 41.1 and 41.2 and MPs 43.5 and 43.6:

  - whenever possible, minimize construction right-of-way and temporary workspaces that result in temporary disturbance within the 150-foot visually sensitive corridor and visual subclass areas;
  - whenever possible, locate construction right-of-way and ATWS on the north side and farther away from Highway 26 or in areas that are less visible from the highway;
  - maintain the pipeline alignment wherever possible on the north side of the Western Oregon Electric Cooperative 34.3-kVA transmission line corridor, away from Highway 26;
  - replant the temporary disturbance areas after construction with a mixture of native tree species approved by ODF;
  - replant the permanent right-of-way with a mixture of herbaceous native plant species approved by ODF;
  - minimize cut along sloped areas to maintain slope stability; and
  - return sloped areas to natural grades and provide additional slope stability measures after construction following its Plan.

The ODF uses a method called the Land Management Classification System to describe the management emphasis for state forest land. This emphasis identifies the extent to which forest land should be managed for a variety of forest resources, including visual quality. Thus, the visual subclass

has been placed over specific ODF-owned forest land areas to provide a more focused approach in managing those areas for visual quality.

Highway 30

The crossing of Highway 30 at MP 80.8 would be crossed perpendicular to the highway right-of-way using the conventional bore technique. The crossing point of Highway 30 was selected to minimize conflict with the quarry to the south and industrial area to the north. Some trees within the construction right-of-way on the west side of Highway 30 would be removed. Trees removed in these temporary workspace areas would be replanted following completion of construction. Temporary disturbance areas would be replanted with a mixture of native tree species and the permanent right-of-way would be planted with a mixture of herbaceous native plant species, as approved by ODF. Therefore, impacts on the visually sensitive corridor of Highway 30 would be temporary in nature and mitigated.

Washington State Scenic Byway

The section of Washington State Scenic Byway (I-5) that would be crossed by the pipeline at MP 85.7 is also designated as the Lewis and Clark Trail State Scenic Highway. The I-5 crossing would be constructed using the conventional bore technique perpendicular to the highway. Aside from the temporary visual impacts from construction, the perpendicular right-of-way would only briefly be visible by passing motorists, and no portion of the pipeline itself would be visible once construction is complete. Initial consultation with WSDOT has occurred, and Oregon LNG would continue to consult and coordinate with WSDOT to minimize impacts on the scenic byway to the extent feasible during pipeline construction.

Recreation and Public Interest Areas

The Oregon LNG pipeline would not affect any Indian reservations, federal or state designated wild and scenic rivers, wildlife refuges, Wetland Reserve Program lands, Conservation Reserve Program lands, or Environmental Quality Incentive Program lands. Recreation and public interest areas administered by federal, state, or local agencies that would be crossed by or in the vicinity of the pipeline are listed in table 4.1.9-12.

Table 4.1.9-12

Recreational and Public Interest Areas Crossed or Within 0.25 Mile of the Oregon LNG Pipeline

Recreation and Public Interest Area	Milepost		Crossing Distance (miles)
	Begin	End	
Clatsop State Forest	3.4	3.6	Not Crossed [a]
	29.9	30.1	Not Crossed
	34.2	37.5	3.3
	37.5	37.8	Not Crossed
	37.8	37.8	< 0.1
	37.8	38.0	Not Crossed
	38.8	41.3	Not Crossed
	41.3	41.8	0.5
	41.8	43.1	Not Crossed
	43.1	43.4	0.3
	43.6	43.7	0.1
	43.7	44.1	Not Crossed
	47.4	48.1	0.7
	49.0	49.1	Not Crossed
Tillamook State Forest	44.1	44.5	Not Crossed
	44.5	45.8	1.3
	46.2	46.4	0.2
	46.5	47.5	1.0
Tillamook State Forest, Wilark Basin	67.4	69.2	1.8
	69.8	70.0	0.2
Four County Point Monument	47.4	47.4	<0.1
Four County Point Trail	47.5	47.5	Not Crossed
Lewis and Clark National Historic Trail	81.9	82.8	0.9
Martin's Bar/Lions Day Park	82.7	82.9	0.2
Scott Hill Park and Sports Complex	86.1	86.7	0.6
Memorial Cemetery	86.3	86.3	Not Crossed

[a] Within 0.25 mile of the pipeline construction right-of-way.

Lewis and Clark National Historic Trail

The pipeline would cross the LCNHT where it crosses the Columbia River beginning at about MP 81.9. Oregon LNG would cross the river using the HDD method to avoid physical and visual impacts. As discussed in section 4.1.11, use of the HDD method would also avoid any adverse impacts on the LCNHT.

Clatsop and Tillamook State Forests

The pipeline would cross 9.4 miles of the Clatsop and Tillamook State Forests (see figure 4.1.9-8). This would include six separate crossings of the Clatsop State Forest (for about 4.9 miles) and five separate crossings of Tillamook State Forest (for about 4.5 miles), including the Wilark Basin. Recreational activities in these state forests include hunting, target shooting, fishing, camping, hiking, horse riding, mountain biking, scenic viewing, and ORV use.

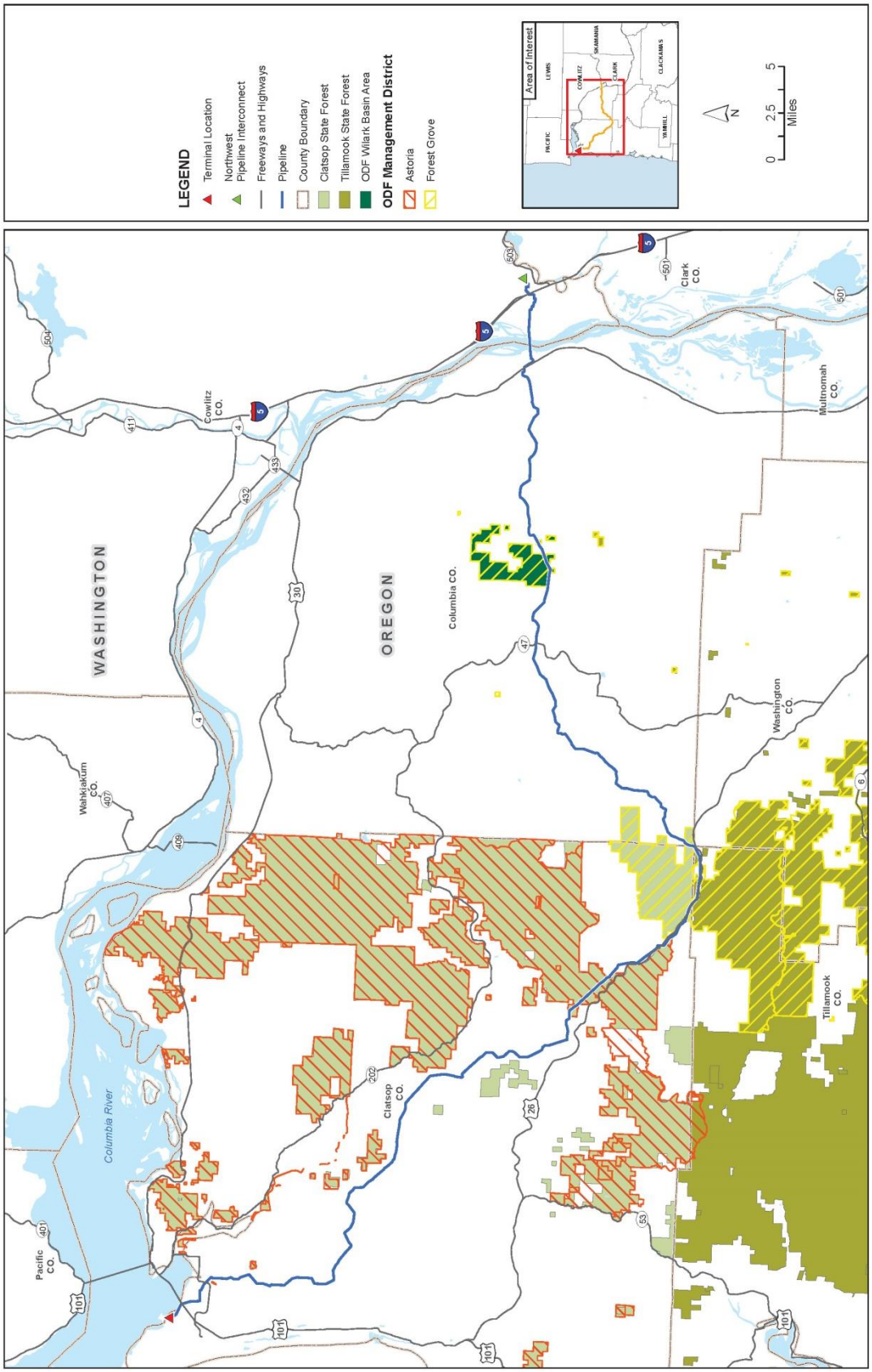


Figure 4.1.9-8: State Forest Lands Crossed by the Project

The Astoria District of the ODF manages the 136,000-acre Clatsop State Forest near Astoria in northwest Oregon. The portions of the Tillamook State Forest that would be crossed by the pipeline are managed by the Forest Grove District. The Clatsop and Tillamook State Forests are managed under the Northwest Oregon State Forests Management Plan (ODF, 2010), 10-year district implementation plans, and annual operations plans. The plans describe each forest resource and explain the concepts and strategies for integrated forest management. The resource management goals and strategies are intended to achieve a balance between the resources and achieve the greatest permanent value through a system of structure-based management. Oregon LNG has stated its plans and project implementation would be consistent with state forest management plans.

In general, impacts on the state forests would be temporary and would be limited to the period of active construction, which typically would last only several days to several weeks in any one area. To minimize permanent and temporary loss of forest productivity and the need to modify the state forests' landscape design for future complex forest structure, Oregon LNG would keep construction corridors to a minimum width, collocate the pipeline in existing utility and road rights-of-way where possible, coordinate construction activities with the ODF so that they occur outside of the primary recreation and special use periods (i.e., after timber harvest), and provide for reforestation of temporarily impacted forest areas. Project-related activities on state forest land would occur under ODF administration and approved annual operations plans, or under easement agreements between the ODF and Oregon LNG (for example, vegetation clearing may occur via an ODF special timber sale).

Pipeline construction activities would be subject to state wildfire prevention and suppression requirements. These requirements include obtaining certain permits, providing fire prevention equipment on machinery, limiting or stopping work during periods of elevated fire danger, providing firefighting tools, providing water supplies and pumping equipment, providing fire watch personnel, suppressing wildfires originating from construction activity, disposing of debris in a specified manner, and accepting liability for the state's cost of suppressing wildfires originating from construction activity. Following pipeline construction, operation and maintenance activities would be subject to many of these same requirements. To comply with the state's wildfire prevention and suppression requirements, Oregon LNG would perform pipeline construction, operation, and maintenance activities that are consistent with wildfire prevention and suppression requirements of ORS 477 and the associated administrative rules.

Merchantable Timber

As part of pipeline construction, Oregon LNG would clear and sell merchantable timber and related forest products in Clatsop and Tillamook State Forests. The ODF, counties, school districts, and other taxing districts along the pipeline route would receive revenue from the sale of timber cleared from state forest lands pursuant to OAR 629-035-0010.

Timber production would be precluded within the permanent right-of-way and would need to be re-established in construction areas located outside the permanent right-of-way. As a result, there would be a loss of timber production, both short- and long-term, in Clatsop and Tillamook State Forests due to development of the pipeline.

Table 4.1.9-13 provides an estimate of permanent and temporary impacts within each state forest. The temporary areas for construction would return to timber production and the permanent areas would remain cleared of timber for the life of the pipeline.

Table 4.1.9-13

Impacts of Oregon LNG Pipeline Within State Forests

State Forest	Area in Temporary Right-of-way (acres) [a]	Area in Permanent Right-of-way (acres)
Clatsop	36.2	31.9
Tillamook	29.9	31.2
Total	66.1	63.1

[a] Does not include area within the permanent right-of-way.

The net present value (NPV) loss in revenue from harvesting the current stand of timber from the temporary right-of-way before reaching financial maturity would be a short-term loss. For both state forests, the overwhelming majority of trees are in the older (40 years plus) age classes, the point of or near financial maturity. Therefore, there would not be a substantial financial loss in NPV associated with harvesting timber within the temporary right-of-way at this time. The timber revenue lost is estimated between $68,000 and $157,000.

The NPV loss of bare land or soil expectation value in the permanent right-of-way, which would remain out of timber production, would be a long-term loss. There would not be a substantial long-term financial loss associated with the permanent right-of-way, especially in comparison to the property taxes that would be paid to the counties in which the pipeline crosses state forest lands (see section 4.1.10.2). The long-term timber revenue loss from maintaining these areas as permanent mainline right-of-way ranges from $36,000 to $126,000.

Oregon LNG would conduct forest practices involving commercial harvest of forest products in compliance with the FPA and its attendant rules (ORS 527, and OAR Chapter 629, divisions 605 through 665). The forest practice rules provide resource protection and set standards for planning forestry practices. They apply to timber harvesting, road construction and maintenance, protecting water quality in waters of the state, limiting effects on specified resource sites (i.e., waterbodies, wetlands, nesting bird sites), providing for public safety downslope of high landslide hazard locations, and determining reforestation or land conversion requirements.

During activities on state forest lands, Oregon LNG would coordinate the construction schedule with the ODF to minimize impacts on planned forest practice operations. Oregon LNG would provide notification to the State Forester for each construction activity area on forest land and written plans if designated sensitive resources occur in or near an activity.

Land Management Classification System

The ODF uses the Land Management Classification System in state forests to designate desired future conditions for forest planning, and stewardship classes for Special and Focused management. The stewardship classes recognize unique values for habitat, cultural resources, water supply, recreation, visual, and transmission, or operational limitations. Oregon LNG would minimize the disruption to state forest planning by avoiding, minimizing, and mitigating impacts on forest areas designated for development toward Layered or Older Forest Structures and areas designated for Special and Focused stewardship.

About 23.6 acres of Silviculturally Capable land in the Clatsop State Forest and 31.1 acres of Silviculturally Capable land in the Tillamook State Forest would be permanently converted to a nonforest use within the pipeline permanent right-of-way.

Four County Point Monument and Trail

The Four County Point Trail and Four County Point Monument are off Highway 26 in the Forest Grove District of the Tillamook State Forest. The trail is about 6 to 10 feet wide. About 1 mile from the trailhead, the granite Four County Point Monument designates the intersection of Clatsop, Columbia, Tillamook, and Washington Counties. Consultations with the ODF have indicated the trail receives a relatively low degree of use overall, but has been known to be a good winter trail near the Portland metropolitan area because it is typically not covered by an annual snowpack. Maintenance of the trail is conducted by the ODF.

In October 2007, Oregon LNG representatives met with the ODF to address concerns about impacts on the Four County Point Trail and the Four County Point Monument. The impacts on the trail and monument would be temporary. The pipeline route would cross the Four County Point Monument area, which is located at the end of the trail near MP 47.4. Although the trail would not be crossed by the pipeline, it would be within the temporary workspace area necessary for construction due to steep topography; therefore, ODF has indicated that closing the trail briefly during construction would be an appropriate safety measure. Oregon LNG would continue coordinating with the ODF to investigate mitigation options to reduce the temporary workspace and temporary impacts on recreational activities.

This would include developing a coordination plan with the ODF that contains:

- notification of when construction would necessitate trail closure;
- the ODF actions to notify the general public and concerned stakeholders;
- Oregon LNG's method to close the trail and post notices/signs on-site; and
- a post-construction trail and monument rehabilitation plan.

Oregon LNG would also obtain applicable permits and follow guidelines outlined by the ODF during construction. **We recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary the coordination plan for the Four County Point Trail and the Four County Point Monument along with documentation of consultation with the ODF.**

Martin's Bar/Lions Day Park

The Port of Woodland's Lions Day Park is in the Martin's Bar area along the eastern shoreline of the Columbia River, west of Dike Road in Cowlitz County. It is currently used as a recreational open space and shoreline area. As mentioned above under *Planned Developments*, development of a boat launch, trailer parking area, and associated facilities is planned at Lions Day Park. The greater Martin's Bar area is promoted as prime heavy industrial property with excellent waterfront capabilities; however, there are no specific plans in place to industrially develop the area (Port of Woodland, 2011).

Oregon LNG would cross a portion of Lions Day Park using the HDD method; however, the HDD exit point and associated ATWS would be within the park. The Dike Road crossing would be constructed using auger-bore or other trenchless installation method and the workspace for that crossing would also be within the park. The road would be closed temporarily during the bore and pipeline

installation activities. During operation of the project, no temporary or permanent structures would be permitted within the permanent pipeline right-of-way. Because the project could temporarily affect users of Lions Day Park, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, a plan that identifies and provides measures to mitigate impacts of pipeline construction and operation on Lions Day Park and its users. Oregon LNG should develop this plan in consultation with the Port of Woodland. .**

Scott Hill Park and Sports Complex

In 2011, the City of Woodland purchased about 39 acres of land on the top of Scott Hill for development of the Scott Hill Park and Sports Complex. Development plans include baseball and softball fields, concessions stand, soccer fields, a walking trail with workout stations, a covered area for community gatherings, a playground, and open green space. The City and Rotary Club of Woodland are currently fundraising to support development. We received comments from the City of Woodland regarding the proposed park and sports complex development, which would be crossed by the pipeline right-of-way. Oregon LNG has indicated it would work with the City to minimize impacts on the proposed park and sports complex.

Memorial Cemetery

Memorial Cemetery is located along East Scott Avenue in Woodland. The cemetery is about 0.2 mile from the pipeline construction right-of-way and would not be impacted by the Oregon LNG Project.

General Recreation

Much of the general recreation of the area that would be affected by the pipeline facilities is similar to that described for the terminal. These uses include sightseeing, wildlife viewing, hiking, swimming, fishing, camping, and picnicking activities. The primary impact associated with construction of the Oregon LNG Project would be visual. Construction would alter visual aesthetics by removing existing vegetation and disturbing soils. Visual impacts are further discussed in the *Visual Resources* section below. Construction would also generate dust and noise, which would be a nuisance to recreational users. In addition, construction would interfere with or diminish the quality of the recreational experience by affecting wildlife movements or disturbing trails. In general, impacts on recreation and public interest areas would be temporary and limited to the period of active construction, which typically would last only several days to several weeks in any one area. Oregon LNG would minimize construction-related impacts on these areas by installing the pipeline adjacent to existing rights-of-way to the extent possible and ensuring effective post-construction restoration of the right-of-way to preconstruction conditions.

Operation of the pipeline and aboveground facilities would not have any significant direct impacts on general recreational activities within the Oregon LNG Project area. Regional tourism would not be significantly affected because the pipeline would be installed underground and, therefore, after the right-of-way is properly restored following construction, the pipeline would not be visible to most visitors.

Off-Road Vehicle Use

ORV use is a popular recreational activity in some areas crossed by the pipeline and is the most popular recreational activity in the Tillamook Forest. Typically, unauthorized ORV access can be

difficult to control in some heavily used ORV areas. If not managed correctly, the pipeline right-of-way could increase ORV access and potential resource impacts.

Oregon LNG prefers to limit ORV use on the right-of-way to avoid problems with revegetation efforts, prevent potential erosion, and to address landowner concerns. To minimize ORV access on the right-of-way, Oregon LNG would follow the guidelines in its Plan, which includes installation of ORV barriers at appropriate locations in coordination with the appropriate land management agency and individual landowners. These barriers may include signs, fences with locking gates, slash/timber barriers, pipe barriers, boulders, trees, and shrubs. During operation of the pipeline, Oregon LNG would continue to monitor and implement corrective measures in heavy ORV use areas to minimize unauthorized ORV access on the permanent right-of-way. As necessary, Oregon LNG would continue to coordinate with affected land management agencies and landowners to establish mitigation measures to address ORV trespass.

Special Land Use Areas

The Astoria Marine Construction Company, a Superfund site spanning two adjacent parcels, is within 0.25 mile (about 300 feet northeast) of the pipeline between MPs 3.2 and 3.3 (EPA, 2013). However, this site would not be crossed by the pipeline right-of-way. Therefore, there would be no impacts on the Superfund site from the Oregon LNG Project, and the Superfund site would not affect the pipeline. Additionally, the pipeline would span the Lewis and Clark River by HDD, exiting beyond the Superfund site area, and would not disturb contaminated sediments in the streambed. No other landfills, hazardous waste sites, or other special use lands are within 0.25 mile of the pipeline (EPA, 2013a). The Astoria Marine Superfund site is further addressed in section 4.1.2.2.

Visual Resources

Pipeline

Visual resources along the proposed pipeline route are a function of geology, climate, and historical processes and include topographic relief, vegetation, water, wildlife, land use, human uses, and development. The vegetation along the route consists mainly of medium-to-large-diameter trees on mostly rolling terrain.

Visual impacts associated with the construction right-of-way and ATWS would include the removal of existing vegetation and exposure of bare soils, as well as earthwork and grading scars associated with heavy equipment tracks, trenching, and machinery and tool storage. Other visual effects would result from the removal of large individual trees that have intrinsic aesthetic value, the removal or alteration of vegetation that may currently provide a visual barrier from undesirable views, or landform changes that introduce contrasts in visual scale, spatial characteristics, form, line, color, or texture.

Oregon LNG would clear vegetation during construction of the pipeline resulting in both short-term and long-term impacts on visual resources, depending on the type of vegetation that is removed. About 12 percent of the pipeline would be adjacent to existing right-of-way corridors. Construction within, or adjacent to, existing rights-of-way typically reduces impacts on visual resources because it minimizes vegetation clearing. However, permanent clearing would be necessary to properly maintain and operate the pipeline right-of-way.

Oregon LNG would minimize impacts on visual resources during construction by utilizing the BMPs in its Plan and Procedures. During construction, Oregon LNG would reduce visual impacts as much as practicable by maintaining existing hedgerows, landscaping, or other vegetative buffers.

Revegetation of the right-of-way is an important mitigation measure that Oregon LNG would use to reduce visual impacts of pipeline construction and operation. After pipeline installation, Oregon LNG would recontour and revegetate the landscape to as near to preconstruction conditions as possible. Any preexisting turf, ornamental shrubs, and specialized landscaping in residential areas would be restored in accordance with Oregon LNG's agreement with the affected landowners. Oregon LNG would monitor and measure revegetation success in accordance with its Plan for proper establishment of the desired species and weed control.

Visual impacts would be greatest where the pipeline route parallels or crosses roads, areas where vegetation used for visual screening of existing utility rights-of-way and forest would be removed, allowing the pipeline right-of-way to be seen by passing motorists or residents. The duration of visual impacts would depend on the type of vegetation that is cleared or altered. The impact of vegetation clearing would be shortest in agricultural and open lands, where the reestablishment of vegetation following construction would be relatively fast (generally less than 5 years).

The visual impacts would be greater in forest land, which would take many years to regenerate mature trees. The greatest potential visual impact would result from the removal of large specimen trees, which would take longer than other vegetation types to regenerate and would be prevented from reestablishing on the permanent right-of-way. The establishment of a new pipeline right-of-way through these forested areas would create a permanent visual impact. Although the temporary portion of the construction right-of-way would be allowed to revert to preconstruction conditions, the new permanent right-of-way would be maintained in an herbaceous state along a 10-foot-wide strip centered on the pipeline. Within the cleared construction right-of-way in forested areas, Oregon LNG would plant in-kind trees outside of the 30-foot-wide corridor centered on the pipeline. In forested and scrub/shrub wetlands, Oregon LNG would replant the right-of-way with in-kind wetland shrub specimens, with the exception of the 10-foot-wide mow strip, thereby minimizing the extent of disturbance. Nearly complete canopy coverage over the pipeline would be expected to develop in most forested upland and forested wetland areas within about 20 years. In general, visual contrasts in forested areas would be noticeable primarily from road crossings and the scattered rural residences. Several major roads would be crossed by the pipeline; therefore, many motorists would be visually aware of pipeline construction and would notice permanent tree removal to accommodate the permanent right-of-way. Visual impacts on national and state scenic highways were addressed previously under *National and State Scenic Highways*.

Aboveground Facilities

Construction and operation of the new aboveground facilities associated with the pipeline would have a permanent impact on visual resources. However, none of these sites would be in areas identified as having any special or unique scenic characteristics or in areas with any designated protection for scenic values. The facilities would be in industrial or rural areas with generally moderate to low scenic values that, due to a low number of potential viewers, are not sensitive to visual resource changes. However, construction and ground disturbances would be noticeable to viewers in the vicinity of these activities.

During construction of the aboveground facilities, Oregon LNG would maintain existing hedge easements or landscaping where practicable to lessen the visual impact of construction to landowners. The majority of the Oregon LNG Project, however, would be in industrial forest or rural areas where visual impacts would be negligible. Oregon LNG would parallel existing right-of-way corridors to the greatest extent possible. Placement of the Oregon LNG Project adjacent to existing rights-of-way would minimize woodland clearing, avoid additional habitat fragmentation, and reduce visual impacts. In addition, temporary construction workspaces located outside of the permanent right-of-way would be recontoured and allowed to revert to preconstruction conditions.

Permanent structures would be relatively small and, as such, would remain subordinate to the visual landscape in which they would be located. Further, Oregon LNG would paint the meter stations a nonreflective color that would blend with the surrounding landscape, which would reduce the visual impacts associated with operation of the aboveground facilities. The compressor station would include visual screening along its western/southwestern side to help screen views from Highway 30 and other areas farther west. The specific type and dimensions of screening would be determined during more detailed design; however, the screening could include fencing, a wall, a planted landscaped buffer, or a combination of these items. If used, a planted landscape buffer would consist of native coniferous and deciduous trees combined with lower shrubs and groundcovers and would be planted to give it a more natural appearance as possible. Existing, mature vegetation would screen views of the compressor station along the north, east, or south sides of the site, including areas along both sides of Deer Island Slough. Therefore, we conclude that impacts of the pipeline on visual resources would be adequately minimized.

4.1.10 Socioeconomics

The potential socioeconomic effects associated with the Oregon LNG Project include impacts on local population, employment, housing, traffic, the economy, public services, local tax revenues, and property values and environmental justice. These impacts would occur primarily in Clatsop County, Oregon because of the construction and operation of the terminal and in Clatsop and Columbia Counties in Oregon and Cowlitz County, Washington because of the construction of the pipeline. However, socioeconomic effects of construction would also extend into the Portland Metropolitan Statistical Area (PMSA). The PMSA includes Yamhill, Washington, Multnomah, and Clackamas Counties in Oregon and Clark and Skamania Counties in Washington.

4.1.10.1 Terminal

The potential impacts associated with the LNG marine carriers entering the lower Columbia River estuary and from the construction and operation of the terminal are discussed together because the potential impacts are similar and affect the same areas. Construction of the terminal would occur in the City of Warrenton. Other potentially affected areas along the waterway and in the vicinity of the terminal include the City of Astoria, Clatsop and Columbia Counties, and the PMSA in Oregon and the City of Ilwaco and Pacific County in Washington.

Population

Population statistics for areas where potential socioeconomic effects would occur are provided in table 4.1.10-1. Astoria is the most densely populated city in the waterway and terminal area with an average of 1,554 people per square mile in 2010. Clatsop County had a population density of 45 persons per square mile (U.S. Census Bureau, 2010).

Table 4.1.10-1

Populations in Terminal Area

Area	Population	Population Density [a]
Oregon	3,831,074	40
Clatsop County	37,039	45
Warrenton [b]	4,989	406
Astoria [c]	9,477	1,554
PMSA	2,212,125	331
Washington	6,724,540	101
Pacific County	20,920	22
Ilwaco (RM 3)	936	446

[a] Persons per square mile based on population and land area size: Oregon (95,997 square miles), Clatsop County (827 square miles), Warrenton (12 square miles), Astoria (6 square miles), Columbia County (657 square miles), PMSA (5,028 square miles); Washington (66,544 square miles), Pacific County (975 square miles), and Ilwaco (2 square miles).

[b] Information from the U.S. Census Bureau includes the communities of Fort Stevens and Hammond as part of the City of Warrenton.

[c] Information from the U.S. Census Bureau includes the community of Navy Heights as part of the City of Astoria.

Source: U.S. Census Bureau, 2010.

Based on an economic impact analysis of the project (ECONorthwest, 2012), construction of the terminal would create an average of 2,755 direct jobs. Of these jobs, 2,480 positions would be the result of hires from within Oregon and Washington. The majority of the construction workforce would travel to the project site from areas such as the PMSA and nearby counties in Oregon and Washington, including Clatsop County. Some of these workers would commute; some would temporarily relocate to the project area. The remaining 275 workers would come from other states and would relocate or occupy temporary accommodations. It is estimated that on an annual basis, 1,791 workers (65 percent) would commute daily, 937 (34 percent) would stay in nearby temporary accommodations, and 28 (1 percent) would relocate. The addition of approximately 2,755 workers on an average annual basis would create a local population increase of about 19 percent. Relatively minor and temporary increases in population levels would occur in Clatsop County as workers move into the area.

Operation of the terminal would generate 145 direct, permanent jobs in Clatsop County. Some of these workers would commute from nearby areas and some would permanently relocate to the project area. Assuming that 87 percent of the workers would permanently relocate to Clatsop County and the 126 relocating households would each consist of 3.08 people on average, the population would conservatively increase by up to 389. However, when compared to the current population of the county, operation of the LNG terminal would not directly result in a notable population increase in the local community.

In addition, LNG marine carrier traffic would not be expected to affect the distribution of population because it would not result in people moving into or out of the communities along the waterway. LNG marine carriers are operated by personnel that enter and leave the port with the carrier. The only additional workers that would be newly employed as a result of LNG marine traffic would be the crews of the tug and escort boats; it is likely that most of these operators would be local citizens.

Economy and Employment

Table 4.1.10-2 provides a summary of per capita income, workforce (civilian), unemployment rates, and employment by industry and sector for counties and cities in the waterway and terminal area.

Average per capita income in 2010 in Clatsop County ($25,347) and Pacific County ($23,326) was lower than the averages for their respective states of Oregon ($26,171) and Washington ($29,733). In contrast, the per capita income for the PMSA was $27,922, which was higher than average for the State of Oregon. The average unemployment rates during 2010 in Clatsop County (8.9 percent) and Pacific County (12.7 percent) were also lower than the averages for Oregon and Washington (8.4 and 7.5 percent, respectively).

According to the U.S. Census Bureau (2010), the top three industries in the terminal area in Oregon were (1) Educational Services, Healthcare, and Social Assistance (21.7 percent); (2) Manufacturing (11.3 percent); and (3) Retail Trade (12.5 percent). The top three industries in the terminal area in Washington were (1) Educational Services, Healthcare, and Social Assistance (21.0 percent); (2) Retail Trade (12.5 percent); and (3) Professional, Scientific, Management, Administrative, and Waste Management Services (11.8 percent).

Georgia-Pacific is a major employer in Clatsop and Columbia Counties, with a combined total of approximately 1,000 employees (Georgia-Pacific, 2013). Other major employers in Clatsop County include the State of Oregon, and the U.S. Coast Guard (Clatsop County, 2005). Other major employers in Columbia County include retailer Fred Meyer and flooring manufacturer Armstrong World Industries (Columbia County Economic Team, 2013). Major employers in Cowlitz County include St. Johns Medical Center, with about 1,600 employees, and Weyerhaeuser Company, with about 1,500 employees.

Table 4.1.10-2

Economic Conditions in the Terminal Area

Area	Per Capita Income	Labor Force	Unemployment Rate (Percent)	Top Industries by Employment
Oregon	$26,171	1,951,500	8.4	Educational Services, Healthcare, and Social Assistance; Manufacturing, Retail Trade
Clatsop County	$25,347	19,918	8.9	Educational Services, Healthcare, and Social Assistance; Arts, Entertainment, Recreation, Accommodation, and Food Services; Retail Trade
Warrenton	$19,606	2,560	6.8	Educational Services, Healthcare, and Social Assistance; Arts, Entertainment, Recreation, Accommodation, and Food Services; Retail Trade
Astoria	$28,322	4,869	8.4	Retail Trade; Educational Services, Healthcare, and Social Assistance; Arts, Entertainment, Recreation, Accommodation, and Food Services
PMSA	$27,922	1,1 84,200	7.3	Educational Services, Healthcare, and Social Assistance; Manufacturing; Retail Trade
Washington	$29,733	3,465,500	7.5	Educational Services, Healthcare, and Social Assistance; Retail Trade; Professional, Scientific, Management, Administrative, and Waste Management Services
Pacific County	$23,326	8,433	12.7	Educational Services, Healthcare, and Social Assistance; Arts, Entertainment, Recreation, Accommodation, and Food Services; Retail Trade
Ilwaco	$22,713	544	2.8	Transportation, Warehousing, and Utilities; Educational Services, Healthcare, and Social Assistance; Agriculture, Forestry, Fishing, and Hunting, and Mining

Source: U.S. Census Bureau, 2010.

Construction of the terminal would occur over a 48-month (4-year) construction period. Based on an economic analysis conducted for the project by ECONorthwest (2012), terminal construction would stimulate an estimated 9,584 jobs (direct, indirect, and induced) in Oregon. Total direct construction

costs for the LNG terminal would be about $5.8 billion. Direct personal income (including both wages and benefits) for the construction of the terminal facilities would be about $2.3 billion.

We received public comments that the project would help the community by creating jobs. During construction, about 2,755 direct jobs (an average of 689 jobs annually) would be created. The labor force in Clatsop County is almost 20,000 people and therefore, can contribute to fulfilling project construction-related employment needs. However, many of the workers experienced in heavy and civil engineering construction live in the Portland area and elsewhere. About 2,480 workers would come from Oregon and Washington, with about 1 in 10 of those construction jobs (248 direct jobs) filled by people currently living in Clatsop County. The remaining 275 would come from other states, and would relocate or occupy transient accommodations. Even though Clatsop County's economy can provide only a portion of the workers, goods, and services needed, construction of the terminal would stimulate about 2,327 indirect jobs, $710 million in personal income, and $2.5 billion in output. Additionally, the income earned by workers and local businesses due to construction would induce 4,502 jobs, $922 million in personal income, and $2.8 billion in output. Construction-related freight would generate an estimated 84 jobs (direct, indirect, and induced).

Oregon LNG would directly employ about 145 workers for terminal operations in Clatsop County. Terminal operations would generate over $14 million in direct net personal income annually and nearly $6.1 billion annually in output of natural gas. Most indirect and induced employment would be full- and part-time employment in the service sector. Terminal operations would result in the purchase of local goods and services, stimulating nearly $238 million per year in indirect output. About 772 indirect jobs would be created in Oregon and southwest Washington, including shipping and marine aspects of the terminal (e.g., marine pilots, longshoremen), generating over $62 million annually in personal income. In addition, induced growth from the creation of new jobs would create 654 additional jobs, generating over $24 million annually in personal income, and $72 million in output. Of the indirect jobs, about 260 would be created in Clatsop County, generating $25 million annually in personal income, and in $101 million in output. In addition, induced growth from the creation of new jobs would create 229 additional jobs in Clatsop County, generating over $7 million annually in personal income, and $22 million in output.

The construction and operation of the LNG terminal would have positive economic benefits for the local communities, as the project would generate direct and indirect jobs, income from wages, purchases, rental of housing, and taxes, which would help future growth and output in Clatsop County.

Tax Revenues

We received several comments about how the project would positively impact the local tax base and economy. Construction and operation of the Oregon LNG terminal would have beneficial impacts on property, personal income, and corporate tax revenue in Clatsop County. The LNG terminal would significantly strengthen the property tax base for the local school district and other government services in the local community. Property tax, calculated on the assessed value of the property, would be collected by Clatsop County and distributed to special districts in the county. Any additional public needs in the surrounding counties would need to be covered through other revenue sources, including grants. Oregon LNG estimates that the property tax from the terminal would generate about $51.9 million in average revenue annually, based on the average tax for the City of Warrenton.

Personal income taxes from all the construction-related income (terminal and pipeline) would range from $25.4 million to $56.3 million annually over the construction duration. In total, construction would yield $219.8 million in Oregon income tax. Operation-related income taxes would total about

$4.6 million annually for the life of the project, which is at least 60 years. Oregon LNG estimates that the corporate income tax and business and occupancy tax would be about $4.0 million total during terminal construction and $7.5 million during terminal operation.

Housing

Temporary housing availability varies seasonally and includes bed and breakfasts, hotels and motels, apartments, mobile homes, and houses. In addition, temporary housing is available in campgrounds and recreational vehicle parks.

Housing statistics for the counties and communities in the terminal area are presented in table 4.1.10-3. During 2010, Clatsop County had 2,973 vacant housing units. The cities of Warrenton and Astoria had 260 and 441 vacant housing units, respectively. Pacific County, Washington had 2,021 vacant housing units and the City of Ilwaco had 84 vacant housing units.

In 2011 Astoria hotels had average vacancy rate of 72 percent in the fall/winter and 50 percent in the spring/summer (Dohaniuk, 2012). About 75 hotels operate within a 50-mile radius of Warrenton, offering a combined 4,091 rooms. Vacancy rates obtained from the City of Astoria for 30 area hotels, motels, and bed and breakfasts show that during 2011, a large number of rooms were available. In addition, there are about 28 campgrounds and recreational vehicle parks near the terminal site in Clatsop and Pacific Counties.

Table 4.1.10-3

Housing Characteristics in the Waterway and Terminal Area

Area	Total Housing Units	Total Vacant Housing Units	Rental Vacancy Rate (Percent)	Median Gross Monthly Rent
Oregon	1,675,562	160,854	7.0	$811
Clatsop County	21,546	2,973	10.1	$742
Warrenton	2,034	260	8.7	$785
Astoria	5,187	441	8.5	$659
PMSA	904,735	68,760	5.6	$876
Washington	2,885,677	291,453	7.6	$904
Pacific County	15,547	2,021	9.5	$627
Ilwaco	654	84	8.7	$607

Source: U.S. Census Bureau, 2010.

It is anticipated that a relatively small number of terminal construction workers would be from Clatsop County and that these workers would have existing housing. Construction workers coming from outside Clatsop County would be expected to commute daily if within driving distance; rent apartments, houses, or hotel/motel rooms temporarily; or transport a trailer to a nearby trailer park or campsite. A small number of workers may decide to purchase homes as a result of the length of the construction. Some of the terminal operation workers would commute from nearby areas and some would permanently relocate to the area and purchase homes. The estimated 937 transient construction workers have a sufficient number of accommodations available to them, including 2,176 active rental properties in Clatsop County, 4,091 hotel rooms, and many other types of lodging. The number of vacant housing units in Clatsop County is sufficient to satisfy the estimated 28 construction workers and 126 terminal operation workers who would relocate.

Because there is adequate available housing, both temporary and permanent, construction and operation of the LNG terminal would not significantly affect the availability of housing in the terminal area. LNG marine carrier traffic should not result in significant changes in demand for housing in the communities along the waterway because LNG marine traffic would not, in and of itself, result in people moving into or out of the communities along the waterway.

There are no other active large development projects within the general vicinity of the LNG terminal. Local city staff and officials have identified two large projects still in the planning stages including a new campus for Clatsop Community College and a conference center at Port of Astoria. No construction schedule has been developed for either project; therefore, competition for available housing during the planned construction time frame for the terminal is limited to tourism at this time. Considering the amount of vacant housing units available, the number of nonlocal people requiring housing would not adversely affect the local or regional housing market.

Property Values

The total real market value of assessed property in Clatsop County, Oregon in the fiscal year 2013 to 2014 was $7,279,208 (Oregon Department of Revenue, 2014). From 2008 to 2012, the estimated median value of a house in Warrenton was $207,500 and in Astoria it was $247,900 (U.S. Census, 2014).

We received several comments from persons concerned with a potential loss of property values associated with the presence of the LNG marine carriers and the LNG terminal. If the LNG terminal were authorized and constructed, commercial river traffic would increase by about 3 to 4 percent over average levels between 2003 and 2011. Safety and security measures associated with the LNG marine waterway are addressed in section 4.1.13.

An EcoNorthwest study (2006) examined local county assessment records for neighborhoods surrounding existing LNG "peak storage" facilities in Newport and Portland, Oregon. The study found that property values around the Newport LNG plant are not depressed, and within 0.5 mile of the facility there are about 25 homes with above-average market value. The study concluded there is no evidence to support the concern that the presence of an LNG storage facility would reduce nearby property values.

Public Services

Infrastructure and Utilities

At the LNG terminal site, Oregon LNG would construct an on-site stormwater treatment system and a fire protection system, which are described in section 2.1.1.1. The City of Warrenton would provide water and wastewater service (see section 2.1.1.1), as well as solid waste service for the terminal. Construction and operation of the terminal would increase the quantity of solid waste in the area. Oregon LNG would work with the City of Warrenton Public Works Department to ensure adequate access to hauling services, as well as sufficient capacity at disposal locations. Disposal of all solid waste materials would follow local, state, and federal regulations and properly transported to approved waste disposal sites.

No major or critical infrastructure is within the vapor dispersion or thermal exclusion zones surrounding the LNG terminal. No communications infrastructure is currently installed at the terminal site, therefore communications infrastructure for telephone service and fiber optic cables would be installed at the terminal site to connect to a local service provider.

Direct purchases of utilities for both terminal and pipeline construction would be $3,308,195 spread over the entire construction period. Expenditures by the utilities to supply services to the project would be $2,231,910.

Government and Emergency Services

A summary existing government and emergency services in the area of the waterway and LNG terminal is provided in table 4.1.10-4.

Table 4.1.10-4

Existing Public Services in the Vicinity of the Terminal and Waterway

Facility	Location	Details
Fire Departments	Warrenton	Warrenton Fire Department
	Astoria	Astoria Fire Department
	Astoria	Lewis and Clark Rural Fire Protection District (RFPD)
	Astoria	Olney Walluski Fire and Rescue
	Astoria	John Day-Fernhill RFPD
	Astoria	Knappa Fire District
	Seaside	Elsie-Vinemaple RFPD
	Ilwaco	Ilwaco Fire Department
	Long Beach	Long Beach Fire Department
	Ocean Park	Pacific County Fire District 1
Law Enforcement	Clatsop County	Clatsop County Sheriff's Office
	Warrenton	Warrenton Police Department
	Astoria	Astoria Police Department
	Long Beach	Long Beach Police Department
	Long Beach	Pacific County Sheriff
Hospitals	Astoria	Columbia Memorial Hospital — Level III Trauma Center 25 beds
	Ilwaco	Ocean Beach Hospital — 15 beds
	Seaside	Providence Seaside — 47 beds
Ambulance Services	Warrenton	Medix Ambulance

Sources: Clatsop County, 2013b.

Fire protection at the LNG terminal would be provided by the Warrenton Fire Department. The Clatsop County Sheriff's Office and Oregon State Police would be the primary law enforcement agencies responsible for the LNG terminal. Fire and other emergencies at the proposed LNG terminal would require the services of additional local fire departments and emergency response units. Assuming public safety costs are proportional to population, the cost of public safety as a result of project construction activity would average $706,452 per year.

Columbia Memorial Hospital serves the Astoria-Warrenton area, where the LNG terminal would be located. The hospital is the regional medical center with a full-service, critical access, Level III trauma center, and access to Life Flight emergency transportation via helicopter from locations surrounding the area to the hospital or to locations such as Legacy Emanuel Hospital in Portland.

During both construction and operation, Oregon LNG would provide on-site security 24 hours a day, 7 days a week, which would minimize dependence on local law enforcement. The terminal would also have an on-site fire protection system with sufficient capacity to respond to fire events within the facility boundaries, which would also minimize need for local services.

Oregon LNG entered into an MOU with the ODOE in August 2014 to establish the framework of cooperation and responsibilities between Oregon LNG and ODOE in developing an emergency planning and preparedness program for the terminal (see appendix C2). In accordance with the EPAct, Oregon LNG's emergency response plan (ERP) must offer a Cost-sharing Plan, and outline how Oregon LNG would fill resource gaps and supplement the first-responder capabilities of the local jurisdictions. Oregon LNG would be required to file a final ERP including a Cost-sharing Plan for review and approval by the Director of OEP prior to the beginning of project construction activities. The Cost-sharing Plan included in the ERP would address comments that the emergency response for the project would not place an undue burden on local resources. Other than the services of local first responders, construction and operation of the LNG terminal would not have any other adverse impacts on local infrastructure and public services. Upon completion of construction, Oregon LNG would also employ its own security force, thereby minimizing the need for local public services. The emergency preparedness MOU for the terminal and Oregon LNG's ERP for its pipeline are discussed in more detail in section 4.1.13.

Schools

Clatsop County has five school districts with a total enrollment of 4,932 students (U.S. Department of Education, 2014). The LNG terminal would be within the Warrenton-Hammond School District, which consists of one elementary school and one high school. During the 2011-2012 school year, enrollment in the school district was 875 students (U.S. Department of Education, 2014). Because most workers would be expected to commute from their current residences or find temporary housing, only a nominal increase in enrollment at the local public schools would occur as a result of the relocation of construction or operation workers and their families. Over the four years of construction on the terminal, relocating worker households would result in about 15 additional public school students would be enrolled into Clatsop County school districts. Fifteen additional students over 4 years would result in public education costs increasing by $184,470, of which $45,915 would come from local revenue sources. The remainder would come from state, federal, and other nonlocal resources.

Transportation and Traffic

Marine Traffic

Commercial River Uses

Commercial activities along the lower Columbia River include shipping, commercial fishing, charter boat services, cruises, ship piloting (both along the river and at the bar), tugboat operations and long-shoring, and miscellaneous shore-based activities in the Astoria area. Construction of the terminal would not affect commercial river uses in the federal navigation channel, but LNG marine carriers would use the federal navigation channel during operations.

The average number of ships crossing the Columbia River bar each month has been declining since the late 1990s, from 321 a month from 1998 through 2002 to approximately 276 from 2003 through 2011 (Columbia River Bar Pilots, 2012). Most of these ships are traveling to or from ports upriver of the terminal. In addition to ships passing by the terminal area, cargo ships are frequently seen docked at berths or waiting offshore in the general terminal area at Tansy Point, Astoria, and the Hampton Affiliates (formerly Weyerhaeuser) facility. The project would add about 125 LNG marine carriers per year to the existing marine traffic. The use of the federal navigation channel by LNG marine carriers would be consistent with its current use by other commercial ships. The increase of 125 vessels per year from the Oregon LNG Project represents an approximate increase in large vessel traffic of 3 to 4 percent over the average levels between 2003 and 2011. The LNG marine carriers would be limited to movement within the federal navigation channel and the turning basin at the terminal.

As described in section 4.1.13.8, the Coast Guard has recommended certain safety and security measures for LNG marine carrier operations in its LOR for the Oregon LNG Project. Based on the level of LNG traffic proposed and the coordination that would be implemented, we conclude that the project would have minor effects on commercial ship traffic.

The Port of Astoria receives ship calls from a number of river-based cruise vessels (riverboats) and ocean-going cruise ships. These ships would pass the terminal during arrivals and departures. The riverboats vary in size, with the larger vessels carrying 200 to 250 passengers. The cruises begin in Portland, Oregon, with stops along the Columbia, including Astoria. The riverboats moor at the Astoria Maritime Museum dock upriver of the Astoria-Megler Bridge, which is outside of the Zones of Concern; however, a small number of riverboats pass the Astoria-Megler Bridge and approach the Columbia River Bar. The riverboat cruising season is year-round, though the majority of the river cruise boat visits in Astoria occur from spring through fall. The combined number of cruise ship and river cruise calls at the Port of Astoria has decreased while the number of passengers has increased, from approximately 134 vessel calls and 20,000 passengers in 2000 to approximately 97 vessel calls and 27,500 passengers in 2007.

In 2013, 21 cruise ships docked at Astoria. Oregon LNG consultation with the Port of Astoria and cruise ship representatives indicated that their only concern was that the LNG marine carriers not affect the arrival and departure schedules of the cruise ships. The cruise ships typically arrive at about 8:00 a.m. and depart around 5:00 p.m., which allows passengers limited time to disembark and visit Astoria and the surrounding attractions. If the LNG marine carriers arrived during the arrival or departure of the cruise ships, cruise ship operation would be affected. Furthermore, if the LNG marine carriers inconvenience cruise ships as they enter and leave the area, they could decrease the amount of time that tourists spend in Astoria and neighboring communities, which could decrease revenues that local businesses derive from tourism. The Coast Guard's recommendations in its LOR Analysis (see section 4.1.13.8) include coordination of inbound and outbound transit details between the Coast Guard, Federal Bureau of Investigations, bar and river pilots, escort tug masters, and other escort assets 24 hours prior to arrival. Subsequent coordination meetings or phone call confirmation would be required 4 hours prior to arrival and 1 hour prior to arrival. This provision would avoid conflicts between LNG marine carrier and cruise ship schedules. Consequently, we conclude that the project would not have significant impacts on cruise-based tourism.

An estimated two to three tug or tug/barge combinations currently transit past the terminal site each day. There is an average of 40 monthly (20 inbound and outbound) tug and barge transits passing the terminal site. These transits can be anytime during the day or night except for the Tidewater tugs, which normally conduct their work at the Warrenton Fiber Plant on Tansy Point between 3:00 a.m. and 12:00 p.m. on Monday, Wednesday, and Friday. Representatives of the tug companies indicated that their primary concern was that the tugs must be able to transit past the terminal and LNG vessels moored at the facility while remaining in the channel. The moored LNG marine carrier and 200-yard security zone around the LNG marine carrier while the carrier is moored at the facility would not impact the movement of vessels in the shipping channel nor would it limit movement in and out of the Skipanon Waterway.

Commercial and Recreational Fishing

As discussed in section 4.1.9.1, the lower Columbia River supports diverse commercial and recreational fishing industries that harvest salmon, smelt, sturgeon, shad, anchovy, crab, and shrimp. The primary commercial fisheries operating on the Columbia River are gill netters, with the largest fishery being salmon, and crabbers. The gill netters are active from May through October, with the busiest period during summer months. However, the fishing season for salmon and sturgeon has been reduced in recent

years. The commercial crabbing peak season is from December to February. Youngs Bay and the mouth of the Columbia River are the two locations near the East Skipanon Peninsula where commercial fishing activities are concentrated. A number of commercial fishing vessels that operate in the ocean are moored at various locations up the Columbia River.

The salmon, steelhead, and sturgeon fisheries draw thousands of recreational fishing boats each year to the lower Columbia River. The popular Chinook and coho salmon "Buoy 10" fishery occurs in the late summer, with the season varying from year to year. Sturgeon fishing runs from May through July and peaks in June. This is the largest sport fishing season, measured by boat numbers, in the lower Columbia River. In 2011, there were 143,343 angler trips in the in the lower Columbia recreational fishery, with 49,409 angler trips at Buoy 10 (WDFW and ODFW, 2012). It extends from Buoy 10, near the entrance to the Columbia River, upriver past the terminal location and the Astoria-Megler Bridge to Tongue Point.

Public and ODFW comments raised concerns about the potential impacts on the commercial and recreational fishing opportunities from the LNG marine carrier transit and terminal development. We conclude that the project would have minimal impacts on commercial and recreational fishing.

As discussed in section 4.1.9.1, dredging and other terminal construction activities would not affect ship traffic within the federal navigation channel. Recreational vessels would be restricted from the construction area during construction and from the security zones at the terminal during operation. However, the restrictions during construction would be temporary and the security zones would present a minor inconvenience relative to the size of the river at this location.

Commercial and recreational fishermen are already accustomed to the presence of large tankers in the federal navigation channel. The Coast Guard's safety and security measures would require fishermen in the vicinity of the federal navigation channel or proposed turning basin to temporarily move out of the way of LNG marine carriers to avoid the safety zone recommended by the Coast Guard. However, this temporary inconvenience would last only a short time as the ship passes, at which point the fishing activities would be allowed to resume at the original positions within the river. In its LOR Analysis, the Coast Guard has recommended coordination of vessel transits and bar crossings to minimize conflicts with other deep draft vessels, recreational boaters, seasonal fisheries, and other marine events (see section 4.1.13.8). Oregon LNG also may restrict LNG marine carrier arrivals and departures to nighttime periods or when the number of fishermen has decreased during the Buoy 10 fishing season. In addition, Oregon LNG has committed to funding the acquisition of additional communication equipment currently missing from commercial fishing vessels permanently moored in the project area and that is necessary for communicating with the Coast Guard about pending LNG marine carrier transits.

Native American Treaty Fishing

Fishing is an important ceremonial and subsistence activity for the Native American tribes (Nez Perce, Umatilla, Warm Springs, and Yakama) that participate in tribal fisheries in the mainstream Columbia River and tributaries upriver from the Bonneville Dam (RM 146). These four tribes signed a treaty with the U.S. government in 1855 in which they reserved the right to fish at their "usual and accustomed" fishing sites (Allen, 2003). There are currently no designated tribal fishing grounds below the Bonneville Dam (Allen, 2003), but the fish populations that support the Treaty Indian Fishery do migrate through the lower Columbia River estuary. Oregon LNG would consult with the four tribes prior to construction to confirm that there have not been any new treaty fishing sites established downstream from the Bonneville Dam. In the event that new treaty fishing sites are established, Oregon LNG would coordinate with the affected tribes to develop a mutually approved plan for potential compensation due to

a recordable loss. No significant adverse impacts on Indian treaty fishing rights are anticipated as a result of the project.

Road Traffic

A new 20-foot-wide gravel road on the south side of the site, accessed from King Avenue, would provide primary access to the terminal during construction. Workers and construction trucks would access King Avenue via Warrenton-Astoria Highway and the Oregon Coastal Highway (US 101/26). Workers could also travel into the area via Fort Stevens Highway 104 and Warrenton Astoria Highway 105.

Following ODOT's recommendation during scoping, Oregon LNG prepared a traffic impact study for the project, which included an analysis of the year of peak construction to evaluate traffic impacts due to the transport of materials, manpower, supplies, and other items to and from the terminal site during construction (CH2M HILL, 2013f). Construction would last about 48 months, commencing with site work preparation.

The anticipated daily heavy truck volume for the project during the peak construction period would be about 617 trips per day and personnel or light-duty vehicle travel during peak construction would be about 309 trips per day. Up to 96 heavy truck trips and about 279 personnel or light-duty vehicle trips would be generated during the afternoon peak hour of terminal construction.

Of these vehicle trips, dredging and excavation activity during peak construction would average up to 65 truck trips per hour. These additional construction vehicles would increase the amount of traffic on local surface roads throughout the duration of construction, primarily between Warrenton and Astoria, and the project site. However, the amount of project-related traffic during the construction period is a small percentage when compared to existing traffic on the surrounding roadways. Oregon LNG would encourage carpooling to reduce the passenger traffic to and from the site.

Oregon LNG analyzed the function of nearby intersections, comparing background traffic volumes with the addition of construction- and operation-related traffic. Traffic operations are reported as volume to capacity ratio, delay time, and level of service. A volume to capacity ratio is the peak hour traffic volume (vehicles/hour) on a highway section divided by the maximum volume that the highway section can handle (ODOT, 1999). Level of service is a measure describing traffic conditions in terms of speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and delay. Letter definitions from A to F are used to measure performance with A representing the best operating conditions (no congestion) and F representing the worst conditions (near gridlock).

As indicated in table 4.1.10-5 and table 4.1.10-6, the existing (2012) and future (2016) conditions of four intersections reviewed in the traffic analysis currently fail to meet operational standards (volume to capacity ratio and level of service).

Table 4.1.10-5

Existing Intersection Conditions (2012)

Intersection				Worst Approach [a]			
Major Approach	**Minor Approach**	**Control**	**OHP Highway Mobility Standard**	**Direction**	**Volume to Capacity Ratio**	**Delay (seconds)**	**Level of Service**
East Harbor Street	Main Avenue	AWSC	0.90	Eastbound	0.71	22.2	C
East Harbor Street	King Avenue	TWSC	0.90	Northbound	0.04	38.2	E
East Harbor Street	Marlin Avenue	TWSC	0.90	Northbound	**1.23**	174.9	F
East Harbor Street	Neptune Avenue	TWSC	0.90	Northbound	**0.95**	59.7	F
US 101	East Harbor Street	Signalized	0.80	**-**	**0.91**	48.4	D
US 101	Neptune Avenue	Signalized	0.80	-	0.77	27.2	C
US 101	Marlin Avenue	Signalized	0.80	**-**	**1.08**	79.5	E

OHP = Oregon Highway Plan

AWSC = All-way stop-controlled intersection

TWSC = Two-way stop-controlled intersection

Bold type indicates failing intersections.

[a] Volume to Capacity Ratio, Delay, and Level of Service are reported for worst approach (stop-controlled intersections) or for overall operations (signal-controlled intersections).

Source: CH2M HILL, 2013f.

Table 4.1.10-6

Background Traffic Growth Intersection Conditions (2016)

Intersection				Worst Approach [a]			
Major Approach	**Minor Approach**	**Control**	**OHP Highway Mobility Standard**	**Direction**	**Volume to Capacity Ratio**	**Delay (seconds)**	**Level of Service**
East Harbor Street	Main Avenue	AWSC	0.90	Eastbound	0.73	23.7	C
East Harbor Street	King Avenue	TWSC	0.90	Northbound	0.04	39.7	E
East Harbor Street	Marlin Avenue	TWSC	0.90	Northbound	**1.30**	200.7	F
East Harbor Street	Neptune Avenue	TWSC	0.90	Northbound	**1.01**	68.7	F
US 101	East Harbor Street	Signalized	0.80	**-**	**0.92**	37.1	D
US 101	Neptune Avenue	Signalized	0.80	-	0.79	21.5	C
US 101	Marlin Avenue	Signalized	0.80	**-**	**1.10**	59.1	E

OHP = Oregon Highway Plan

AWSC = All-way stop-controlled intersection

TWSC = Two-way stop-controlled intersection

Bold type indicates failing intersections.

[a] Volume to Capacity Ratio, Delay, and Level of Service are reported for worst approach (stop-controlled intersections) or for overall operations (signal-controlled intersections).

Source: CH2M HILL, 2013f.

To conservatively analyze traffic at the intersections during the peak of construction, the construction-generated trips were added to the projected 2016 volumes (see table 4.1.10-7). During construction, five of the intersections are expected to fail. The added trips due to construction would further worsen existing traffic operations, but only temporarily. The additional traffic from construction

would result in an increased volume to capacity ratio, increased traffic delays, and diminished levels of service for most of the intersections near the terminal site.

Table 4.1.10-7

Total Traffic Intersection Conditions (2016)

Intersection				Worst Approach [a]			
Major Approach	Minor Approach	Control	OHP Highway Mobility Standard	Direction	Volume to Capacity Ratio	Delay (seconds)	Level of Service
East Harbor Street	Main Avenue	AWSC	0.90	Eastbound	0.75	25.3	D
East Harbor Street	King Avenue	TWSC	0.90	Southbound	6.13	Err [b]	F
East Harbor Street	Marlin Avenue	TWSC	0.90	Northbound	**2.26**	Err [b]	F
East Harbor Street	Neptune Avenue	TWSC	0.90	Northbound	**1.40**	144.7	F
US 101	East Harbor Street	Signalized	0.80	**-**	**1.03**	55.4	E
US 101	Neptune Avenue	Signalized	0.80	-	0.80	21.0	C
US 101	Marlin Avenue	Signalized	0.80	**-**	**1.31**	115.9	F

OHP = Oregon Highway Plan

AWSC = All-way stop-controlled intersection

TWSC = Two-way stop-controlled intersection

Bold type indicates failing intersections.

[a] Volume to Capacity Ratio, Delay, and Level of Service are reported for worst approach (stop-controlled intersections) or for overall operations (signal-controlled intersections).

[b] Delay exceeds 600 seconds of delay per vehicle and cannot be reasonably calculated.

Source: CH2M HILL, 2013f.

Construction of the Oregon LNG terminal would affect roadway transportation and traffic in the project area by increasing the number of vehicle trips per day on area roads as a result of worker commuting and construction vehicle traffic. The increase in traffic would cause short-term localized delays in traffic movement, resulting in potential short-term economic losses due to delays caused by the increase in traffic volumes.

Prior to construction, Oregon LNG must obtain site plan approval for construction of the terminal and must obtain an Access Permit from ODOT to cross state funded roadways. Additionally, due to the currently high volume to capacity ratios, poor levels of service at traffic intersections near the terminal facility, and to minimize the potential for construction traffic to further impact traffic, **we recommend that:**

- **<u>Prior to terminal construction,</u> Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, a Terminal Construction Traffic Management Plan prepared in consultation with the City of Warrenton and ODOT. The plan should address total vehicular traffic at the construction site, volume of traffic from other employees and schedule of shift changes, and describe potential restrictions of construction traffic if necessary.**

To determine operational impacts, operational trips were added to the background traffic volumes for the year of opening (2019). Four of the intersections would fail to meet operational standards. As only 93 daily trips would be added to the traffic network during the peak hour of terminal operation, traffic at the completion of the project is expected to be similar to baseline conditions during the year of opening. Therefore, at the year of project opening, additional traffic generated by trucks and personnel required to work at the terminal would not significantly affect traffic conditions at the study intersections.

Although some volume to capacity ratios exceed the Oregon Highway Plan mobility standard at the year of opening, this would not be caused by traffic generated by the LNG terminal facility. Background traffic levels alone during the year of opening are expected to result in continued intersection operational failure. However, because the volume to capacity ratios and levels of service at most of the study intersections currently fail, added trips due to growth and operations may further worsen traffic conditions during the first year of operations.

In comments, the public expressed concern that the security zone around docked LNG marine carriers would extend inland and restrict traffic. However, the security zone recommended by the Coast Guard ends at the shoreline and would not impact the movement of traffic near the terminal.

Air Traffic

Several comments were received related to the potential impacts of airplanes using the Astoria Regional Airport and the location of the terminal LNG storage tanks. Because the LNG storage tanks would protrude into protected airspace in the vicinity of the airport, the FAA conducted an aeronautical study to evaluate whether the LNG storage tanks would be a hazard to navigation at the Astoria Regional Airport (under the provisions of 49 U.S.C. Section 44718 and 14 CFR Part 77). The FAA found that the LNG storage tanks would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities, and issued a Determination of "No Hazard to Air Navigation" (FAA, 2011). This determination was updated in 2014 for the revised terminal design. However, the FAA imposed certain conditions on Oregon LNG to ensure aircraft safety.

As a condition of the FAA's determination, Oregon LNG would minimize the overall height of the tanks by mounting any ladders, walkways, valves, and vent lines on the side of the storage tanks instead of on the top as in typical configuration for LNG storage tanks. Oregon LNG would also place navigation lights on the tank per FAA guidance. In addition, Oregon LNG would upgrade the conventional very high frequency omni-directional radio navigational signal at the Astoria Regional Airport to a new Doppler very high frequency omni-directional radio to mitigate the impact of the two LNG storage tanks on the existing navigation signals. These measures would allow for the intrusion of the LNG storage tanks into the navigation airspace without disrupting visual or instrument flight paths.

Environmental Justice

Executive Order 12898 requires that agencies that are part of the federal government identify and address disproportionately high and adverse human health and environmental effects of their actions, programs, and policies on minority and low-income populations with the goal of achieving environmental protection for all communities. Executive Order 12898 also requires that federal agencies produce project documents, notices, and hearings that are readily available to the public. Although FERC is an independent regulatory agency, we carry out our programs in accordance with Executive Order 12898 as appropriate. As discussed in section 1.6, FERC issued notices and held public meetings to inform local communities about the project, and provided information about involving the public in FERC's review process. All documents that form the administrative record for these proceedings are available to the public through the eLibrary link on FERC's internet web page at www.ferc.gov.

The three primary steps in assessing environmental justice issues are to determine: 1) the geographic distribution of minority and low-income populations; 2) whether any impacts would be high and adverse; and 3) whether these impacts would disproportionately affect the minority and low-income populations. To assess the minority and low-income composition within terminal area relative to that of its surroundings, Warrenton and Astoria demographic data were compared with county and state data (U.S. Census Bureau, 2010).

Table 4.1.10-8 describes the ethnic and racial composition and table 4.1.10-9 summarizes the population living below federal standards defining poverty (i.e., low-income).

Table 4.1.10-8

Demographics in the Vicinity of the Terminal

Area	Total Population	Percent White	Percent African American	Percent American Indian & Alaska Native	Percent Asian	Percent Native Hawaiian & Other Pacific Islander	Percent Hispanic or Latino	Percent Other Race(s)	Percent Total Minority
Oregon	3,831,074	87.1	2.6	2.9	4.9	0.7	6.0	6.1	23.2
Clatsop County	37,039	93.6	0.9	2.3	2.1	0.6	4.2	3.6	13.7
Warrenton	4,989	91.5	0.6	1.3	1.1	0.7	5.7	1.8	11.2
Astoria	9,477	89.2	0.6	1.1	1.8	0.1	9.8	3.9	17.2

Source: U.S. Census Bureau, 2010.

Table 4.1.10-9

Income Distribution in the Vicinity of the Terminal

Area	Total Population	Percent of Persons Below Poverty
Oregon	3,831,074	14.6
Clatsop County	37,039	12.6
Warrenton	4,989	12.1
Astoria	9,477	16.2
PMSA	2,212,125	12.4

Source: U.S. Census Bureau, 2010.

About 17 percent of the population of Astoria is minority, which is higher than that of Warrenton (11 percent) and Clatsop County (14 percent), but lower than that of Oregon (23 percent). About 16 percent of the population of Astoria live below poverty level (i.e., low-income), which is higher than that of Warrenton (12 percent), Clatsop County (13 percent), and Oregon (15 percent).

Because the terminal would be on private industrial land, there would be no residences on the proposed terminal site and no residential acquisitions would occur as a part of terminal construction. The closest residential areas are in Warrenton, about 1 mile west of the terminal site and 0.5 mile from the waterway.

The EPA commented that the project may impact minority and low-income communities; particularly health risks from wind-blown dust and earthworks, as well as increased noise, light, and traffic emissions during construction and air impacts associated with vessel operations. The analysis of demographic data indicates that there are no disproportionately high percentages of low-income or minority populations along the waterway or near the terminal; therefore, LNG marine carriers and the LNG terminal would not cause a high and disproportionate adverse effect on environmental justice populations. In addition, the public involvement process did not identify community concerns regarding effects on minority or low-income populations. Therefore, the project would impact minority or low-income individuals in the same manner as other individuals.

4.1.10.2 Pipeline and Associated Facilities

The pipeline would be constructed in the City of Warrenton and in Clatsop, Tillamook, and Columbia Counties in Oregon and Cowlitz County in Washington. As previously noted, Yamhill, Washington, Multnomah, and Clackamas Counties in Oregon and Clark and Skamania Counties in Washington are the six combined counties referenced as the PMSA, where the majority of the construction workforce for the pipeline facilities would be expected to reside.

Construction of the pipeline is proposed to take about 36 months (3 years). The work would be divided into four construction spreads. The four spreads range from about 5 to 34 miles in length. Construction of the pipeline would involve an annual average workforce of about 426 workers spread over the length of the pipeline. Oregon LNG estimates that about 50 percent of the workers needed to build the pipeline and associated facilities would come from within Oregon and Washington. Oregon LNG may employ some specialized out-of-state workers with previous pipeline construction experience. Upon completion of construction, about four permanent workers would be required to operate the compressor station.

Population

Population data for the counties that would be crossed by the pipeline are summarized in table 4.1.10-10. The pipeline route would be in rural areas with low population densities. Of the four counties that would be crossed by the pipeline, Cowlitz County has the greatest population density.

Table 4.1.10-10

Populations in Counties Crossed by the Oregon LNG Pipeline Route (2010)

Area	Land Area Size (Square Miles)	Population	Population Density [a]
Oregon	98,466	3,831,074	39
Clatsop County	827	37,039	45
Warrenton	18	4,989	282
Astoria	11	9,477	894
Tillamook County	1,133	25,250	22
Columbia County	648	49,351	76
St. Helens	5	12,883	2,431
PMSA	6,684	2,212,125	331
Washington	71,362	6,724,540	94
Cowlitz County	1,166	102,410	88
Woodland	4	5,509	1,574
Longview	14	36,648	2,599

[a] Persons per square mile based on population and land area size.

Sources: U.S. Census Bureau, 2010.

Construction of the pipeline would involve a workforce of about 426 workers spread over the length of the pipeline. About 50 percent of the construction workers would be hired on a temporary basis from areas about an hour drive away and would commute daily to the construction site from the municipalities closest to each of the four pipeline construction spreads. Minor increases in population levels would occur as workers with specialized skills move into the area. These increases would be limited to the duration of construction. Construction of the pipeline facilities would not have significant adverse impacts on the populations in the counties along the pipeline route, because the project workforce would be temporarily distributed throughout at least four counties over the four construction spreads. The four permanent workers would have a negligible impact on population.

Economy and Employment

Per capita income, unemployment rates, and employment by economic sectors in 2010 are presented in table 4.1.10-11. Within the affected counties, average per capita income was generally slightly lower than the Oregon ($26,171) and Washington ($29,733) averages. The per capita incomes for Astoria and the PMSA were $28,322 and $27,922, respectively, which were slightly higher than the Oregon average. The unemployment rates for counties along the pipeline route were generally higher than the Oregon (8.4 percent) and Washington (7.5 percent) averages. Educational Services, Healthcare, and Social Assistance was the top industry in most areas. Astoria's unemployment rate was the same as the Oregon average. The unemployment rates for Warrenton and the PMSA were 6.8 and 7.3, respectively, which was slightly lower than the Oregon average.

Table 4.1.10-11

Selected Socioeconomic Characteristics in Counties Crossed by the Oregon LNG Pipeline Route

Area	Per Capita Income	Labor Force	Unemployment Rate (Percent)	Top Industry by Employment
Oregon	$26,171	1,951,500	8.4	Educational Services, Healthcare, and Social Assistance (21.7%); Retail Trade (12.5%); Manufacturing (11.3%)
Clatsop County	$25,347	19,918	8.9	Arts, Entertainment, Recreation, Accommodation and Food Services (20.2%); Educational Services, Healthcare, and Social Assistance (16.4%); Retail Trade (13.6%)
Warrenton	$19,606	2,560	6.8	Educational Services, Healthcare, and Social Assistance (14.4%); Arts, Entertainment, Recreation, Accommodation, and Food Services (13.3%); Retail Trade (13.2%)
Astoria	$28,322	4,869	8.4	Retail Trade (19.3%); Educational Services, Healthcare, and Social Assistance (16.9%); Arts, Entertainment, Recreation, Accommodation, and Food Services (16.3%)
Tillamook County	$25,250	12,341	9.5	Manufacturing (14.9%); Educational Services, Healthcare, and Social Assistance (14.2%); Retail Trade (13.2%)
Columbia County	$24,613	24,055	10.5	Educational Services, Healthcare, and Social Assistance (19.5%); Manufacturing (18.9%); Construction (9.8%)
St. Helens	$21,317	6,579	16.7	Educational Services, Healthcare, and Social Assistance (17.4%); Manufacturing (14.9%); Retail Trade (11.5%)
PMSA	$27,922	1,184,200	7.3	Educational Services, Healthcare, and Social Assistance (21.0%); Manufacturing (12.8%); Retail Trade (11.7%)
Washington	$29,733	3,465,500	7.5	Educational Services, Healthcare, and Social Assistance (21.0%); Professional, Scientific, Management, Administrative, and Waste Management Services (11.8%); Retail Trade (11.6%)
Cowlitz County	$22,948	42,762	11.9	Educational Services, Healthcare, and Social Assistance (23.4%); Manufacturing (14.7%); Retail Trade (11.5%)
Woodland	$18,216	2,476	16.9	Manufacturing (19.4%); Educational Services, Healthcare, and Social Assistance (17.8%); Construction (10.1%)
Longview	$23,246	16,479	12.2	Educational Services, Healthcare, and Social Assistance (26.1%); Manufacturing (13.6%); Retail Trade (11.4%)

Source: U.S. Census Bureau, 2010.

Based on an economic analysis conducted for the project by ECONorthwest (2012), pipeline construction would stimulate an estimated 256 direct jobs in Oregon and Washington and $195 million in personal income. Total direct construction costs for the pipeline facilities would be about $680 million. Of this, direct expenditures on goods, equipment, and services during construction of the pipeline facilities would amount to $485 million. Direct payroll (both wages and benefits) for the construction of the pipeline facilities would amount to $195 million. Construction of the pipeline would stimulate about 237 indirect jobs, $68 million in personal income, and $235 million in output. Additionally, the income earned by workers and local businesses due to construction would induce 278 jobs in the county, $57 million in personal income, and $172 million in output.

During operation, Oregon LNG would directly employ about 4 workers to operate the compressor station. Indirect and induced employment would create an additional 17 jobs in Oregon and southwest Washington. In total, pipeline operations would generate over $1 million in net personal income annually (direct, indirect, and induced). Further, pipeline operation would result in the purchasing of local goods and services, stimulating over $167 million per year in total output (including indirect and induced).

Construction and operation of the pipeline facilities would have a beneficial impact on the local economy. Project-related employment and expenditures would have a direct and positive effect on employment and economy within the project area.

Tax Revenues

Oregon LNG would pay property tax for the length of the pipeline representing significant tax revenue contributions to the counties crossed by the pipeline. Tax revenue would be based on the portion of the pipeline in each county and tax rates from the different taxing entities. The apportioned amounts of property taxes would be paid based on the portion of the infrastructure based in that county. Table 4.1.10-12 shows the estimated property tax resulting from the pipeline within each county. Oregon LNG has estimated that total pipeline property taxes would be about $5 million.

Table 4.1.10-12

Forecast of Assessed Value and Property Tax

State County	Gas Pipeline (Miles)	Assessed Value ($)	Tax Rate	Property Tax Imposed ($)
Oregon				
Clatsop	44.1	197,933,450	12.26	2,426,664
Tillamook	3.3	14,811,347	11.11	164,554
Columbia	34.9	156,641,181	13.54	2,120,922
Washington				
Cowlitz	4.4	19,748,458	10.81	213,481
Total	**86.8**	**389,134,436**	**12.66**	**4,925,621**

Source: ECONorthwest, 2013; based on 2011-2012 property tax rate information provided by the Oregon Department of Revenue).

A portion of the revenue in Clatsop, Tillamook, and Columbia Counties would result from the development across state forest lands, as shown in table 4.1.10-13. An estimated $566,909 in taxes would be generated by the pipeline on an annual basis.

Table 4.1.10-13

Forecast of Assessed Value and Property Tax Imposed Within State Forests

State Forest (County)	Gas Pipeline (Miles)	Assessed Value ($) [a]	Tax Rate	Property Tax Imposed ($)
Clatsop State Forest (Clatsop)	4.73	21,229,593	12.26	260,275
Clatsop State Forest (Columbia)	0.53	2,378,792	13.54	32,209
Tillamook State Forest (Columbia)	2.11	9,919,114	13.54	134,305
Tillamook State Forest (Tillamook)	2.81	12,612,086	11.11	140,120
Total	**10.18**	**46,139,585**	**12.29**	**566,909**

[a] Assessed value and property tax imposed are based on fiscal year 2010-2011 rates and assessments.
Source: Oregon Department of Revenue, 2011-2012.

Construction and operation of the proposed pipeline would have beneficial impacts on property and corporate tax revenue in the counties and state forest lands affected by the project. In Oregon, property taxes on the pipeline would be assessed by and paid to Clatsop, Tillamook, and Columbia Counties and Clatsop and Tillamook State Forests. In Washington, property taxes on the pipeline would be assessed by and paid to Cowlitz County. Generally, the pipeline easement would not directly cause a

change in land use. To the extent a change in land use does occur, the impact would most likely be negligible. Therefore, there should be no changes to a landowner's property taxes directly resulting from the pipeline crossing the property.

Housing

Housing statistics for the counties affected by construction of the pipeline facilities are presented in table 4.1.10-14. The rental vacancy rates for most of the counties along the pipeline route are similar to the Oregon and Washington statewide averages.

Table 4.1.10-14

Housing Characteristics in Counties Crossed by the Oregon LNG Pipeline Route

Area	Total Housing Units	Total Vacant Housing Units	Rental Vacancy Rate (Percent)	Median Monthly Gross Rent
Oregon	1,675,562	160,856	7.0	$811
Clatsop County	21,546	2,973	10.1	$742
Astoria	5,187	441	8.5	$659
Warrenton	2,034	260	8.7	$785
Tillamook County	18,359	2,093	7.2	$666
Columbia County	20,698	1,883	6.8	$750
St. Helens	5,006	445	6.5	$708
PMSA	904,735	68,760	5.6	$876
Washington	2,885,677	291,453	7.6	$904
Cowlitz County	43,450	4,084	7.2	$683
Woodland	1,924	90	4.7	$711
Longview	16,641	1,198	5.2	$650

Source: U.S. Census Bureau, 2010.

As discussed previously, most construction workers would be hired on a temporary basis from nearby areas and would commute to the construction site. The number of vacant units and vacancy rates within counties crossed by the pipeline suggest the project area would absorb the estimated temporary workforce, some of which would be drawn from the local workforce, over the construction period. Temporary housing availability would vary, but because the estimated workforce is small relative to the overall population and housing availability in the project area, pipeline construction would not have a significant effect on the local housing markets.

Property Values

Several public comments were received regarding loss of property value, use, and income due to construction of the pipeline, permanent easements that would be necessary for maintenance, and presence of a pipeline. In particular, we received comments expressing concern related to the removal of high value crops along the pipeline route.

As described in section 4.1.9.2 under *Land Ownership and Easements*, Oregon LNG would compensate landowners for use of the land and for damage to property during construction, loss of use during construction (such as crops), and losses related to long-term access and maintenance of the right-of-way. Other than the easement, construction of the pipeline would not place any restrictions on a landowner's ability to sell or transfer ownership of a property during or after construction.

The impact on the value of a given tract of land depends on many factors, including the size of the tract, current value of the land, current land use, values of adjacent properties, and presence of other utilities. A potential purchaser of property may make a decision to purchase land based on his or her planned use, such as agricultural, future subdivision, or second home on the property in question. If the presence of a pipeline renders the planned use infeasible, it is possible that a potential purchaser would decide not to purchase the property; however, each potential purchaser has different criteria and differing capabilities to purchase land.

Production of herbaceous (nonwoody) crops would be allowed to continue unrestricted within the pipeline right-of-way following construction. Farmers would retain the flexibility to switch crops based on market conditions. However, woody and deep-rooted vegetation, including trees, shrubs, cane berries, vines, and any crops requiring trellising that can cause damage to the buried pipeline, may be restricted within the permanent pipeline right-of-way (see section 4.1.9.2). Oregon LNG may negotiate with landowners, on an individual basis, to allow production of certain specialty crops within the permanent pipeline right-of-way, as long as the proposed activities do not interfere with the safe operation of the pipeline or Oregon LNG's ability to maintain the right-of-way.

The INGAA Foundation conducted a national case study to determine if the presence of a pipeline on a piece of property affected the property value or sales price of the property. The researchers reviewed four case studies in different parts of the country, including medium value rural homes, medium-to-high value suburban homes, higher value suburban homes, and commercial properties. The INGAA Foundation Natural Gas Pipeline Impact Study (INGAA, 2004) found that there was no discernable impact on the sales price or demand for properties along natural gas pipelines. It was further determined that neither the size of the pipeline (diameter) nor the product carried via a pipeline has any significant impact on property sale prices.

In addition, ECONorthwest conducted a study on NW Natural's South Mist Pipeline Extension to determine if the presence of the pipeline on properties in Washington, Marian, and Clackamas County affected the property value or sale price. The South Mist Pipeline Extension is a similar natural gas pipeline that went into service in September 2004. Information from more than 10,000 property transactions within 1 mile of the pipeline was used to test for statistical or economical significance on residential property values. The study found there was not a statistically significant impact on the sale price of properties along the South Mist Pipeline Extension; therefore, the pipeline had no discernible impact on property values (EcoNorthwest, 2008).

Whatcom County, Washington analyzed the impacts on property values associated with pipelines to determine the effect of the Olympic pipeline explosion on sales of real estate on or near the pipeline route. The analysis determined that the explosion of the pipeline, which transported liquid petroleum fuel, had little effect on property values (Whatcom County, 2001).

Based on data reviewed from previous prepared studies of natural gas pipelines in the Pacific Northwest and effects on property values, we have determined that there is no substantial evidence the proposed pipeline would have a significant effect on property values.

Public Services

A range of public services are provided in the cities and counties that would be crossed by the pipeline.

Utilities

Table 4.1.10-15 lists the major utilities that would be crossed by the pipeline. Public and private utilities provided in the pipeline project area include natural gas, electricity, water, and sewer. During construction there may be temporary interruptions of services; however, these disruptions would have only minor, temporary impacts on the local community facilities, services, and infrastructure. Service from local utilities, including electricity, would be needed at the meter stations, compressor station, and contractor and pipe storage yards. Water for hydrostatic testing and dust control would also be required for pipeline construction. However, no construction or expansion of wastewater and stormwater treatment facilities would be required.

Table 4.1.10-15

Major Utilities Crossed by the Pipeline

County	Owner	Milepost	Type of Utility
Clatsop	West Oregon Electric Cooperative	33.6	Power Line
	West Oregon Electric Cooperative	34.0	Power Line
	West Oregon Electric Cooperative	43.6	Power Line
Columbia	Northwest Natural Gas	63.3	Gas Transmission Line
	Columbia County	67.8	Power Line
	Columbia County	77.2	Power Line
	Portland General Electric	77.2	Power Line
	Columbia County	80.1	Power Line
	Northwest Natural Gas	81.3	Gas Transmission Line

Government and Emergency Services

Table 4.1.10-16 provides a listing of emergency services within the counties where the pipeline and compressor station would be located. There are seven police departments in these counties. There are also 7 fire departments and 260 fire fighting and other protective service workers in these areas.

Table 4.1.10-16

Emergency Services in Counties Crossed by the Oregon LNG Pipeline Route

County	Police/Sheriff's Department	Fire and Rescue Department
Clatsop	Clatsop County Sheriff's Office	Olney-Walluski Fire District #35
	Astoria Police Department	Astoria Fire Department
	Warrenton Police Department	Warrenton Fire Department
Tillamook	Tillamook County Sheriff's Office	Tillamook Fire Department
Columbia	Columbia County Sheriff's Office	Vernonia Rural Fire Protection District
Cowlitz	Cowlitz County Sheriff's Office	Cowlitz County Fire District 5
	Woodland Police Department	Cowlitz County Fire District 2

Table 4.1.10-17 provides fire district information by pipeline milepost. There would be six fire districts in the vicinity of the pipeline.

Table 4.1.10-17

Fire Districts Crossed by the Oregon LNG Pipeline Route

County	Fire District Name	Approximate Mileposts
Clatsop	Lewis and Clark	3.0 to 11.0
	Elsie-Vinemaple	33.0 to 35.5
Columbia	Vernonia Rural	57.8 to 58.0 61.0 to 62.3 63.5 to 64.3
	Mist-Birkenfeld Rural	63.0 to 63.3
	St. Helens-Rainier	74.5 to 81.5
Cowlitz	Woodland	82.5-86.8

Sources: ODF, 2013; WDNR, 2013.

Several comments were received indicating the concern that the project may result in a strain on current fire protection resources in the case of an emergency involving the LNG terminal and associated pipeline. The DOT is mandated to provide pipeline safety, and the DOT pipeline standards are published in 49 CFR Parts 190-199. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues. Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

There are four hospitals near the pipeline route, with a total of 443 beds (see table 4.1.10-18). Emergency medical providers with helicopter medical evacuation services are available in the Astoria-Warrenton area at Columbia Memorial Hospital.

Table 4.1.10-18

Hospitals in Counties Crossed by the Oregon LNG Pipeline Route

County	Hospital Name	Number of Beds	Approximate Distance from Pipeline (miles)
Clatsop	Columbia Memorial Hospital	25	5.0
Clatsop	Providence Seaside Hospital	47	13.0
Tillamook	Tillamook County General Hospital	25	32.0
Cowlitz	PeaceHealth St. John Medical Center	346	15.6

As discussed in section 4.1.13.10, because of current safety regulations governing the construction design, monitoring, and operation of interstate natural gas pipelines, the potential for an accident involving the pipeline is very low. The pipeline would be safely installed and operated according to DOT regulations, and would not be a threat to public safety. In addition, Oregon LNG would have an integrity management plan in place to minimize the potential for an accident and an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency (see section 4.1.13.10). Additionally, Oregon LNG would provide the appropriate training to local emergency service personnel before the pipeline is placed in service, establish and maintain liaison with emergency responders and public officials, One-Call Center participation, and a Pipeline Education and Awareness Program. Therefore, the pipeline would not have significant adverse impacts on local police, fire departments, or hospitals.

Schools

School districts and school enrollment by district within the counties that would be crossed by the Oregon LNG pipeline are summarized by county in table 4.1.10-19.

Table 4.1.10-19

Number of School Districts and Enrollment in the Oregon LNG Pipeline Area

County	Number of School Districts	Enrollment
Clatsop	3	2,985
Tillamook	1	737
Columbia	2	4,128
Cowlitz	1	2,164
Total		**10,014**

Source: U.S. Department of Education, 2013.

Because most construction workers would be expected to commute from their current residences, only a nominal increase in enrollment at the local public schools would occur as a result of the relocation of construction workers and their families. Four households would be expected to move to the pipeline construction affected area. Construction of the pipeline would increase the number of enrolled students in the seven-district area by two students over 3 years resulting in $24,596 in increased annual expenditures for public schools. About $6,122 per year would come from local revenue sources. The remainder would come from state, federal, and other nonlocal resources.

The permanent relocation of four compressor station employees and their families to the area would not affect enrollment of local schools.

Transportation and Traffic

Road Traffic

Construction of the pipeline would occur simultaneously with construction of the terminal. The majority of the pipeline would not be in the same area as the terminal; therefore, most of the vehicles associated with pipeline construction would not overlap with construction trips destined for the terminal. During the peak pipeline construction period, there would be a total of about 610 heavy trucks (1,220 trips) and 1,066 personnel vehicles/light duty trucks (2,132 trips) per day. The pipeline construction spreads would be constructed simultaneously. Each spread would have a contractor and pipe storage yard where large construction materials would be stored. Trucks would move the materials and equipment on surface streets from the contractor and pipe storage yards to the final pipeline location.

The first spread would include the pipeline from its beginning at MP 0.0 to MP 33.0. The contractor and pipe storage yard for this spread would be at Tongue Point in Astoria. From the contractor and pipe storage yard, trucks carrying construction loads would most likely travel west along U.S. Highway 30 (also known as Marine Drive) from Tongue Point to either State Highway 202 southbound or continue across the Youngs Bay Bridge on Highway 101. From Highway 101 southbound, trucks would continue south along the Oregon coast and then east on U.S. Highway 26 towards pipeline access roads. From Highway 202, trucks would use multiple county or local access construction roads to reach the pipeline alignment. About 486 heavy truck and 812 personnel vehicle/light duty truck trips per day would be needed to construct this segment.

The second spread would extend between MPs 33.0 and 47.5. The contractor and pipe storage yard for this spread would be near the junction of Timber Road and Highway 26. From this yard, construction vehicles would take Highway 26 or State Highway 47 to pipeline access roads. About 162 heavy truck and 270 personnel vehicle/light duty truck trips per day would be necessary to construct this segment.

The third spread would be about 34.5 miles in length and extend southeast from MP 47.5 to MP 82.0. The contractor and pipe storage yard for this spread would be on the east side of Highway 30, north of Columbia City, Oregon. Construction vehicles would travel north to local pipeline access roads or south along Highway 30 or Highway 26 westbound. From Highway 26 westbound, construction vehicles would use Highway 47 northbound and various local or private access roads to reach pipeline construction locations. About 462 heavy truck and 842 personnel vehicle/light duty truck trips per day would be necessary to construct this segment.

The fourth spread would extend from MP 82.0 to MP 86.8. The contractor and pipe storage yard for this spread would be on the west side of I-5 south of Kalama, Washington. About 112 heavy truck and 208 personnel vehicle/light duty truck trips per day would be necessary to construct this segment. From the contractor and pipe storage yard, vehicles would travel south on I-5 to Dike Access Road (Exit 22). From Dike Access Road, construction vehicles would use various local or private roads to the east and west of I-5 to access pipeline construction locations.

Based on the various tasks necessary to construct the pipeline, it is likely that only a portion of construction-related vehicles would access the same location on the same day or within the same peak hour. Equipment delivery, assembly, and other construction activities would likely occur at various construction locations along the pipeline. Therefore, only 80 percent of the daily construction vehicles (approximately 520 vehicles for Spread 1, 170 vehicles for Spread 2, 520 vehicles for Spread 3, and 130 vehicles for Spread 4) are assumed to affect traffic conditions by accessing a single location along the pipeline spreads on a peak day.

Construction of the pipeline would affect transportation and traffic in the project area by increasing the number of vehicle trips per day on area roads as a result of commuting and construction vehicle traffic as well as temporary closures of some minor roads. During the initial staging, temporary impacts on local transportation systems may result from the transport of construction equipment and materials to the respective staging areas. Temporary impacts on public roadways would include increased congestion or longer travel times near or through areas where the proposed pipeline would be constructed. After construction begins, daily movement of equipment and materials within the project area would create minor impacts on the flow of traffic. Once the construction corridor has been cleared and graded, much of the equipment movement would occur along the corridor rather than local roadways. When it is necessary for construction equipment and material to cross roadways, traffic flow may be briefly interrupted. The transport of equipment and materials would be minimized through planning and coordination. Oregon LNG would attempt to coordinate the movement of heavy equipment and slow-moving machinery during times when impacts on traffic flow is minimal.

To facilitate construction activities, existing access road modifications proposed by Oregon LNG would be limited to widening and the addition of gravel to prevent rutting. On completion of the pipeline facilities installation, previously existing roads that were used for access would be returned to original or better condition, or as otherwise requested by the landowner. The total cost of road maintenance and repair is forecast to be $735,426 due to heavy vehicles and $71,787 from small vehicles (8,754,570 miles times 0.82 cents) on the roads in the affected area. The total cost would be $807,213 over 4 years. These

costs are recovered through the state motor fuel tax of $0.30 per gallon plus a local tax of $0.03 per gallon for fuel purchased in Warrenton. Additionally, trucks exceeding 26,000 pound pay a weight-mile tax.

To manage and alleviate temporary impacts from pipeline construction traffic, Oregon LNG would develop a Traffic Mitigation Plan.

Table 4.1.10-20 lists the major roads and highways that would be crossed by the pipeline route and Oregon LNG's proposed crossing method.

Table 4.1.10-20

Major Roads Crossed by the Oregon LNG Pipeline Route

Road	County	MP	Proposed Crossing Method
Highway 101	Clatsop	0.9	HDD
Highway 101 Alt.	Clatsop	3.0	HDD
Highway 103	Clatsop	34.0	Bore
Highway 26	Clatsop	41.1	HDD
Highway 26	Clatsop	43.5	HDD
Highway 47	Columbia	63.8	HDD
Highway 30	Columbia	80.6	Bore
Interstate 5	Cowlitz	85.7	Bore

In an effort to minimize disturbance to traffic flow during road crossings, Oregon LNG would construct the pipeline across paved roadways by conventional bore or HDD. Little or no disruption of traffic would occur at road crossings that are bored. Most smaller, unpaved roads and driveways would likely be crossed by means of open-cut trenching, which may slightly disrupt local traffic flow. Emergency vehicle and passenger vehicle access would be maintained across these dirt roads through the use of metal plates or other such measures. Appropriate control measures would be used during construction, such as detouring of traffic where possible, flagging, signage, and flashing lights. Roadways would be repaired to their preconstruction condition when installation of the proposed pipeline is completed in those areas.

Oregon LNG would apply for all permits necessary for road access and crossings, and would comply with all permit stipulations. Any special requirements due to traffic volumes and weight limitations would be addressed via this process. Additionally, Oregon LNG would coordinate construction activities with jurisdictional highway authorities, emergency responders, school transportation departments, other local groups such as private homeowners associations and individual homeowners to minimize traffic impacts associated with the construction of the pipeline. During construction, traffic flow for general access, and in particular for emergency response, would be maintained along roads that are the sole access to homes and communities.

Operation of the pipeline would not result in traffic impacts.

Rail Traffic

As Oregon LNG could use railroads for delivery of materials and equipment to the contractor and pipe storage yards, rail service could be temporarily affected. Delays in service could occur during loading and unloading of rail cars; however, Oregon LNG would likely construct rail spurs off the main rail lines in certain areas for offloading of materials, which would limit impacts on existing railroad operations. Oregon LNG's use of existing railroad tracks to deliver materials would result in an

economic benefit to railroad companies because payment would be made to use the railroad for freight delivery.

The pipeline would cross the Portland and Western railroad at MP 80.8 and Burlington Northern Santa Fe railroad at MP 85.2. Construction of the proposed pipeline would not affect existing railroad tracks because it would be installed underneath the tracks via a bore with casing or HDD at depths required by the railroad companies. Thus, the railroads would be able to operate over the pipeline even during construction.

Environmental Justice

In terms of minority representation, table 4.1.10-21 and table 4.1.10-22 describe the ethnic and racial composition of the counties that would be crossed by the pipeline. Table 4.1.10-23 and table 4.1.10-24 describe the income distribution of the affected counties crossed by the pipeline. To assess the minority and low-income composition within the pipeline area relative to that of its surroundings, city and county demographic data were compared with other areas that would be crossed by the pipeline and state data (U.S. Census Bureau, 2010). Additionally, the minority and low-income composition was assessed within the census tracts that would be crossed.

Individual minority populations of cities and counties that would be crossed by the pipeline are not noticeably greater than surrounding areas. The "other races" category in Woodland (8.4 percent) has a noticeably greater population than the other cities and counties that would be crossed, as well as the Oregon and Washington averages (6.0 and 6.1 percent, respectively). All of the counties that would be crossed by the pipeline have a smaller minority population than that of Oregon (23.2 percent) and Washington (27.6 percent). However, Astoria and Tillamook County (17.2 and 17.5 percent, respectively) have a greater minority population than the other counties that would be crossed. The Hispanic populations in Astoria (9.8 percent), Tillamook County (9.0 percent), and Woodland (16.6 percent) are greater than the other counties that would be crossed and the Oregon and Washington averages (6.0 and 5.6 percent, respectively).

Table 4.1.10-21

Demographics of Counties Crossed by the Oregon LNG Pipeline Route

Area	Total Population	Percent White	Percent African American	Percent American Indian & Alaska Native	Percent Asian	Percent Native Hawaiian & Other Pacific Islander	Percent Hispanic or Latino	Percent Other Race(s)	Percent Total Minority
Oregon	3,831,074	87.1	2.6	2.9	4.9	0.7	6.0	6.1	23.2
Clatsop County	37,039	93.6	0.9	2.3	2.1	0.6	4.2	3.6	13.7
Warrenton	4,989	91.5	0.6	1.3	1.1	0.7	5.7	1.8	11.2
Astoria	9,477	89.2	0.6	1.1	1.8	0.1	9.8	3.9	17.2
Tillamook County	25,250	93.8	0.3	2.2	1.4	0.6	9.0	4.0	17.5
Columbia County	49,351	95.8	0.9	3.2	1.8	0.4	2.7	1.6	10.6
Washington	6,724,540	81.4	4.8	3.0	9.0	1.0	5.6	6.0	27.6
Cowlitz County	102,410	92.5	1.2	3.4	2.2	0.5	4.0	4.3	15.6
Woodland	5,509	86.4	0.9	0.7	0.8	0.2	16.6	8.4	11.0

Source: U.S. Census Bureau, 2010.

Minority populations were also compared at the census tract level (see table 4.1.10-22). In general, the average percentages of tract population composition are comparable to those for both states, with Hispanic having the largest minority percentages. However, census tract 001502 in Cowlitz County has a larger percentage of Hispanic populations (13.9 percent) than the greater counties and state.

The pipeline would be routed through approximately 4 miles of census tract 001502. Further analysis of census tract 001502 shows that the set of census blocks within the tract and actually crossed by the pipeline route have a Hispanic population of 8 percent, which is more comparable to the county and state Hispanic population. Census block 3016, within census tract 001502 and crossed by the pipeline route, has a population that is 54.2 percent Hispanic. The total population of this census block is approximately 35 people. The pipeline would primarily affect tax lots currently used for agricultural purposes, crossing only three agricultural parcels within census block 3016, which are owned by two landowners: two parcels owned by a private individual and one by a church. In addition, the crossing of these parcels would occur in open agricultural areas where structures or dwellings would not be directly impacted. Impacts on this census block and track would be temporary during construction and no permanent aboveground facilities having operational emissions would be located in this area. Therefore, any disproportionate impact on Hispanic residents within census block 3016 has been minimized by the routing and no permanent adverse impacts would occur in the area.

Table 4.1.10-22

Demographics of Census Tracts Crossed by the Oregon LNG Pipeline Route

Area	Percent White	Percent African American	Percent American Indian & Alaska Native	Percent Asian	Percent Native Hawaiian & Other Pacific Islander	Percent Hispanic or Latino	Percent Other Race(s)
Oregon	87.1	2.6	2.9	4.9	0.7	6.0	6.1
Census Tract 950500, Clatsop County	91.9	0.4	1.3	1.1	0.8	5.4	1.8
Census Tract 950600, Clatsop	94.3	0.3	3.1	0.7	0.0	5.3	4.8
Census Tract 951200, Clatsop County	96.2	0.0	3.1	0.1	0.2	5.1	3.3
Census Tract 960100 Tillamook County	96.4	0.7	1.2	2.6	0.2	5.2	0.3
Census Tract 971100, Columbia County	94.7	0.4	1.2	0.6	0.1	3.2	0.5
Census Tract 970400, Columbia County	94.5	0.0	1.0	0.7	0.8	2.0	0.7
Census Tract 970500, Columbia County	93.5	0.4	1.0	1.0	1.4	3.3	0.7
Washington	81.4	4.8	3.0	9.0	1.0	5.6	6.0
Census Tract 001502, Cowlitz County	87.4	0.8	0.9	1.1	0.6	13.9	7.0

Source: U.S. Census Bureau, 2010.

Income data for the area that would be crossed by the pipeline is shown in table 4.1.10-23. Tillamook County (19.2 percent), Cowlitz County (18.3 percent), and Woodland (21.0 percent) have a greater low-income population than that of the other areas that would be crossed and the Oregon and Washington state averages (14.6 and 13.0 percent, respectively).

Table 4.1.10-23

Income Distribution of Counties Crossed by the Oregon LNG Pipeline Route

Area	Total Population	Per Capita Income	Median Household Income	Percent of Persons Below Poverty
Oregon	3,831,074	$26,171	$49,033	14.6
Clatsop County	37,039	$25,347	$40,426	12.6
Warrenton	4,989	$19,606	$41,130	12.1
Astoria	9,477	$28,322	$35,509	16.2
Tillamook County	25,250	$22,824	$41,869	19.2
Columbia County	49,351	$24,613	$55,358	13.0
Washington	6,724,540	$29,733	$56,384	12.5
Cowlitz County	102,410	$22,948	$39,045	18.3
Woodland	5,509	$18,216	$48,288	21.0

Source: U.S. Census Bureau, 2010.

Low-income populations were also compared at the census tract level (see table 4.1.10-24). Census tract 001502 has a higher percentage of residents below the poverty line (22 percent) than Oregon (16 percent) and Washington (13 percent).

As previously stated, the pipeline would be routed through approximately 4 miles of census tract 001502 and primarily affect tax lots currently used for agricultural purposes. No structures would be displaced in this census tract.

Table 4.1.10-24

Poverty Status by Census Tract for Area Crossed by the Oregon LNG Pipeline Route

Area	Total Population	Percent of Persons Below Poverty
Oregon	3,831,074	14.8
Census Tract 950500, Clatsop County	4,701	12.7
Census Tract 950600, Clatsop County	2,394	4.6
Census Tract 951200, Clatsop County	2,920	15.8
Census Tract 960100, Tillamook County	3,244	12.0
Census Tract 971100, Columbia County	3,539	6.6
Census Tract 970400, Columbia County	2,472	6.5
Census Tract 970500, Columbia County	6,287	6.6
Washington	6,724,540	13.4
Census Tract 001502, Cowlitz County	7,918	22.1

Source: U.S. Census Bureau, 2010.

The pipeline facilities would be in predominantly sparsely populated, rural regions of each affected county. Of the counties with higher environmental justice populations, one residence is within the immediate vicinity of the proposed pipeline construction right-of-way in Clatsop County and one residence is within the immediate vicinity of the pipeline construction right-of-way in Cowlitz County. However, no residences would be displaced. Specialized construction methods would be employed in areas where residential structures are within 50 feet of the construction work area.

The locations of the pipeline facilities were chosen without preference for, or intentional impacts on, any particular social or economic segment or group. The pipeline facilities were sited to minimize impacts, as much as practicable, to human considerations including minority and low-income residents, engineering constraints, and environmental resources. The public involvement process did not identify community concerns regarding construction effects on minority and low-income populations. Based on information gathered from the public involvement process, combined with analysis of demographic data showing there are no predominantly low-income or minority populations in the vicinity of the pipeline facilities, construction and operation of the pipeline would not cause a high and disproportionate adverse effect on environmental justice populations. Therefore, we conclude that the project would impact environmental justice individuals in the same manner as other individuals.

4.1.11 Cultural Resources

Section 106 of the NHPA requires that FERC take into account the effects of its undertakings (including authorizations under Sections 3 and 7 of the NGA) on historic properties and afford the ACHP an opportunity to comment. While Oregon LNG may gather information and contact the SHPO and interested Indian tribes, in accordance with the regulations implementing Section 106 at 36 CFR 800.2(a)(3) and (c)(4), FERC remains responsible for all official findings of NRHP eligibility and project effects, and for government-to-government consultations with tribes.

The cooperating agencies (USACE, DOT, Coast Guard, DOE, EPA, and FWS) also have responsibilities for considering effects of their undertakings on historic properties, under the NHPA. However, as lead federal agency for this project, FERC would address compliance with Section 106 jointly for all the cooperating agencies in this EIS, in accordance with Part 800.2(a)(2).

4.1.11.1 Consultations

The FERC staff consulted with the SHPOs of Oregon and Washington, other agencies, and with Indian tribes regarding the project's potential impact on historic properties. Oregon LNG also communicated with the SHPOs, other agencies, and Indian tribes, providing information about its project to those parties, and requesting comments on inventory and evaluation investigations.

Consultations with the SHPOs and other State Agencies

We mailed our NOI for the original LNG import project, issued August 24, 2007, to the Oregon SHPO. We also sent the SHPOs of Washington and Oregon a copy of our NOI issued September 24, 2012 for the import/export project. As detailed below, FERC staff met in person with Oregon SHPO staff, and exchanged letters with both the Washington and Oregon SHPOs.

On January 24, 2008, FERC staff met with representatives of the Oregon SHPO to discuss the original LNG import project, our review process, and the status of cultural resources investigations. The SHPO staff explained their permitting process, and requested that Oregon LNG renew its search of the SHPO site files. On March 19, 2008, the Oregon SHPO provided FERC staff with its comments on Oregon LNG's draft environmental Resource Report 4 on cultural resources. FERC staff met with Oregon SHPO representatives again on March 31, 2008 to discuss the Area of Potential Effect (APE) for the project, and the status of ethnographic studies. In a letter to FERC staff dated May 13, 2008, the Oregon SHPO provided comments on Oregon LNG's draft cultural resources survey report. On June 12, 2008, the Oregon SHPO provided FERC with its comments on the second draft of Resource Report 4. The Oregon SHPO provided FERC staff with its comments on Oregon LNG's October 2008 cultural resources survey report in a letter dated March 14, 2011.

On May 22, 2012, the Oregon SHPO commented to the FERC on the change in definition of the APE. The Oregon SHPO accepted Oregon LNG's revised definition of the APE in a letter to the FERC staff dated May 21, 2013. On July 22, 2013, the Oregon SHPO commented on the survey report filed with Oregon LNG's June 2013 amended application for the import/export project. The Oregon SHPO provided FERC with comments on a revised cultural resources survey and evaluation report for the import/export project (Wilt and McClintock, 2014) on June 13, 2014.

Besides the SHPO, FERC staff also consulted with other state agencies, including the Oregon Legislative Commission on Indian Services and the ODF. On October 17, 2007, we contacted Karen Quigley, Executive Director of the Oregon Legislative Commission on Indian Services, who suggested that FERC inform the Grand Ronde, Siletz, and Warm Springs Tribes about the project. We contacted those tribes, as discussed below.

On September 21, 2007, the ODF raised concerns to FERC about the project's potential to affect cultural resources within State Forests and indicated that if archaeological surveys identified sites within the State Forests, the ODF should be notified. In a letter to FERC dated December 13, 2012, the ODF reiterated its concerns and also noted that the proposed pipeline route would be in close proximity to the Buster Camp, a class I protected cultural site in the Clatsop State Forest. In response to this comment, Oregon LNG stated that no archaeological sites were found during its survey of Clatsop State Forest land and that the project would avoid the Buster Camp site.

Oregon LNG also communicated with the Oregon SHPO and other state agencies. On October 30, 2007, and February 11, 2008, Oregon LNG met with representatives of Oregon Parks and Recreation Department to discuss the pipeline route. Oregon LNG met with the Oregon State Archaeologist on April 24, 2007 and June 1, 2007 to go over SHPO guidelines and discuss the project. On June 22, 2007, Oregon LNG provided the SHPO with its Scope of Work (Bard, 2007). Oregon LNG first submitted applications to conduct archaeological surveys on state, county, and city lands on July 9, 2007. The survey permit applications were revised on July 31 and August 1, 2007. The SHPO issued permits for this project between October 2 and 19, 2007, and January 17, 2008. Oregon LNG conducted site file searches at the SHPO on August 8, 2007. Representatives of Oregon LNG attended meetings with the Oregon SHPO and FERC staff on January 8, January 24, and March 31, 2008.

On February 13, 2008, Oregon LNG submitted its first draft of Resource Report 4 to the SHPO, who provided comments on that report on March 19, 2008. On May 27, 2008, Oregon LNG requested the Oregon SHPO review its definition of the APE as a 300-foot-wide corridor along the pipeline route for direct effects and a 2-mile-wide corridor for indirect effects. The Oregon SHPO concurred in a letter dated June 5, 2008. A copy of Oregon LNG's first cultural resources survey report for the import project (Bard and McClintock, 2008) was submitted to the Oregon SHPO on November 6, 2008. The Oregon SHPO commented on that report in a letter dated March 14, 2011.

In 2012, Oregon LNG changed its proposed import project to an import/export project with a pipeline ending in Cowlitz County, Washington. On May 10, 2012, Oregon LNG submitted letters to the Oregon and Washington SHPOs requesting review of its revised definition of the APE for the new pipeline segment between MPs 47.6 and 86.8. Concurrence was received from Washington SHPO on May 14, 2012, and from the Oregon SHPO on May 21, 2013.

On June 4, 2013, Oregon LNG provided a report documenting the results of the cultural resources survey for portions of the import/export project to the Washington and Oregon SHPOs (Wilt and McClintock, 2013). In April 2014, Oregon LNG provided the SHPOs with copies of a revised report

incorporating changes to construction areas and the route proposed for the Oregon LNG pipeline (Wilt and McClintock, 2014).

Consultations with Cooperating Agencies, Other Federal Agencies, and Interested Parties

During communications with cooperating agencies, the USACE indicated to the FERC staff that it would do its own coordination with interested Indian tribes. A USACE representative stated that while the USACE would adopt all the Section 106 and tribal consultations of the lead federal agency (FERC), the USACE felt obligated to maintain its own relationships with tribes.[6] Cooperating agencies were given an opportunity to review an administrative version of this draft EIS.

We sent copies of our August 24, 2007 NOI for the original LNG import project, and our September 24, 2012 NOI for the import/export project to the U.S. Department of the Interior, Bureau of Indian Affairs (BIA) Northwest Regional Office in Portland, Oregon; NPS; and the ACHP. On October 17, 2007, we contacted Dr. B.J. Howorton of the BIA who recommended that FERC contact all nine of the federally recognized tribes in Oregon, the Affiliated Tribes of Northwest Indians, and the Columbia River Inter-Tribal Fish Commission (CRITFC). Chuck James, Cultural Resources Specialist for the BIA, suggested that FERC contact the Confederated Tribes of the Grand Ronde Community (Grand Ronde Tribes), Confederated Tribes of Siletz Indians (Siletz Tribes), Confederated Tribes of the Warm Springs Reservation (Warm Springs Tribes), Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), Confederated Tribes of the Umatilla Indian Reservation (Umatilla Tribes), Nez Perce Tribe, Shoalwater Bay Indian Tribe, and Cowlitz Indian Tribe. He also clarified that the Affiliated Tribes of Northwest Indians includes groups that are not federally recognized tribes. We discuss consultations with tribes below.

In a letter to FERC, dated September 13, 2007, the NPS raised concerns about the project's potential impact on the LCNHP. The NPS stated that it would take an Act of Congress to grant a pipeline easement through any portion of the LCNHP. On November 21, 2008, in a letter to FERC commenting on the Notice of Application for the original LNG import project, the NPS raised concerns about potential visual impacts on the LCNHT and the reconstruction of Fort Clatsop and Visitor Center, which is about 3 miles away from the proposed LNG terminal, and human health and safety risks from the project on visitors to those NPS administered elements. In response to our August 2012 NOI for the import/export project, the NPS reiterated some of those same comments in a November 7, 2012 letter to the FERC.

The FERC staff's review of the Oregon LNG pipeline route indicates that it would not cross any portion of the LCNHP. Because of the safety and security measures that would be implemented by Oregon LNG at its proposed facilities, and design requirements of the DOT for the pipeline, the project would have virtually no potential to affect the health or safety of visitors to the LCNHP. Air emissions and noise from the LNG terminal are addressed in section 4.1.12.

The waterway for LNG vessel marine traffic to the Oregon LNG terminal, and a portion of the pipeline route between about MPs 82.0 and 83.0, where it would cross the Columbia River, would also cross the LCNHT. Risk management measures recommended by the Coast Guard for LNG marine traffic

[6] Holm, J., January 16, 2013, USACE email to FERC staff. FERC staff pointed out to the USACE that EPACT of 2005 required that the FERC be the lead federal agency for environmental reviews of LNG projects, and the FERC would also keep the consolidated record for each proceeding. The USACE has not yet filed with the FERC any data about its separate coordination efforts with Indian tribes regarding the Oregon LNG Project. In addition, the May 2002 *Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted in Conjunction With the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission*, signed by the U.S. Department of the Army, stated that the FERC would be the lead agency for compliance with the NHPA for all jurisdictional natural gas projects.

along the waterway would avoid, reduce or mitigate adverse impacts on the portion of the LCNHT that overlaps with the waterway. The portion of the LCNHT at the pipeline crossing of the Columbia River would not be affected because the pipeline would be installed deep beneath the river using an HDD. While there are numerous campsites related to the 1804-1806 Lewis and Clark expedition along the lower Columbia River, none have been recorded as archaeological sites. We conclude that the project would have no adverse impacts on either the LCNHP or the LCNHT.

Consultations with Indian Tribes

The unique and distinctive political relationship between the United States and federally recognized Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements, and differentiates tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal responsibilities and obligations of the United States toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights. Indian tribes are defined in Part 800.16(m), as "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians."

The FERC acknowledges that it has trust responsibilities to Indian tribes, and so, on July 23, 2003, we issued a "Policy Statement on Consultations with Indian Tribes in Commission Proceedings" in Order 635. That policy statement included the following key objectives:

- The Commission will endeavor to work with Indian tribes on a government-to-government basis, and will seek to address the effects of proposed projects on tribal rights and resources through consultation.
- The Commission will ensure that tribal resources and interests are considered whenever the Commission's actions or decisions have the potential to adversely affect Indian tribes or Indian trust resources.

The FERC staff identified Indian tribes that may attach religious and cultural significance to properties in the APE by contacting the Oregon Legislative Commission on Indian Affairs, the SHPO, the BIA, and reviewing pertinent ethnographic literature, such as the *Handbook of North American Indians* (Suttles, 1990). The FERC initiated government-to-government consultations with Indian tribes by sending copies of our August 24, 2007 and September 24, 2012 NOIs to appropriate tribal government leaders. We followed this up with letters, dated October 22, 2007, to tribal leaders for the Grand Ronde Tribes, Siletz Tribes, Warm Springs Tribes, Yakama Nation, Umatilla Tribes, Nez Perce Tribe, Shoalwater Bay Indian Tribe, and Cowlitz Indian Tribe, describing the original LNG import project and requesting comments or assistance in the identification of traditional cultural properties that may be affected. In response, the Grand Ronde and Warm Springs Tribes requested a meeting with FERC staff to discuss cultural resources issues. On January 16, 2013, we sent out letters to interested Indian tribes describing the revised import/export project (see appendix B3). In response to that letter, on January 18, 2013, the Grand Ronde Tribes requested a copy of Oregon LNG's latest cultural resources survey report.

On January 24, 2008, FERC staff met with representatives of the Cow Creek Band of Umpqua Tribe of Indians and Grand Ronde, Siletz, and Warm Springs Tribes. The meeting discussed FERC project review process, definition of the APE, ethnographic studies, and tribal consultations.

Representatives of FERC's third party environmental contractor attended meetings with cultural resources representatives of the Grand Ronde and Warm Springs Tribes on February 25, 2008. FERC staff met with cultural resources representatives of the Grand Ronde and Warm Springs Tribes again on March 31, 2008 to discuss the APE for the project, and the status of ethnographic studies. On February 12, 2009, the Grand Ronde Tribes filed for intervenor status.

Besides consultations with federally recognized tribal governments, FERC also contacted organizations and individuals lacking federal recognition who have legal or economic relationships with the proposed project, a demonstrated interest in the undertaking, and/or may have concerns regarding the proposed project's effects on cultural resources. We are treating Native American individuals and organizations that are not federally recognized Indian tribes, but who have expressed an interest in the project's potential impact on cultural resources, as either additional consulting parties or members of the public, as defined by Part 800.2(c)(6) and (d) of the ACHP's regulations. We sent copies of NOIs to the Affiliated Tribes of Northwest Indians, CRITFC, Chinook Nation, and Clatsop-Nehalem Confederated Tribes. With the exception of the CRITFC, none of these other parties contacted FERC directly regarding the project. The Clatsop-Nehalem Confederated Tribes provided spoken comments at the October 15, 2012 public scoping meeting in Warrenton, Oregon.

In addition to FERC's consultations, Oregon LNG also communicated with tribal governments and Native American organizations. On June 28, 2007, Oregon LNG sent letters to the Siletz, Grand Ronde, and Warm Springs Tribes to request that the tribes identify any concerns they might have with respect to possible impacts on any cultural resources, including traditional cultural properties. A follow-up letter was sent to these tribes on September 10, 2007. Representatives of Oregon LNG participated in FERC meetings with Indian tribes on January 24, February 25, and March 31, 2008. Oregon LNG sent the Grand Ronde, Siletz, and Warm Springs Tribes copies of its draft Resource Report 4 on February 13, 2008, and a copy of this report was sent to the Nez Perce Tribe on March 12, 2008. Oregon LNG met with cultural resources staff of the Warm Springs and Grand Ronde Tribes on February 26, 2008. Oregon LNG visited the office of the Grand Ronde Tribes on May 30, 2008. The Grand Ronde Tribes indicated it was interested in having tribal monitors present during cultural resources surveys in the Woodburn area.

Oregon LNG also sent copies of its import project application to interested Indian tribes, including its October 2008 cultural resources survey report. In an email on February 2, 2009, the Grand Ronde Tribes indicated that it would not be sending back written comments on the application.

Oregon LNG contacted the CRITFC on October 5, 2007 to discuss the project and met with CRITFC staff on November 5, 2007. In August 2008, representatives of the Grand Ronde Tribes and the CRITFC attended environmental resource sub-group meetings hosted by Oregon LNG, and the Grand Ronde Tribes also participated in interagency group meetings and conference calls hosted by Oregon LNG.

On May 15, 2011, Oregon LNG sent letters to the CRITFC, Grand Ronde Tribes, Siletz Tribes, Nez Perce Tribe, Umatilla Tribes, Warm Springs Tribes, and Yakama Nation, describing the import/export project and requesting comments. Oregon LNG has not filed any responses it received from tribes.

On May 16, 2013, Oregon LNG sent a request for identification of culturally important sites and a summary of Phase I investigation methodology to CRITFC and the Cowlitz, Grand Ronde, Nez Perce, Siletz, Umatilla, Warm Springs, and Yakama Tribes. On August 12, 2013 Oregon LNG sent these same parties and the Shoalwater Bay Tribe copies of its first import/export project survey report (Wilt and

McClintock, 2013). Also on August 12, 2013, Oregon LNG contacted the Cowlitz, Grand Ronde, Shoalwater Bay, Siletz, and Warm Springs Tribes regarding proposed ethnographic studies.

4.1.11.2 Results of Literature Reviews and Cultural Resources Surveys

Oregon LNG conducted literature reviews, site file searches, and cultural resources surveys for the main components of its project: waterway, LNG terminal, and pipeline. Based on our review of basic ethnographic sources and data contained in Oregon LNG's cultural resources report, it appears that at the time of contact with Euro-Americans, the project area was occupied by native people related to the Tillamook, Chinook, Clatskanie, and Cowlitz Tribes. Kraus (Suttles, 1990) stated that the last Clatskanie speaker was documented in 1898. The Tillamook and Chinook tribes signed treaties with Indian agent Anson Dart in 1851 that were never ratified by the U.S. Congress. Members of the Chinook, Shoalwater Bay, and Cowlitz Tribes were present for negotiations with Washington Territorial Governor I.I. Stevens at the council on the Chehalis River in 1855 that failed to result in a treaty (Lane and Lane, 1999). While the Tillamook and Chinook are not federally recognized tribes, individuals have joined the Quinault, Shoalwater Bay, Cowlitz, Grand Ronde, and Siletz Tribes, which are federally recognized.

Euro-American settlement of the project area began with the establishment of the fur trade post of Astoria in 1811. In 1846, Great Britain ceded its claims below the 49th Parallel to the United States; with Oregon Territory created in 1848 and Washington Territory created in 1853. Oregon was granted statehood in 1859, and Washington became a state in 1889.

Waterway

On June 19, 2009, Oregon LNG filed the results of a site file search conducted through the Washington and Oregon SHPOs to identify documented cultural resources located along the waterway to the LNG terminal. That file search noted six documented archaeological sites located within the Cape Disappointment Historic District, and a prehistoric fishing site located along the north shore of the Columbia River, all in Pacific County, Washington. In Clatsop County, Oregon, the file search noted documented sites including Fort Stevens, two prehistoric midden sites, the remains of the T.J. Potter Riverboat in the Young's Bay Tidal Basin, the Daniel Knight Warren House in Warrenton, and the Uniontown-Alameda Historic District in Astoria.

The site file search conducted by Oregon LNG may not have identified all previously recorded sites located along the waterway. For example, staff research for the Bradwood Project (Docket Number CP06-365-000), which would overlap with the Oregon LNG waterway from the sea buoy to Young's Bay at about Columbia RM 11, identified 18 shipwrecks along the Pacific Coast west of Fort Stevens State Park in Oregon. Nor did Oregon LNG discuss the LCNHT and the LCNHP, which we mentioned above.

Nevertheless, we have determined that LNG marine traffic in the waterway to the Oregon LNG terminal should not adversely affect historic properties along the waterway. LNG marine traffic should not result in significant erosion affecting any historic properties along the shoreline. There is also little chance that an oil or fuel leak from an LNG marine carrier in the waterway would adversely affect historic properties, because the ships are double hulled, and each LNG marine carrier would maintain a SOPEP.

Because of Oregon LNG's mitigation measures for LNG marine carriers in the waterway, and the Coast Guard's risk mitigation recommendations, including a vessel traffic management system, LNG marine traffic should not have an adverse effect on the setting or association of the LCNHT near the mouth of the Columbia River. LNG marine carriers would be visible to visitors at various elements of the

LCNHP along the shore of the lower Columbia River for several minutes at a time. These carriers would represent only a minor increase to the current use of the river by commercial vessels, so the viewshed would not be altered or cause a change from the present situation.

Terminal

A review of historic maps and photographs indicates that the northern end of the Skipanon peninsula, where the proposed LNG terminal would be located, did not exist prior to 1900. This area was created through the disposal of dredged materials, mostly since the 1930s. An archaeological survey of a portion of the proposed LNG terminal tract was conducted in 1976 for another project. Twenty-five test holes were dug, and no cultural materials were found.

Geotechnical trenching within the terminal APE was monitored by an archaeologist on August 2, 2007, and no cultural resources were observed. Oregon LNG did not conduct a close interval pedestrian inventory covering the 96 acres of uplands at the terminal location because this area was considered disturbed by former dredged material dumping activities. Because it is not a natural landform, the tract has low potential to contain buried prehistoric cultural remains. Prior to 1900, this area was open water and mud flats (Bard and McClintock, 2008).

No shipwrecks have been identified in the immediate area of Oregon LNG's terminal marine facilities. Oregon LNG consulted with Oregon SHPO on January 7 and 9, 2009 and the SHPO indicated that a submerged archaeological investigation would not be required for the 152 offshore acres covering the pier, berth, and turning basin.

Pipeline and Associated Facilities

Oregon LNG conducted background research at the Oregon SHPO from December 2007 through February 2008 and in 2012 to locate previously recorded cultural resources within 1.0 mile (indirect APE) of the proposed terminal and pipeline route. Oregon LNG conducted research for the pipeline route in Washington using the online Washington Information System for Architectural and Archaeological Records Data in January through March 2012 and in March 2014. Oregon LNG identified 29 cultural resources (including both archaeological sites and historic standing structures) within the indirect APE. In addition, 17 historic sites (including cabins, trails, or roads) were found on U.S. General Land Office (GLO) survey plats dated between 1856 and 1893 within 0.25 mile of the pipeline route. None of the previously recorded archaeological sites in the indirect APE, or the GLO historic sites, were relocated during field surveys. The project should have no impact on those resources.

The easternmost boundary for the LCNHP is located about 0.6 mile west of the direct effects APE. Features within the LCNHP, such as the reconstruction of Fort Clatsop, are at least 0.9 mile west of the direct effects APE. The pipeline should have no impacts on the LCNHP.

Two previously recorded sites (35CLT36 and 35CO48) were identified in the direct APE; however, they were also not relocated during surveys conducted for Oregon LNG. Site 35CO48 is a prehistoric archaeological site recorded in 2002 that the SHPO previously stated was not eligible for the NRHP. However, in a July 22, 2013 letter to FERC, the Oregon SHPO indicated that site 35CO48 should be considered unevaluated outside of the original site boundaries. Site 35CLT36 is a prehistoric archaeological site tested in 1978. It is of undetermined NRHP eligibility. Access was denied to the site area by the landowner, so if the project is authorized, Oregon LNG would have to conduct additional investigations at 35CLT36 after it receives a Certificate from FERC.

Additional research and survey was completed in 2012, to accommodate a revised APE based on design changes to the pipeline route and associated facilities for the import/export project. The area surveyed from MP 0.0 to MP 47.5 was 300 feet wide. The APE for direct effects defined for the surveys from MP 47.5 to MP 86.8 was 200 feet wide. Oregon LNG has surveyed about 70.7 miles of the pipeline route. Apparently, the proposed compressor station location at about MP 80.9 was inventoried along with the pipeline right-of-way. Oregon LNG indicated that it would survey the pipeline route segment between MPs 82.0 and 86.8 that was modified in April 2014 and all other areas not previously inventoried in 2016.

Three new historic era archaeological sites and one prehistoric isolated find were identified by Oregon LNG during surveys in Oregon. These sites are listed in table 4.1.11-1. Sites 35CO69 and 35CO70 and the isolated find were evaluated by Oregon LNG as not eligible for nomination to the NRHP. However, the Oregon SHPO disagreed with the evaluations of sites 35CO69 and 35CO70, and requested addition data. Site 35CLT96 is unevaluated. It requires archaeological testing to assess its NRHP eligibility. Oregon LNG stated it would conduct the additional investigations in 2016.

Table 4.1.11-1

Cultural Resources Identified During Oregon LNG Surveys of the Direct APE Along the Pipeline Route

Site Number	Cultural Resource Type	Evaluation	Recommendation	SHPO's Opinion (date)
35CLT96	Historic logging camp	Unevaluated	Additional investigations	Agree - testing is needed (7/13/14)
35CO69	Historic springhouse	Not eligible	No further work	Disagree – need additional data (7/13/14)
35CO70	Historic railroad grade	Not eligible	No further work	Disagree – need additional data (7/13/14)
IS-DM-01	Prehistoric flake	Not eligible	No further work	Not given

4.1.11.3 Unanticipated Discovery Plan

Oregon LNG's FERC application included a *Plan and Procedures for the Unanticipated Discovery of Cultural Resources and Human Remains* (Discovery Plan). A first draft of the Discovery Plan was submitted to the Oregon SHPO and tribes for review on February 13, 2008. The SHPO provided comments, which were received by Oregon LNG on March 19, 2008. The FERC staff provided comments to Oregon LNG on the first draft Discovery Plan in a February 26, 2008 data request. Oregon LNG addressed the SHPO and FERC staff comments in a second draft response filed April 29, 2009, and in the version included with its October 2008 application for the original LNG import project. Oregon LNG's June 2013 amended application for the import/export project included a copy of the Discovery Plan in appendix 4A of Resource Report 4. Oregon LNG has not yet documented that the latest version of its Discovery Plan was reviewed and approved by the Washington and Oregon SHPOs. Therefore, **we recommend that:**

- **Prior to pipeline construction, Oregon LNG should file with the Secretary documentation that copies of the Discovery Plan were provided to the Washington and Oregon SHPOs, together with their comments on the plan. If the SHPOs do not find the plan acceptable, Oregon LNG should file a revised Discovery Plan that addresses their concerns, for review and approval of the Director of OEP.**

4.1.11.4 Compliance with the NHPA

We have not yet completed the process of complying with the NHPA. Under the ACHP's regulations for implementing Section 106 of the NHPA at 36 CFR 800, FERC, as the lead federal agency, on behalf of the cooperating agencies, consults with the SHPOs and Indian tribes, identifies historic properties in the APE, and makes determinations of project effects. If any historic properties would be adversely affected, a treatment plan would need to be prepared, approved by the consulting parties, and implemented in accordance with an agreement document to resolve adverse effects.

The FERC staff consulted with Indian tribes to identify cultural or religious properties of importance to tribes that may be affected by the project. Oregon LNG has not yet produced the ethnographic studies requested by specific tribes to address potential project impacts on traditional cultural properties. Nor has Oregon LNG filed with the FERC any comments from tribes on its 2013 import/export project cultural resources survey report.

In a letter dated March 19, 2008, the Oregon SHPO provided comments on the first draft of the cultural resource report submitted by Oregon LNG for the original LNG import project. On June 12, 2008, the Oregon SHPO provided comments on the second draft of the cultural resource report submitted by Oregon LNG for the import project. The Oregon SHPO commented on the November 6, 2008 cultural resources report in a letter dated March 14, 2011. On June 13, 2014, the Oregon SHPO commented on the April 2014 revised cultural resources and evaluation report for the import/export project. The SHPO stated that site 35CO48 is not eligible for the NRHP and that sites 35CLT36, 35CLT96, 35CO69, and 35CO70 are currently unevaluated and require additional data. We concur.

Cultural resources surveys for the entire proposed pipeline route and associated ancillary facilities have not been completed as landowner permission has not been obtained for all parcels. Oregon LNG has not yet provided the results of inventories for the water lines, pump station, and the electric line associated with the proposed LNG terminal; about 16 miles of pipeline; all of the newly proposed access roads; and the construction staging, storage, and contractor yards. Nor has Oregon LNG provided avoidance plans, testing plans, or testing reports for the sites which are unevaluated. The FERC, in consultation with the Oregon and Washington SHPOs, would make determinations of NRHP eligibility and project effects when all cultural resources surveys and evaluations are complete.

To ensure that the Commission's responsibilities under the NHPA are met, **we recommend that:**

- **Oregon LNG <u>should not begin construction</u> of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads <u>until</u>:**
  - **a. Oregon LNG files with the Secretary:**
    - **(1) remaining cultural resources survey reports and ethnographic studies;**
    - **(2) site evaluation reports, and avoidance or treatment plans, as required; and**
    - **(3) comments on the reports, studies, and plans from the Oregon and Washington SHPOs and appropriate interested Indian tribes;**
  - **b. the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and**
  - **c. the FERC staff reviews and the Director of OEP approves the cultural resources reports, studies and plans, and notifies Oregon LNG in writing**

that treatment measures (including archaeological data recovery, if necessary) may be implemented and/or construction may proceed.

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."

4.1.12 Air Quality and Noise

4.1.12.1 Air Quality

Existing Environment

The proposed LNG terminal would be in Clatsop County, Oregon, within the northern part of Oregon Climate Zone 1 (Oregon Coast) as established by the National Climatic Data Center. Clatsop County is one of the six counties designated as the Northwest Region by the ODEQ.

The National Weather Service maintains a climate station at the Astoria Regional Airport in Clatsop County. Climate data from this station are available from the Western Regional Climate Center from January 1, 1899 to the present. Because of the close proximity of the terminal site to this climate station, these data are representative of conditions in the area of the proposed terminal.

The pipeline would be within the Oregon Coastal-Lower Columbia and Willamette Valley agroclimatic areas, as well as the Washington East Olympic Cascade-Foothills climate district. The compressor station would be in the Oregon Coastal-Lower Columbia agroclimatic area.

Regional Climate

The Oregon coastal zone (Oregon Climate Zone 1) is characterized by wet winters, relatively dry summers, and mild temperatures year round. Heaviest precipitation occurs mainly during the winter months. Rain, fog, and low clouds, are frequent from the late fall to early summer months. Normal annual precipitation at the Astoria Regional Airport is about 67 inches, with normal annual snowfall of about 3 inches. The higher elevations of the Coast Range can receive up to 200 inches of precipitation with significant snowfall amounts. The highest monthly precipitation values occur during the months of November, December, and January.

The mean maximum temperature is about 58 °F, the mean minimum temperature is about 44 °F, and the mean annual temperature is about 51 °F. Temperatures of 90 °F or higher occur less than once per year, on average, and freezing temperatures occur about 30 days per year, with killing frosts occurring less frequently.

In winter, the wind is predominantly from the east with speeds of 20 mph or more about 5 to 10 percent of the time. In spring and summer, the wind is predominantly from the west. Strong winds occur occasionally, usually in advance of winter storms, and can exceed hurricane force. These strong winds have been known to cause significant damage to structures and vegetation. Such events, however, are typically short-lived, and last less than one day.

The maximum daily highs for temperature (69 ºF) and relative humidity (91 percent), as measured at the National Weather Service climate station at the Astoria Regional Airport, commonly occur in the summer (June through September). As a result of the high relative humidity, advection fog at

the mouth of the river can occur during summer months, with radiation fog affecting the river overall during other months. There is a lower rate of natural dense fog (less than 1 mile visibility) during the months of April, May, June, and July with an average of less than 10 hours of recorded dense fog per month. In the fall and winter months of October to March, between 25 and 40 hours of natural dense fog are recorded per month.

During the winter, the ambient air temperatures can fall into the 30s and 40s ºF. The daytime relative humidity is typically in the upper 70 percent to low 80 percent range. Although winter is the rainy season, the absolute humidity (actual water vapor concentration) of the air is lower than during summer.

In the area of the pipeline, the Oregon Coastal-Lower Columbia agroclimatic area is characterized by wet winters, relatively dry summers, and mild temperatures year-round. The heaviest precipitation occurs mainly during the winter months when moist air masses move off the Pacific Ocean onto land. Normal annual precipitation on the coast ranges from 75 to 90 inches. The higher elevations of the Coast Range can receive up to 200 inches of precipitation with significant snowfall amounts. Mean maximum temperature is about 58 °F, mean minimum temperature is about 44 °F, and mean temperature is about 51 °F. Strong winds occur occasionally, usually in advance of winter storms, and can exceed hurricane force.

The Willamette Valley agroclimatic zone is characterized by cool, wet winters and warm, dry summers. Typical distribution of precipitation includes about 50 percent of the annual total from December through February, with lesser amounts in the spring and fall, and very little during summer. Extreme temperatures in the Valley are rare. Days with maximum temperature above 90 °F occur only six to eight times per year on average, and subzero temperatures occur only about once every 25 years. Mean high temperatures range from the low 80s in the summer to about 40 °F in the coldest months, while average lows are generally in the low 50s in summer and low 30s in winter. Severe storms are rare, but ice storms occasionally occur in the northern portions of the Valley and high winds occur several times per year in association with major weather systems. Relative humidity is highest during early morning hours, and is generally 80 to 100 percent throughout the year.

The easterly movement of moist air from over the ocean produces downslope winds in the foothills along the eastern slope of the Coastal Range and upslope winds in the foothills along the western slope of the Cascade Mountains. The average annual precipitation ranges from 40 inches in the lower valleys near the Columbia River to near 100 inches in areas higher than 1,000 feet above sea level and along the western slope of the Cascade Range. Annual snowfall ranges from less than 10 inches in the lower valleys to 50 inches in elevations above 500 feet. During the winter season, easterly winds in the Columbia River gorge can reach gale force. Rather severe ice storms or "silver thaws" occur in a narrow area westward from the gorge to the vicinity of Vancouver, Washington.

In January, the average maximum temperature ranges from 38° to 45 °F, and the minimum from 25° to 32 °F. In July, the average maximum temperature ranges from 75° to 80 °F and the minimum is near 50°F. Maximum temperatures have reached 100° to 105 °F; however, it is unusual for afternoon temperatures to exceed 90 °F for more than 8 to 15 days in the summer season.

Air Quality Control Regions

Air Quality Control Regions (AQCR) were established by the EPA and local agencies, in accordance with Section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through state implementation plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR.

The Oregon LNG terminal would be in Clatsop County, Oregon, which is within the Northwest Oregon Interstate AQCR (40 CFR 81.249). Clatsop County is currently in attainment of all NAAQS.

The pipeline would be routed through Clatsop, Tillamook, and Columbia Counties in Oregon, and Cowlitz County in Washington. The compressor station would be near MP 81 on the south bank of the Columbia River in Columbia County. Clatsop and Tillamook Counties are within the Northwest Oregon Intrastate AQCR (40 CFR 81.249). Columbia County in Oregon and Cowlitz County in Washington are within the Portland Interstate AQCR (40 CFR 81.51). Clatsop, Tillamook, and Columbia Counties in Oregon and Cowlitz County in Washington are currently in attainment of all NAAQS.

Existing Air Quality

Clatsop, Columbia, and Tillamook Counties in Oregon and Cowlitz County in Washington are currently in attainment of all NAAQS. Motor vehicles are a primary source of air pollution in each county, with large industrial facilities accounting for a minor portion of criteria pollutant emissions. Other sources of air pollution include human activities such as outdoor burning, use of wood stoves, and nonroad vehicle use (e.g., gasoline-powered lawn mowers, motor boats).

Air Quality Regulatory Background

Emissions from all phases of construction and operation of the LNG terminal and pipeline would be subject to applicable state and federal air regulations. Most air quality regulatory programs address emissions from stationary sources of air pollution; these programs would primarily affect operations at the proposed LNG terminal. Air quality regulations affecting the LNG terminal, pipeline, and compressor station construction are primarily concerned with reducing emissions associated with construction equipment and fugitive dust. Air pollutant emission sources are regulated at the federal level by the CAA, as amended, and at the state level by the OARs in Oregon and the WAC in Washington.

Ambient Air Quality Standards

National Ambient Air Quality Standards

The EPA has established National Ambient Air Quality Standards (NAAQS) for seven criteria pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead. The NAAQS were set at levels by the EPA to protect human health (primary standards) and human welfare (secondary standards). The NAAQS, along with the appropriate Significant Impact Levels (SIL) and relevant estimated background concentrations for the project area, are listed in table 4.1.12-1. Ambient background concentrations were provided by the ODEQ and WA Ecology.

Table 4.1.12-1

National Ambient Air Quality Standards and Background Levels

Air Pollutant	Averaging Period	Background Level [a]	Primary Standard	Secondary Standard	SIL for NAAQS
SO_2	1-hour	0.005 ppm	0.075 ppm	N/A	N/A
	3-hour	0.005 ppm	N/A	0.5 ppm	25 $\mu g/m^3$
CO	1-hour [b]	3.0 ppm	35 ppm	N/A	2,000 $\mu g/m^3$
	8-hour [b]	3.6 ppm	9 ppm	N/A	500 $\mu g/m^3$
NO_2	Annual [c]	0.007 ppm	0.053 ppm	0.053 ppm	1 $\mu g/m^3$
	1-hour [d]	0.015 ppm	0.1 ppm	N/A	N/A
Ozone	8-hour [e]	0.056 ppm	0.075 ppm	0.075 ppm	N/A
PM_{10}	24-hour [f]	21 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$	5 $\mu g/m^3$ (1 $\mu g/m^3$ in Oregon)
$PM_{2.5}$	24-hour [g]	28 $\mu g/m^3$	35 $\mu g/m^3$	35 $\mu g/m^3$	N/A
	Annual [h]	8.5 $\mu g/m^3$	12 $\mu g/m^3$	15 $\mu g/m^3$	N/A
Lead [i]	Rolling 3-month Average	N/A	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$	N/A

$\mu g/m^3$ = micrograms per cubic meter, ppm = parts per million

[a] Background information is from ODEQ, 2010, for annual and 24-hour SO_2 and O_3. For all other pollutants and averaging times site-specific background information was provided by WA Ecology. These background concentrations are estimates of site-specific background concentrations obtained by spatially interpolating ambient monitoring data from Washington, Oregon, and Idaho with 2009-2011 AIRPACT model data.

[b] Not to be exceeded more than once per year.

[c] The air quality standard is met when the highest annual average concentration is less than or equal to the applicable standard.

[d] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm.

[e] The air quality standard is met when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.075 ppm.

[f] Not to be exceeded more than once per year on average over 3 years. Note that the historical annual PM_{10} NAAQS was revoked, effective December 18, 2006.

[g] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$.

[h] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 12.0 $\mu g/m^3$.

[i] Lead is not monitored in Oregon.

Oregon and Washington Ambient Air Quality Standards

For most criteria pollutants, Oregon Ambient Air Quality Standards (OAAQS) and Washington Ambient Air Quality Standards (WAAQS) are the same as federal NAAQS. However, both states have set standards for SO_2 that include different averaging periods, and Washington has a more stringent 1-hour standard. The Oregon and Washington SO_2 standards are shown in table 4.1.12-2.

Table 4.1.12-2

SO_2 Ambient Air Quality Standards

Averaging Period	Oregon Standards (ppm)	Washington Standards (ppm)
5-minutes [a]	N/A	0.80
1-hour [b]	N/A	0.40
1-hour [c]	N/A	0.25
24-hour	0.10 [d]	0.10
Annual	0.02 [d]	0.02

[a] The Washington 5-minute SO_2 standard is for the Northwest Clean Air Agency's standard, which applies in Island, Skagit, and Whatcom Counties.

[b] The SO_2 1-hour Washington standard of 0.40 ppm is not to be exceeded more than once in a calendar year.

[c] The SO_2 1-hour Washington standard of 0.25 ppm is not to be exceeded more than twice in a consecutive 7-day period.

[d] Not to be exceeded during any calendar year.

Federal Air Quality Requirements

Mobile Source Regulations

Annex VI of MARPOL 73/78 – IMO Regulations for the Prevention of Air Pollution from Ships (Annex VI of MARPOL 73/78) regulate the maximum sulfur content of marine fuel oil to be no more than 4.5 percent (by weight) and also require that equipment placed in service since January 1, 2000 meet international emissions standards. Specifically, these standards restrict NOx emissions from large nonemergency marine diesel engines (i.e., those with ratings of over 130 kW) and CO and particulate matter emissions from shipboard incinerators. Recent amendments that have been approved by the IMO's Marine Environment Protection Committee include a reduction in the maximum fuel sulfur content to 3.5 percent by weight effective January 1, 2012, then progressively to 0.50 percent by weight effective January 1, 2020, subject to a feasibility review to be completed no later than 2018; and progressive reductions in NOx emission limits for marine engines.

On July 21, 2008, President Bush signed into law the Maritime Pollution Protection Act of 2008, which implements the MARPOL Annex VI provisions for all ships in a port, shipyard, offshore terminal, or U.S. internal waters; and all ships bound for, or departing from, a port, shipyard, offshore terminal, or the internal waters of the United States.

The EPA, along with Canadian Officials, applied to the IMO on March 27, 2009 to designate an Emission Control Area (ECA) under Annex VI for the area within 200 miles of the coastline of the contiguous United States, most of the Hawaiian Islands, and the southern portion of the Alaskan coast. On March 26, 2010, the IMO officially designated waters off North American coasts as an area in which stringent international emission standards would apply to ships. These standards would dramatically reduce air pollution from ships and deliver substantial air quality and public health benefits that extend hundreds of miles inland. In 2020, EPA expects emissions from ships operating in the designated area to be reduced by 320,000 tons for NOx, 90,000 tons for $PM_{2.5}$, and 920,000 tons for SOx, which is 23 percent, 74 percent, and 86 percent, respectively, below predicted levels in 2020 without the ECA (EPA, 2011).

In practice, implementation of the ECA means that ships entering the designated area would need to use compliant fuel for the duration of their voyage that is within that area, including time in port as well as voyages whose routes pass through the area without calling on a port. The quality of fuel that complies with the ECA standard will change over time. From the effective date in 2012 until 2015, fuel

used by all vessels operating in designated areas cannot exceed 1.0 percent sulfur (10,000 ppm). Beginning in 2015, fuel used by vessels operating in these areas cannot exceed 0.1 percent sulfur (1,000 ppm). Beginning in 2016, NOx after treatment requirements become applicable.

40 CFR 94, Final Rule, Control of Emissions from Marine Compression-Ignition Engines – All marine diesel engines larger than 37 kW that have been manufactured in the United States since January 1, 2004 are required to meet federal emissions standards identified in 40 CFR 94. Although most engines on existing LNG marine carriers were not manufactured in the United States, some of the newer engines installed on tugs and other local support vessels may have been subject to these regulations.

40 CFR 80, Final Rule, EPA Regulations on Fuels – Any fuel oil sold in the United States that is used in or intended for use in marine diesel engines is subject to federal regulations (40 CFR 80, Subpart I). The cetane index must be at least 40, or else the aromatic content must be no more than 35 percent by volume. Nonroad, locomotive, and marine diesel sold in the United States must have a sulfur content no greater than 15 ppm. (Small refiners and entities with sufficient documentation of hardship may have alternative compliance provisions.) There is currently no requirement that LNG marine carriers be fueled in the United States.

Title II of the CAA Amendments of 1990 – These regulations contain provisions relating to highway and off-road mobile sources and are aimed at reducing pollution from heavy-duty diesel engines, including marine and locomotive engines.

40 CFR Parts 69, 80, and 86, Final Rule, Control of Air Pollution from New Motor Vehicles: Heavy-duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements – This rule requires a reduction in emissions from on-road diesel engines and establishes sulfur limits for diesel fuel. Currently, the requirements are for new engines only and the standards began to take effect in model year 2007. Although the emissions standards are for new engines only, the reduced sulfur diesel fuel, which is required to have a sulfur content less than 0.05 percent (500 parts per million by weight, [ppmw]), a limit that was lowered to 15 ppmw starting in June 2006, would also reduce particulate and SO_2 emissions from existing diesel engines.

40 CFR Parts 9 and 69 et al., Final Rule, Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel – This rule requires emissions reductions from nonroad diesel engines by establishing emission limits and fuel sulfur content limits. This rule targets agricultural equipment, construction equipment, and other nonroad diesel engines. As with the previous rule, the reduced sulfur fuel would lower particulate and sulfur dioxide emissions from existing diesel engines even though the requirements would only apply to new engines.

Both nonroad and highway use vehicles and construction equipment used for the project would be required to use the new low sulfur diesel fuel.

New Source Performance Standards

New Source Performance Standards (NSPS) regulations (40 CFR Part 60) establish pollutant emission limits and monitoring, reporting, and recordkeeping requirements for various emission sources based on source type and size. The NSPS appy to new, modified, or reconstructed sources. The NSPS are incorporated by reference in OAR 340-238-0060.

Subpart Dc of 40 CFR Part 60, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, would apply to fossil fuel-fired steam-generating units with a heat input capacity of less than 100 million British Thermal Units (MMBtu) per hour but greater than

10 MMBtu per hour. The definition of an applicable unit includes sources that produce steam, that heat water, or any other heat transfer medium. Natural-gas fired heaters used in the amine treatment units and molecular sieve would be rated at 86 to 92 MMBtu per hour heat input; therefore, these units would be subject to the requirements of Subpart Dc.

Subpart Db of 40 CFR Part 60, Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units, applies to fossil fuel-fired steam-generating units with a heat input capacity of more than 100 MMBtu per hour. The natural-gas fired heaters used to warm fuel gas for LNG vaporization in the import mode would be rated at 115 MMBtu per hour heat input; therefore, these units would be subject to the requirements of Subpart Db.

40 CFR Part 60, Subparts Ka and Kb, Standards of Performance for Volatile Organic Liquid Storage Vessels, apply to emission sources such as storage vessels containing volatile organic liquids, unless otherwise exempted. The LNG terminal would have LNG, diesel, and water storage vessels with a capacity less than or equal to 75 m^3 on-site. The capacity of these vessels would be below the applicability thresholds in 40 CFR 60 Subpart Ka, and therefore this regulation would not apply. In addition, 40 CFR Part 60 Subpart Kb would not be applicable since all storage tanks would be installed after July 23, 1984.

40 CFR Part 60, Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, would apply to emissions from stationary compression ignition internal combustion engines. This subpart would also apply to fuel, monitoring, and maintenance requirements, depending on the model year, the date of manufacture, and the date when the unit was modified or reconstructed. The LNG terminal would include one 2,000-kw diesel generator, one 470-hp fire pump, and two 850-hp deluge fire pumps in its operation. 40 CFR Part 60 Subpart IIII would be applicable to all of these units.

40 CFR Part 60, Subpart KKK, Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants, would apply to facilities at onshore natural gas processing plants. All fugitive volatile organic compound (VOC) emissions from equipment leaks would be subject to the requirements in 40 CFR Part 60 Subpart KKK. The compressor station would not be subject to 40 CFR Part 60 Subpart KKK per Section 60.630(e), which exempts compressor stations that are not located at a natural gas processing plant site.

40 CFR Part 60, Subpart LLL, Standards of Performance for Onshore Natural Gas Processing, SO_2 emissions, would apply to the amine sweetening units the LNG terminal that would be equipped with one 80-MMBtu/hr thermal oxidizer to treat the sulfur compounds in the waste gas from the amine sweetening train regenerative towers. Both LNG terminal amine units would be subject to the requirements in 40 CFR Part 60 Subpart LLL.

The new stationary air emission sources associated with operating the terminal would be subject to the requirements of the NSPS regulations. These stationary sources are listed in table 4.1.12-3.

Table 4.1.12-3

Stationary Source Information

Air Emission Source (Quantity)	Heat Rating (MMBtu/hr)	Horsepower Rating (bhp)	Energy Source
Molecular Sieve Heater	92	-	Natural Gas
Amine Pretreatment Heaters (2)	86	-	Natural Gas
Vaporization Heaters (4)	115	-	Natural Gas
Amine Sweetening Unit Thermal Oxidizer	80	-	Natural Gas
Emergency Generator	-	2,682	Diesel Fuel
Emergency Fire Water Pump	-	470	Diesel Fuel
Deluge Fire Water Pumps (4)	-	850	Diesel Fuel

MMBtu/hr = million British thermal units per hour
bhp = brake horsepower

During the scoping period, we received a number of comments expressing concerns about venting of natural gas at the terminal. At the terminal, the vapor handling system would include an atmospheric vent system that would be used in the event that the vapor handling system is not functioning correctly or during other emergency situations.

Prevention of Significant Deterioration

Title I of the CAA establishes guidelines for the preconstruction/modification review of large air emission sources. Construction of sources in attainment areas must be reviewed in accordance with Prevention of Significant Deterioration (PSD) regulations. ODEQ is the lead air permitting authority for the LNG terminal. ODEQ's air permitting requirements (OAR 340-224-0070) incorporate the federal PSD requirements. Clatsop County is an attainment area; therefore, PSD rules are potentially applicable.

To be classified as a new major source, the potential emissions from the source must be either greater than 100 tons per year (tpy) for any pollutant regulated by the EPA under the CAA for sources that are among the 28 source categories listed in Section 169 of the CAA, or greater than 250 tpy for any pollutant regulated by the EPA under the CAA for sources that are not among the 28 source categories listed in Section 169 of the CAA.

The air emissions from LNG marine carriers while they are docked at the terminal are included as part of the LNG terminal emissions because they directly support terminal operations.

Oregon administers a Major New Source Review Program encompassing new facility construction or modification in nonattainment and attainment/unclassifiable areas (OAR 340-224). Because the stationary source portion of the planned project (i.e., the terminal) would be located in attainment/unclassifiable areas for all criteria pollutants, only the PSD portion of Oregon's Major New Source Review Program is potentially applicable.

Title V Operating Permits

Title V of the CAA requires states to establish an air operating permit program. The requirements of Title V are outlined in 40 CFR Part 70 and the permits required by these regulations are often referred to as Part 70 permits. The EPA has delegated authority to issue Part 70 permits to the ODEQ.

If a facility's potential to emit exceeds the criteria pollutant or hazardous air pollutant (HAP) thresholds, the facility is considered a Title V major source. Under Part 70, the major source threshold

for an air emission source in Oregon is 100 tpy for any criteria pollutant, 10 tpy for any individual HAP, or 25 tpy for the aggregate of all HAPs.

The major source threshold for an air emission source in Oregon is 100 tpy for any criteria pollutant, 10 tpy for any individual HAP, or 25 tpy for the aggregate of all HAPs. The CO potential to emit for the terminal would exceed the 100 tpy Part 70 Operating Permit program major source threshold for criteria pollutants. Therefore, the terminal would be a Part 70 major source for CO and would require a Part 70 Operating Permit.

National Emission Standards for Hazardous Air Pollutants

NESHAPs are codified in 40 CFR Parts 61 and 63, and incorporated by reference in OAR 340-244-0220. The NESHAPs rules were developed to address certain individual HAPs and HAP emissions from a variety of source categories.

The source category NESHAPs (40 CFR Part 63) typically apply to facilities that are classified as major sources of HAPs and operate affected equipment as listed in each standard. However, several of these source category NESHAPs also apply to affected equipment at area sources of HAPs. A facility is a major source of HAPs if it emits any individual HAP in excess of 10 tpy or a combination of HAPs in excess of 25 tpy. A facility is an area source of HAPs if it emits HAPs below major source thresholds.

Terminal

EPA has adopted NESHAPs for reciprocating internal combustion engines in 40 CFR Part 63 Subpart ZZZZ. These standards apply to reciprocating internal combustion engines at both major source and area sources of HAPs. For the 2,000-kW diesel generator, the one 470-hp fire pump, and the two 850-hp deluge fire pumps, 40 CFR Part 63 Subpart ZZZZ requires only that the engines meet the requirements of 40 CFR 60 Subpart III. No further requirements would apply to the engines under 40 CFR Part 63 Subpart ZZZZ.

Units subject to 40 CFR Part 63 Subpart DDDDD are industrial, commercial, or institutional boilers or process heaters that are located at a major source of HAPs. The terminal would not be a major source of HAPs and, therefore, 40 CFR Part 63 Subpart DDDDD would not be applicable to the proposed natural gas heaters (regasification and pretreatment).

40 CFR Part 63 Subpart HH, the NESHAP for Oil and Natural Gas Production Facilities, is applicable to area and major source facilities that process, upgrade, or store natural gas that contain a specified affected source. For area sources, the specified affected source is each triethylene glycol dehydration unit. Per Section 63.760(d), if the facility is an area source and does not use a triethylene glycol dehydration unit, then the subpart would not be applicable. The terminal would be an area source of HAPs that would not include a triethylene glycol dehydration unit; therefore 40 CFR Part 63 Subpart HH would not be applicable.

40 CFR Part 63 Subpart Y, the NESHAP for Marine Tank Vessel Loading Operations, requires applicable loading operations to meet emission standards by implementation of maximum achievable control technology or reasonably available control technology. Per Section 63.560(d)(2), Subpart Y would not be applicable to loading/unloading operations where emissions are reduced by using a vapor balancing system. Because a vapor recovery system would be used during export and import operations, the terminal would not be subject to 40 CFR Part 63 Subpart Y.

The Oregon LNG Project would be an area source of HAPs and would not be a major source of HAPs.

Pipeline and Associated Aboveground Facilities

40 CFR Part 63 Subpart HHH, the NESHAP for Natural Gas Transmission and Storage Facilities is only applicable to major sources of HAPs. Because the pipeline and compressor station would not be major sources of HAPs, 40 CFR Part 63 Subpart HHH would not be applicable.

Federal Class I Area Protection

In 1977, the U.S. Congress designated certain lands as Mandatory Federal Class I (Class I) areas. Class I areas were designated because the air quality was considered a special feature of the area (e.g., national parks or wilderness areas). These Class I areas, and any other areas that have been redesignated Class I areas since 1977, are given special protection under the PSD program. The PSD program establishes air pollution increment increases that are allowed by new or modified air pollution sources. If the new stationary source is required to comply with PSD program requirements and is near a Class I area, the source is required to determine its impacts at the nearby Class I area(s). The source is also required to notify the appropriate federal land manager(s) for the nearby Class I area(s).

Terminal

Oregon LNG completed an analysis of air quality impacts on nearby Class I areas. The terminal is within about 300 km of six federal Class I areas. The Columbia River Gorge National Scenic Area was also evaluated. The Columbia River Gorge National Scenic Area is not a Class I Area, but is afforded special visibility protections in Oregon and Washington. These areas and their distances are:

- Mount Hood Wilderness Area (154 km);
- Mount Adams Wilderness Area (177 km);
- Goat Rocks Wilderness Area (182 km);
- Mount Jefferson Wilderness Area (220 km);
- Olympic National Park (126 km);
- Mount Rainier National Park (166 km); and
- Columbia River Gorge National Scenic Area (130 km).

General Conformity

A conformity analysis must be conducted if a federal action would generate emissions that would exceed the conformity threshold levels (*de minimis* levels) of the pollutant(s) for which an area is designated as a nonattainment area or maintenance area. There are no nonattainment areas in the vicinity of the project. Therefore, general conformity would not apply to the Oregon LNG project.

Chemical Accident Prevention

The chemical accident prevention provisions, codified in 40 CFR Part 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. Portions of 40 CFR Part 68 are incorporated by reference in OAR 340-244-0230. Oregon regulations reference the federal list of substances and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulation, the facility must prepare and submit a Risk Management Plan (RMP). If a facility does not have a listed substance on-site, or the quantity of a listed substance is below the applicability threshold, the facility would not have to prepare an RMP. In the latter case, the facility still must comply with requirements of the general duty provisions in Section 112(r)(1) of the 1990 CAAA if there is any regulated substance or other

extremely hazardous substance on-site. The general duty provision requires hazard assessment and implementation of measures to prevent releases and mitigate releases which do occur.

With the exception of natural gas constituents (e.g., methane, ethane, and propane), no regulated substance would be handled or stored in quantities greater than the applicable Chemical Accident Prevention Provisions threshold in the pipeline. In addition, natural gas pipelines are not covered by the RMP provisions if they are regulated by the DOT or an equivalent state natural gas program certified by DOT in accordance with 49 CFR Part 6010.5. Storage of natural gas incidental to transportation (i.e., gas taken from a pipeline during nonpeak periods and placed in storage, then returned to the pipeline when needed) would not be covered. Consequently, an RMP would not be required for the pipeline or compressor station. Oregon LNG would maintain awareness of hazard issues and would meet the goals of the general duty provisions.

Greenhouse Gas Reporting

On November 8, 2010, the EPA finalized reporting requirements for the petroleum and natural gas industry under 40 CFR Part 98 Subpart W. This subpart was then amended on December 23, 2011. Subpart W requires petroleum and natural gas facilities that emit 25,000 metric tons or more of CO_2e per year to report annual emissions of specified greenhouse gases (GHG) from various processes within the facility. LNG storage and LNG import and export equipment are considered part of the source category regulated by Subpart W. This requirement would be applicable to the LNG terminal operation.

Oregon Air Quality Requirements

Oregon Construction Permit

ODEQ air permitting requirements are codified in OAR Chapter 340 and establish permit review procedures for all facilities that can emit pollutants to the ambient air. New facilities are required to obtain an ACDP prior to initiating construction under OAR 340-216. Oregon LNG submitted an ACDP application for the proposed terminal to ODEQ in June 2013.

During scoping, comments were received related to concerns over dust containing agricultural chemicals becoming airborne during pipeline construction activities. Proposed pipeline construction activities would be regulated under the Visible Emissions and Nuisance Requirements of OAR 340-208.

These rules address fugitive dust, nuisances (including odors), and particle fallout. Fugitive dust regulations (340-208-0210) require that persons use reasonable precautions to prevent particulate matter from becoming airborne, including but not limited to using water or chemicals for dust suppression. Nuisance regulations (340-208-0300) prohibit air emissions from creating a nuisance and require that operators who create a suspected nuisance enter into a Best Work Practices Agreement with ODEQ. Particle fallout regulations prohibit any person from creating an observable deposition of particulate matter on another's property.

Oregon LNG submitted an ACDP application for the proposed terminal to ODEQ in June, 2013. As required by ODEQ, the application provided the following information:

- a description of the nature, location, design capacity, and typical operating schedule of the source;
- an estimate of the maximum amount and type of regulated air pollutants emitted on a short-term basis and yearly;
- a description of the applicable requirements; and

- an analysis of air quality impacts of the source, including meteorological and topographical data, specific details of the models used, and other information necessary to estimate air quality impacts.

Plant Site Emission Limits

Facilities that require an Oregon ACDP must obtain plant site emission limits (PSEL) for all regulated pollutants (OAR 340-222-0020). These PSELs are incorporated into the facility's ACDP. For pollutants whose potential to emit exceeds significant emission rates (SER), the proposed terminal would likely receive site-specific PSELs set equal to the facility's potential to emit. However, a new source requesting a PSEL that equals or exceeds the SER for that pollutant must demonstrate compliance with the NAAQS and PSD increments by conducting an air quality analysis in accordance with OAR 340-225-0050(1) and (2) and 340-225-0060.

Greenhouse Gas Reporting

OAR 340-215-0030 requires any source required to obtain a Title V permit or ACDP to register and report GHGs directly emitted during the previous year if the source's direct emissions of CO_2e meet or exceed 2,500 metric tons during the previous year. Once a source's direct emissions of CO_2e meet or exceed 2,500 metric tons during a year, the source must annually register and report in each subsequent year, regardless of the amount of the source's direct emissions of GHGs in future years, unless the source's direct emissions are less than 2,500 metric tons of CO_2e per year for 3 consecutive years or the source ceases all operations that lead to direct emissions of GHGs (i.e., source closes permanently). This requirement would be applicable to the Oregon LNG project.

Visible Emission and Nuisance Requirements

State visible emissions and nuisance abatement regulations are codified in OAR 340-208. Both construction and operation phases of the proposed LNG terminal would be subject to visible emission limits stated in terms of opacity. In order to comply with state regulations, the LNG terminal may not emit contaminants causing opacity to equal or exceed 20 percent in any period or periods aggregating more than 3 minutes in any hour. In addition, no person may create an observable deposition of particulate matter on another person's property (OAR 340-208-540).

The state of Oregon imposes specific fugitive emission control requirements on facilities that are within "special control areas" or are determined to be a nuisance by the ODEQ. The proposed LNG terminal would not be in one of the special control area counties or basins listed in OAR 340-204-0070; however, it would be within 3 miles of the corporate limits of the city of Warrenton, which has a population greater than 4,000. Therefore, the Oregon LNG terminal would be subject to the fugitive emission requirements of OAR 340-208-0210. Fugitive emission requirements state that reasonable precautions must be taken to prevent particulate matter from becoming airborne. Dust control measures that may be used are discussed in the *Construction Emission Mitigation* section below.

Washington Air Quality Requirements

The project construction activities would be regulated in Washington under WAC 173-400-040. These rules address fugitive dust, nuisances (including odors), and particle fallout.

WAC 173-400-040(9) requires that reasonable precautions be used to prevent particulate matter emissions from becoming airborne, including but not limited to using water or chemicals for dust suppression. Washington regulations (WAC 173-400-040(5)) require facilities that generate odor which unreasonably interfere with any other property owner's use and enjoyment of property to use recognized good practices and procedures to reduce odors to a reasonable minimum.

Construction Air Quality Impacts and Mitigation

Construction Emissions

There are no nonattainment areas in the vicinity of the project. Therefore, general conformity does not apply to the Oregon LNG Project.

Terminal

Air pollutant emissions from the construction of the terminal would occur during the about 48 month construction period. Construction at the terminal site would include dredging of the berth and turning basin to accommodate LNG marine carriers, construction of the pier and docking facilities, and construction and installation of buildings and equipment. Construction emissions would result from combustion of fuel-burning equipment/vehicles, fugitive dust associated with site preparation/grading and travel on the access road, and dredging activities. Regulated pollutant emissions associated with construction include criteria pollutants (NOx, CO, SO_2, VOCs, PM_{10}, and $PM_{2.5}$), HAPs, and GHGs reported as CO_2e. Impacts associated with construction vehicles are difficult to estimate precisely based on the time and space variant characteristics of the emissions. Estimates are complicated by the fact that the construction equipment would not follow defined paths (such as paved roadways) and would frequently change speed and direction. An emissions estimate for the construction of the terminal was prepared based on the best available information and is summarized in table 4.1.12-4.

Table 4.1.12-4

Summary of Air Pollutant Emissions from Terminal Construction Activities

Equipment	NOx (tpy)	CO (tpy)	SO_2 (tpy)	VOCs (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	HAPs (tpy)	CO_2e (tpy)
Year 1 [a]								
Road Vehicles	0.2	0.6	1.0E-02	0.1	1.0E-02	1.0E-02	3.6E-06	116.0
Construction Equipment	3.0	2.9	1.5	0.3	0.2	0.2	N/A	8,131.0
Fugitive Dust	N/A	N/A	N/A	N/A	305.8	305.8	N/A	N/A
Year 2								
Road Vehicles	0.3	1.7	2.0E-02	0.1	2.0E-02	2.0E-02	6.8E-06	231.8
Construction Equipment	15.0	14.0	1.2	1.6	0.9	0.9	N/A	39,754.6
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 3								
Road Vehicles	0.3	1.6	2.0E-02	0.1	2.0E-02	1.5E-02	3.3E-06	231.8
Construction Equipment	10.0	7.5	3.3	1.0	0.6	0.6	N/A	12,232.5
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 4								
Road Vehicles	0.3	1.5	2.0E-02	0.1	2.0E-02	8.7E-03	6.1E-06	231.7
Construction Equipment	3.0	4.1	1.0E-02	0.4	0.2	0.2	N/A	13,384.2
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 5								
Road Vehicles	0.1	1.0	1.0E-02	3.0E-02	1.0E-02	4.3E-03	N/A	115.8
Construction Equipment	1.2	4.0	0.0	0.2	0.1	0.1	2.9E-06	10,843.6
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Total	**33.4**	**38.9**	**6.0**	**3.9**	**319.0**	**319.0**	**2.3E-05**	**50,986.0**

N/A = not applicable

[a] The analysis assumes 48 months of construction across 5 calendar years.

Construction emissions would not have a long-term impact on ambient air quality, and implementation of Oregon LNG's proposed emission control measures, as well as other measures specified by the ODEQ, would further reduce construction emissions.

Pipeline and Associated Aboveground Facilities

Construction of the pipeline would have temporary adverse impacts on air quality due to a number of activities. Air pollutants related to the construction activities include the following:

- emissions from fuel-burning construction equipment and vehicles;
- fugitive dust emissions from site preparation, trenching, and backfilling; and,
- fugitive dust emissions from travel of vehicles/equipment on paved and unpaved roads.

Construction emissions may also occur as the result of wildfire ignited by construction activities.

Impacts associated with construction vehicles are difficult to estimate based on the time and space variant characteristics of the emissions. Estimates are complicated by the fact that the construction equipment would not follow defined paths (such as paved roadways) and would frequently change speed and direction. Emissions would be intermittent and temporary in nature. In addition, the primary pollutants emitted by the construction vehicles would be NOx and CO. The ambient air quality standard for NO_2 is an annual average and the CO standards are significantly higher than any other standards. For these reasons, the short-term and intermittent NO_2 and CO emissions from the construction vehicles are not expected to exceed the NAAQS for NO_2 or CO. Because of their temporary nature, construction emissions would not have a long-term impact on ambient air quality.

Construction of the proposed metering and receiving stations, the pig launchers/receivers, pipe storage yards, and access roads would have temporary adverse impacts on air quality due to a number of activities. Impacts and mitigation would be the same as described above for construction of the pipeline.

Construction of the proposed compressor station would take 1 year and have temporary adverse impacts on air quality similar to pipeline construction as describe above. Regulated pollutant emissions associated with construction include criteria pollutants (NOx, CO, SO_2, VOCs, PM_{10}, and $PM_{2.5}$), HAPs, and GHGs. Construction phase air pollutant emissions estimates for the compressor station are summarized in table 4.1.12-5.

Table 4.1.12-5

Summary of Construction Emissions from the Oregon LNG Compressor Station

Equipment Group	NOx (tpy)	CO (tpy)	SO_2 (tpy)	VOCs (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	HAPs (tpy)	CO_2e (tpy)
Road Vehicles [a]	3.5	17.3	0.2	1.0	0.2	0.1	3.5E-02	1,588.0
Construction Equipment [b]	3.0	1.3	4.7E-3	0.2	0.2	0.2	N/A	315.5
Fugitive Emissions [c]	N/A	N/A	N/A	2.1E-04	112.3	112.3	N/A	N/A
Total	6.5	18.6.	0.2	1.2	112.7	112.6	3.5E-02	1,903.6

[a] Road vehicle emissions include construction worker commuter traffic and heavy-duty delivery trucks.

[b] Construction equipment includes construction and installation of buildings and equipment. Hazardous air pollutant emission factors for construction equipment are not available.

[c] Fugitive emissions include dust generated during site clearing and grading.

N/A = not applicable

Total Project Construction Emissions

Total emissions for construction of the terminal and compressor station are provided in table 4.1.12-6.

Table 4.1.12-6

Summary of Construction Air Pollutant Emissions from the Project

Equipment	NOx (tpy)	CO (tpy)	SO_2 (tpy)	VOCs (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	HAPs (tpy)	CO_2e (tpy)
Year 1[a]								
Road Vehicles	0.2	0.6	1.0E-02	0.1	1.0E-02	1.0E-02	3.6E-06	116.0
Construction Equipment	3.0	2.9	1.5	0.3	0.2	0.2	N/A	8,131.0
Fugitive Dust	N/A	N/A	N/A	N/A	305.8	305.8	N/A	N/A
Year 2								
Road Vehicles	0.3	1.7	2.0E-02	0.1	2.0E-02	2.0E-02	6.8E-06	231.8
Construction Equipment	15.0	14.0	1.2	1.6	0.9	0.9	N/A	39,754.6
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 3								
Road Vehicles	0.3	1.6	2.0E-02	0.1	2.0E-02	1.5E-02	3.3E-06	231.8
Construction Equipment	10.0	7.5	3.3	1.0	0.6	0.6	N/A	12,232.50
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 4 [b]								
Road Vehicles	1.47	7.27	0.09	0.43	0.09	0.042	1.17E-02	861.8
Construction Equipment	4	4.53	1.2E-02	0.5	0.3	0.3	N/A	13,509.4
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Year 5 [b]								
Road Vehicles	2.43	12.5	0.14	0.70	0.14	0.071	2.33E-02	1,376.2
Construction Equipment	3.2	4.87	3.1E-03	0.3	0.2	0.2	2.90E-06	11,094.0
Fugitive Dust	N/A	N/A	N/A	N/A	2.8	2.8	N/A	N/A
Total	**39.9**	**57.5**	**6.29**	**5.13**	**394**	**394**	**0.04**	**87,538.9**

N/A = not applicable

[a] The analysis assumes 48 months of construction across 5 calendar years.

[b] The analysis assumes 6 months of compressor station construction would occur in Year 4 and 12 months of compressor station construction in Year 5.

Construction Emissions Mitigation

In its construction contracts, Oregon LNG has committed to requiring its contractors to employ standard dust-control measures during construction to reduce generation of fugitive dust due to surface disturbance. Dust-control measures may include the following:

- apply water during grading;
- conduct paving, chip sealing, or chemical stabilization of internal roadways after completion of grading;
- reduce speeds on unpaved roads to 15 miles per hour or less;
- use sweepers or water trucks to remove "track-out" at any point of public street access; and
- stabilize dirt storage piles with chemical binders, tarps, fencing, or other erosion control.

Oregon LNG would also require its contractors to implement the following measures to reduce emissions from vehicles and construction equipment during terminal construction:

- properly maintain construction equipment in accordance with manufacturers' specification or standard practices;
- encourage carpooling by construction workers;
- implement a shuttle service to and from retail services and food establishments during lunch hours or provide lunch services at the site; and
- limit truck idling to the extent practicable.

Compressor station construction activities would be regulated under the Visible Emissions and Nuisance Requirements of OAR 340-208. These rules address fugitive dust, nuisances (including odors), and particle fallout. Fugitive dust regulations (340-208-0210) require that persons use reasonable precautions to prevent particulate matter from becoming airborne, including but not limited to using water or chemicals for dust suppression. Nuisance regulations (OAR 340-208-0300) prohibit air emissions from creating a nuisance and require that operators who create a suspected nuisance enter into a Best Work Practices Agreement with ODEQ. Particle fallout regulations prohibit any person from creating an observable deposition of particulate matter on another's property.

Operational Impact Analysis

Terminal

Operation of the LNG terminal would result in direct air emissions from stationary equipment (liquefaction trains, heaters, flares, generators, pumps, etc.) and marine vessels (LNG marine carriers during loading and unloading operations). The terminal would operate 24 hours per day, 7 days per week (8,760 hours per year).

Table 4.1.12-7 presents the annual maximum potential emissions from the proposed LNG terminal.

Table 4.1.12-7

Summary of Potential Emissions from the Terminal During Operation [a]

Emission Unit (Quantity)	Potential to Emit (tpy)								
	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC	H_2SO_4	HAPS	CO_2e
Liquefaction									
Heaters (3)	6.4	6.4	9.6	34.3	17.0	2.2	0.9	2.1	160,733
Amine Sweetening Treatment Units and Thermal Oxidizer with Acid Gas Scrubber	2.6	2.6	35.0	28.9	8.1	1.9	0.2	0.6	2,881,598
Cooling Tower	1.3	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ground Flare	1.6	1.6	14.6	79.3	3.1	30.0	0.2	0.4	29,905
Amine and Hot Oil Storage Tank	N/A	N/A	N/A	N/A	N/A	7.9E-02	N/A	N/A	N/A
Fugitives	N/A	N/A	N/A	N/A	N/A	0.1	N/A	N/A	371
Regasification									
Heaters (4)	0.4	0.4	2.2	6.2	2.4	0.9	0.1	0.3	23,017
Fugitives	N/A	N/A	N/A	N/A	N/A	5.4E-04		N/A	0.1
Vapor Handling System									
Low-Pressure Flare	2.3E-03	2.3E-03	2.1E-02	0.1	4.6E-03	4.4E-02	2.5E-04	5.8E-04	43
Utilities									
Breakers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	480
2,000-kW Emergency Diesel Generator [b]	0.2	0.2	8.7	0.7	7.3E-3	0.4	N/A	1.9E-02	989
470-hp Diesel Fire Pump [b]	5.0E-02	5.0E-02	0.8	0.2	1.3E-03	0.0	N/A	3.3E-03	167
850-hp Deluge Fire Pumps (2) [b]	0.2	0.2	4.6	0.6	4.0E-03	0.2	N/A	1.2E-02	520
Diesel Tanks	N/A	N/A	N/A	N/A	N/A	7.9E-02	N/A	1.8E-03	N/A
Marine Facility									
Fugitives	N/A	N/A	N/A	N/A	N/A	7.0E-04	N/A	N/A	3
LNG Unloading	4.8E-02	4.8E-02	0.6	0.2	0.1	2.3E-02	N/A	N/A	210
Total	**12.8**	**12.8**	**76.1**	**150.5**	**30.7**	**35.9**	**1.4**	**3.4**	3,097,825

N/A = not applicable

[a] Emissions of the other PSD-regulated pollutants (sulfuric acid mist, asbestos, fluorides, hydrogen sulfide, total reduced sulfur, reduced sulfur compounds, chlorofluorocarbons, halons, and ozone depleting substances are negligible.

[b] Emergency generator and firewater pump potential emissions calculations based on a 500-hour-per-year operation.

In addition to the direct air emissions described above, indirect air pollutant emissions would result from LNG marine carriers and harbor craft that would transit from the Pacific Ocean via the Columbia River to and from the terminal. Emissions from the LNG marine carriers and from harbor craft would occur during carrier and tug operations. In calculating the operating scenarios, the following assumptions were used.

- Emission estimates were performed for all locations for which LNG marine carriers would be within 200 nautical miles from the U.S. coast emission control. The LNG marine carriers would pass through the Oregon EEZ and the Alaska EEZ.
- For the harbor craft, the calculations for transit emissions estimates start and end at the sea buoy at the entrance of the channel to the ocean, which is as far as harbor craft would go.

- The fuel assumed in calculations of transit and docking and undocking emissions is diesel.
- LNG marine carriers that are hoteling (moored/anchored and not actively loading/unloading cargo) would be powered by diesel or dual fuel (diesel and natural gas) engines depending on the size of the vessel.
- Sulfur content of fuel is 0.1 percent by weight as required by MARPOL Annex VI and 40 CFR 1043.[7]

Table 4.1.12-8 presents a summary of the indirect emissions from LNG marine carriers and harbor craft.

Table 4.1.12-8

Summary of Indirect Emissions from Terminal Operation

Operation	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	NOx [a] (tpy)	CO (tpy)	SO_2 (tpy)	VOC (tpy)	CO2e (tpy)
Transit in Oregon EEZ	22.4	22.4	299.8	80.7	37.0	7.0	54,054.6
Transit in Alaskan EEZ	23.0	23.0	301.8	82.5	38.2	7.1	55,797.1
Docking and Undocking	0.8	0.8	23.4	6.8	1.6	3.7	881.1
Hoteling	1.8	1.8	25.9	11.8	2.9	6.6	5,994.1
Maintenance Dredging	0.1	0.1	1.5	0.3	1.5	0.1	1,391.0

[a] As required by MARPOL Annex VI and 40 CFR 1043, NOx emissions in the North American Emission Control Area within 200 nautical miles from the U.S. coast calculated using an emission factor equal to NOx emission standard in 40 CFR 1043 of 3.4 grams per kilowatt-hour for engines with engine speeds less than 130 revolutions per minute. NOx emissions from tugs not based on the NOx emission standard of 3.4 grams per kilowatt-hour as tugs are excluded per 40 CFR 1043.10(a)(2).

About 125 LNG marine carriers per year would be used to export and import LNG from the terminal, resulting in an estimated increase in current ship traffic on the North Pacific Great Circle Route. Ship traffic forecasts developed for the Aleutian Islands based on analysis of market trends (Det Norske Veritas and ERM-West, Inc., 2010) estimate that in the future, the terminal operation would contribute to westbound traffic by about 2 percent and eastbound traffic by about 4 percent. In comparison to the annual marine vessel traffic along the shipping route within the Alaskan EEZ, the number of marine vessels associated with the project would be a very small fraction and thus a small contributor to the impacts from all marine vessels.

Table 4.1.12-9 compares global shipping emissions from the year 2000 to the estimated project-related marine emissions.

Table 4.1.12-9

Marine Vessel Emissions Comparison

Source	PM_{10}	NOx	SO_2	CO_2
Year 2000 Global Shipping Emissions [a] (tpy)	1,873,929	23,589,462	13,227,735	895,076,784
Terminal Operation (tpy)	48.7	660.0	80.9	118,544.6
Emissions from Terminal Operation Versus Year 2000 Global Shipping Emissions (percent)	0.0026	0.0028	0.0006	0.0132

[a] Source: Eyring et al. (2007).

[7] MARPOL Annex VI and 40 CFR 1043 restrict fuel sulfur concentration to 0.1 percent for ships operating within 200 nautical miles of the coast of North America, also known as the North American Emission Control Area, by 2016.

Table 4.1.12-9 shows that the project-related marine vessel emissions are less than 0.01 percent of estimated calendar year 2000 global marine vessel emissions. Therefore, while marine vessel emissions from the project would have an impact on air quality, the additional marine vessels would be a very small contributor to air impacts on a global scale.

In addition to emissions from LNG marine carriers and support vessels, indirect emissions would also occur from maintenance dredging. It is estimated that maintenance dredging would be conducted every 3 years with a volume of about 200,000 to 300,000 cubic yards per dredging event. An estimate of emissions from maintenance dredging is also provided in table 4.1.12-8.

Pipeline and Associated Aboveground Facilities

Negligible emissions are anticipated from operation of the compressor station because the turbines would be electrically powered. Only extremely small emissions are expected from the valves and fittings at both the compressor station and the proposed pipeline. At these levels, no regulatory requirements would apply. A backup generator used for emergencies at the compressor station would be exempt from permitting requirements (OAR 340-216-0020) but would be subject to Subpart IIII of 40 CFR Part 60, which applies to stationary compression ignition internal combustion engines that are modified, constructed, or reconstructed after July 11, 2005. Periodic maintenance activities at the compressor station would produce only negligible air emissions.

During the scoping period, a number of comments were received expressing concerns about venting of natural gas along the pipeline and odors. However, natural gas would not be vented along the pipeline under normal operating conditions. In addition, the natural gas moving through the pipeline would not be odorized.

Prevention of Significant Deterioration

Terminal

The terminal systems and activities with equipment that would emit air pollutants include liquefaction, regasification, utilities, vapor handling, and marine sources.

Operation of the LNG terminal would occur under the following operating scenarios:

- up to 8,760 hours per year as an export facility, where natural gas from the pipeline is processed to LNG at the terminal by the liquefaction process and exported via LNG marine carriers; and
- up to 720 hours per year (30 days) as an import facility, where LNG is processed to natural gas by the regasification process from either LNG stored in the two storage tanks or from LNG imported and unloaded from up to two LNG marine carriers per year.

Prior to the process of liquefaction, natural gas would be treated at a feed gas pretreatment facility to meet CO_2, hydrogen sulfide (H_2S), water, and mercury content specifications. Following pretreatment, the natural gas would be liquefied via two identical liquefaction trains. Emission sources at the liquefaction facilities would consist of the following equipment:

- two identical natural-gas-fired heaters to support the amine treatment units with maximum heat input capacity of 86 MMBtu per hour;

- one natural-gas-fired heater to support the molecular sieve dehydration system with maximum heat input capacity of 92 MMBtu per hour;
- two amine sweetening treatment units equipped with one 80-MMBtu per hour thermal oxidizer having an acid gas scrubber with a control efficiency of 85 percent to control SO2 emissions;
- two 16-cell evaporative cooling tower banks;
- one ground flare, used for disposal of hydrocarbon releases from relief valves and relief valves/devices on all equipment from the pretreatment facility and liquefaction process during unforeseen events and maintenance activities; only pilot gas would be combusted during normal operations;
- one 500-barrel amine storage tank;
- one 200-barrel hot oil storage tank; and
- fugitive emissions from leaks, valves, pump seals, connectors, etc.

During the regasification process of the LNG terminal in import mode, in-tank, column-mounted LNG electric pumps would send LNG to vaporization systems that would consist of shell-and-tube heat exchangers using an intermittent ethylene glycol water solution heated in natural gas-fired heaters. Emission sources at the regasification facilities would consist of four natural-gas-fired heaters with a maximum heat input capacity of 115 MMBtu per hour and fugitive emissions from leaks, valves, pump seals, connectors, etc.

Emissions sources from utilities at the LNG terminal would consist of the following equipment:

- fifty-one circuit breakers;
- one 2,000-kW diesel-fired emergency power generator;
- one 470-hp diesel-fired firewater pump;
- two 850-hp diesel-fired deluge firewater pumps;
- one 3,800-gallon diesel storage tank for the emergency power generator;
- one 550-gallon diesel storage tank for the firewater pump; and
- two 950-gallon diesel storage tanks for the deluge firewater pumps.

A vapor handling system would be used to handle vapors from the BOG header, LNG tank vapor space, LNG marine carrier vapor return line, onshore BOG compressors, and overpressure relief line to the low-pressure flare. Under normal operations, all BOG, including the BOG generated due to the heat leak into the LNG storage tanks, pumping systems and piping systems, and vapor displaced by the incoming LNG to tanks and LNG marine carrier, would be recycled to the liquefaction feed gas system upstream of the main cryogenic heat exchanger. However, under emergency conditions, such as power failure, the gas would be vented to the low-pressure flare. During normal operations, only pilot gas would be sent to the low-pressure flare.

During LNG marine carrier loading/unloading, a single LNG marine carrier would moor at the loading berth. Following cool down of the loading arms, sub-cooled LNG would be transferred into or out of the LNG marine carrier via electric in-tank LNG sendout pumps at 10,000 m^3 per hour. Therefore, no emissions would be associated with the loading of LNG to LNG marine carriers. Unloading of LNG from the LNG marine carrier to the terminal would be performed by electric, diesel, or natural-gas pumps.

Therefore, it is assumed that LNG marine carrier pumps may generate unloading emissions. Because a vapor recovery system would be used, it is expected that fugitive sources of emissions may also result from leaks, valves, pump seals, and connectors, and these emissions have been included in the modeling analysis performed at the terminal.

Loading of LNG to the LNG marine carrier would be performed via in-tank LNG send out pumps with no associated emissions. Unloading of LNG from the LNG marine carrier to the LNG terminal would be performed by electric, diesel, or natural gas pumps installed on the LNG marine carrier. Therefore, it is assumed that unloading emissions would be generated from LNG marine carrier pumps. Fugitive emissions may also result from leaks, valves, pump seals, connectors, etc.

The proposed terminal would not have the potential to emit criteria pollutants (i.e., PM_{10}, $PM_{2.5}$, NOx, CO, SO_2) above 250 tpy, as shown in table 4.1.12-7 and therefore, would not be subject to PSD review under OAR 340-224-0070.

The Oregon Major New Source Review Program uses the same applicability determination as is used for the federal PSD program. The proposed facility would not be subject to Oregon's Major New Source Review Program.

LNG terminal-related air quality impacts were estimated using the EPA AERMOD model with meteorological data from the Astoria National Weather Service station at the Astoria Airport for NOx, CO, PM_{10}, $PM_{2.5,}$ and SO_2. Modeled annual emissions were based on the facility's "potential to emit" (the maximum capacity of a stationary source to emit a pollutant under its physical and operational design). Short-term modeled emissions were based on the maximum hourly emission rate from each piece of equipment.

Table 4.1.12-10 presents the AERMOD modeling results. The results of the analysis show that emissions from the terminal would not cause impacts exceeding the NAAQS or exceed the PSD increments.

Table 4.1.12-10

Air Quality Modeling Results Compared to National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS ($\mu g/m^3$)	LNG Terminal Modeling Results ($\mu g/m^3$)	PSD Increment	Background Concentrations Used ($\mu g/m^3$) [e]	Total Concentration ($\mu g/m^3$)
SO_2	Annual [a]	80	0.9	20	5.0	5.9
	24-hour [a]	365	37.1	91	30.0	67.1
	3-hour	1,300	73.9	512	13.1	87.0
	1-Hour	N/A	90.5	N/A	13.1	103.6
PM_{10}	Annual	50	0.4	17	N/A	N/A
	24-hour	150	7.7	30	21.0	28.7
$PM_{2.5}$	Annual	15	0.5	4	6.0	6.5
	24-hour [b]	65	6.3	9	8.0	14.3
CO	8-hour	10,000	133.3	N/A	414.5	473.4
	1-Hour	40,000	417.9	N/A	340.1	832.4
NOx	Annual [c]	100	2.8	25	13.2	15.9
	1-Hour [d]	N/A	88.6	N/A	28.2	116.8

[a] The 1971 annual and 24-hour SO_2 standards (EPA, 1971) were revoked. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

[b] 24-hour $PM_{2.5}$ uses the 98th percentile.

[c] Annual NOx multiplied by 0.75 to convert to NO_2, and 1-hour NOx multiplied by 0.8 to convert to NO_2.

[d] 1-Hour NOx uses the 98th percentile of the 1-hour daily maximum concentrations.

[e] Background information is from ODEQ (2010), for annual and 24-hour SO_2. For all other pollutants and averaging times, site-specific background information was provided by WA Ecology. These background concentrations are estimates of site-specific background concentrations obtained by spatially interpolating ambient monitoring data from Washington, Oregon, and Idaho with 2009–2011 AIRPACT model data.

$\mu g/m^3$ = micrograms per cubic meter

N/A = not applicable

The results of the analysis show that emissions from the terminal would not cause impacts exceeding the NAAQS or exceed the PSD increments.

Pipeline and Associated Aboveground Facilities

All the Compressor Station equipment would be electric except for the emergency generator and a fire pump. No sources of air pollutant emissions (other than the emergency generator) would be operated at the Compressor Station. The emergency generator and fire pump would be diesel-fueled. The minor emissions associated with emergency generator and fire pump use would not trigger PSD requirements.

Federal Class I Area Protection

Terminal

For the Class I increment analysis, impacts were estimated using the American Meteorological Society/Environmental Protection AERMOD model with receptors placed at a distance of 50 kilometers (km), the range of the accepted accuracy of AERMOD. Class I modeling results are summarized in table 4.1.12-11.

Table 4.1.12-11

Class I Modeling Results for the Terminal [a]

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Class I Significant Impact Level (µg/m³)	Class I PSD Increment (µg/m³)
NO_2	Annual	0.012	0.1	2.5
SO_2	Annual	0.005	0.10	2.0
	24-hour	0.393 [b]	0.028	5.0
	3-hour	1.498 [b]	1.23	25.0
PM_{10}	Annual	0.002	0.2	4.0
	24-hour	0.092	0.3	8.0
$PM_{2.5}$	Annual	0.002	0.06	1.0
	24-hour	0.102 [b]	0.07	2.0

[a] Includes ambient background concentrations.

[b] Some maximum modeled concentrations may be above the Class I Significant Impact Level at 50 km, but the proposed facility is 126 km away from the nearest Class I Area. In addition, there are intervening terrain features such that it is reasonable to conclude that impacts would be below their respective Class I Significant Impact Level at all Class I Areas.

Air quality impacts are also evaluated at Class I Areas through the analysis of air quality related values (AQRVs). The AQRVs reflect characteristics of the Class I Areas that may be affected by air emissions. They include changes in visibility, and sulfate and nitrate deposition. The U.S. Forest Service and the NPS are the Federal Land Managers responsible for protecting these Class I Areas.

The AQRV Class I analysis conducted for the LNG terminal was based on the emissions over distance screening test outlined in the Federal Land Managers' *Air Quality Related Values Work Group (FLAG): Phase I Report – Revised (2010)* (NPS et al., 2010). A facility is considered to have negligible impacts with respect to AQRVs if its total SO_2, NOx, PM_{10}, and sulfuric acid annual emissions (in tpy, based on 24-hour maximum allowable emissions) divided by the distance (in km) from the Class I Area (that is, quantity divided by distance [Q/D]) is 10 or less. Emissions used for this AQRV screening analysis are summarized in table 4.1.12-12.

Table 4.1.12-12

Emissions used in Class I AQRV Screening Analysis of Terminal

Source Description	Potential to Emit (lb/hr)				Q (tpy)			
	PM_{10}	NOx	SO_2	H_2SO_4	PM_{10}	NOx	SO_2	H_2SO_4
Liquefaction								
Three Heaters	1.5	2.3	3.9	0.2	6.6	10.1	17.1	0.9
Amine Sweetening Treatment Units and Thermal Oxidizer with Acid Gas Scrubber	0.6	8.0	1.9	0.1	2.6	35.0	8.3	0.4
Cooling Tower	0.3	-	-	-	1.3	-	-	-
Ground Flare	0.4	3.3	0.7	4.6E-02	1.6	14.6	3.1	0.2
Regasification								
Four Heaters	1.4	6.2	6.8	0.3	6.1	27.2	29.8	1.3
Vapor Handling System								
Low-Pressure Flare	5.3E-4	4.8E-3	1.0E-3	5.6E-5	2.3E-3	2.1E-2	4.4E-3	2.5E-4
Utilities								
2,000-kW Emergency Diesel Generator	0.7	34.8	2.9E-2	-	3.1	152.4	0.1	-
470-hp Diesel Fire Pump	0.2	3.1	5.0E-3	-	0.9	13.6	0.0	-
Two 850-hp Deluge Fire Pumps	0.6	18	2.0E-2	-	2.6	78.8	0.1	-
Marine Facility								
LNG Unloading	3.4	42.6	7.1	-	14.9	186.6	31.1	-
Total	**9.1**	**118.3**	**20.5**	**0.6**	**39.7**	**518.3**	**89.6**	**2.8**
Total Q						**650.5**		

lb/hr = pounds per hour

Based on a maximum emission amount of 651 tpy, the AQRV Class I analysis resulted in a Q/D of less than 10 for all Class I Areas. The terminal is therefore not predicted to result in impacts with respect to AQRVs and no significant impacts on Class I areas.

Pipeline and Associated Aboveground Facilities

The Compressor Station equipment would be electric except for the emergency generator and a fire pump. The minor emissions associated with emergency generator and fire pump use would not trigger PSD requirements, and so are not required to be analyzed for Class I Area impacts.

Chemical Accident Prevention

Terminal

Portions of 40 CFR Part 68 are incorporated by reference in OAR 340-244-0230. Stationary sources are defined in 40 CFR Part 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities belonging to the same industrial group, located on one or more contiguous properties, under the control of the same person (or persons under common control), and from which an accidental release may occur. However, the federal definition also states that the term "stationary source" would not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term "transportation" includes transportation subject to oversight or regulation under 49 CFR Parts 192, 193 or 195 or a state natural gas or hazardous liquid program for which the state has in effect a certification to DOT under 49 USC 60105.

The transportation exemption to the rules in 40 CFR 60 would apply to LNG facilities subject to oversight or regulation under 49 CFR parts 192, 193, or 195, or a state natural gas or hazardous liquid program for which the state has in effect a certification to DOT under 49 USC Section 60105. These facilities include those used to liquefy natural or synthetic gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the terminal would not require an RMP.

Pipeline and Associated Aboveground Facilities

With the exception of natural gas constituents (e.g., methane, ethane, and propane), no regulated substance would be handled or stored in quantities greater than the applicability threshold. In addition, natural gas pipelines are not covered by the RMP provisions if they are regulated by the USDOT or an equivalent state natural gas program certified by USDOT in accordance with 49 CFR Part 6010.5. Consequently, an RMP is not required for the pipeline or compressor station. Oregon LNG would maintain awareness of hazard issues and would meet the goals of the above-listed general duty provisions.

Greenhouse Gas Emissions

Terminal

During the scoping period, comments were received expressing concerns regarding emissions of GHG from the project. The principle GHG are methane, CO_2, nitrous oxide (N_2O), and various fluorinated gases that trap heat in the atmosphere and are the primary driver of the increase in global mean temperature, known as global warming. No fluorinated gases would be emitted by the project so we need only look at N_2O, methane, and CO_2. There are no federal regulations at this time limiting the emissions of CO_2; however, emissions of methane are limited by valve and pipe leak standards.

Emissions of GHG are typically estimated as carbon dioxide equivalents. The GHG are ranked by their global warming potential (GWP). The GWP is a ratio relative to CO_2, which is based on the properties of the GHG to absorb solar radiation as well as the residence time within the atmosphere. Thus CO_2 has a GWP of 1, methane has a GWP of about 25, and N_2O has a GWP of about 298. Estimates of GHGs from construction and operational activities are provided in the sections above.

Oregon LNG signed an MOU in June, 2009, with the ODE (ODE, 2009) which established a framework for cooperation and outlines responsibilities for the State of Oregon and Oregon LNG to work together to provide risk mitigation measures for a number of areas of concern, including CO_2 emissions from the operation of the proposed LNG terminal. The 2009 MOU is being updated to reflect the change from an import terminal to an import/exportfacility and the format is changing to two stand-alone MOUs. One MOU addressing emergency preparedness for the terminal has been completed, and the second will address carbon dioxide (CO_2) emissions and financial obligations for facility retirement.

Pipeline and Associated Aboveground Facilities

In the event of a fire or other abnormal event, the compressor station would be shut in (isolated) from the pipeline utilizing fail close ball valves. The inventory of gas would be released to the atmosphere, usually in a short amount of time. This operation is typically referred to as blowdown. Blowdown emissions were estimated using a conservative assumption that such a blowdown would occur once every 5 years. Emissions would consist of methane and ethane. Nonmethane, nonethane VOC emissions would be zero. Using the global warming potential of 25 for methane, the carbon dioxide equivalent of the methane released would be 107 tpy.

Water Vapor (Fog) Effects from Terminal Operation

During scoping, comments were received regarding concerns about fog generated at the terminal migrating off site. When the terminal was originally designed as an import-only facility, Oregon LNG proposed to use ambient air vaporizers. These vaporizers can create fog under certain atmospheric conditions. Instead of ambient air vaporizers, Oregon LNG now proposes to use shell-and-tube vaporizers, which do not create fog. The facility, as currently designed, would include cooling towers associated with process cooling for the pretreatment and liquefaction processes. A total recirculation cooling tower flow rate of 304,230 gallons per minute is required for process cooling for the pretreatment and liquefaction process. It is anticipated that the maximum total dissolved solids concentration of the recirculation flow would be less than 1,500 mg/L. The cooling tower would have an estimated maximum summertime evaporation rate of 4,750 gallons per minute and would be equipped with drift eliminators that would reduce the number of water droplets carried out of the cooling tower with the exhaust air to 0.0005 percent.

Under certain ambient conditions, plumes of water vapor (fog) can result from the discharge from cooling towers. Fogging conditions typically occur when the relative humidity is greater than 90 percent and temperatures are below 25 ºF. This condition occurs infrequently in the terminal area. Based on an evaluation of the Astoria Airport surface data from 2006 through 2010, conditions of 25 ºF and 90 percent relative humidity occurred less than 0.02 percent of that 5-year period.

Operational Air Quality Mitigation

To mitigate vessel-related emissions, Oregon LNG has committed to negotiate with LNG marine carriers to reduce their speed as they approach land (excluding the route through the Aleutian Islands) to decrease emissions. However, the use of electric power while in port would not be considered due to a Coast Guard requirement that an LNG marine carrier be capable of getting underway immediately at all times while in port.

Under PSD review, the LNG terminal would be subject to PSD rules (OAR 340-224-0070) for pollutants for which it has the potential to emit any regulated air pollutant at or above a SER, as outlined in OAR 340-200. Pollutant emissions from the LNG terminal would have the potential to exceed the applicable SER thresholds for NOx, CO, and $PM_{2.5}$. Therefore the LNG terminal would be subject to PSD preconstruction permitting requirements for NOx, CO, and $PM_{2.5}$. As part of the PSD permitting process, Oregon LNG would be required to mitigate emissions based on the installation of emission reduction technologies to meet application air quality standards.

The terminal would be required to apply for a permit under Title V because it meets the criteria as a Part 70 major source for CO. Oregon LNG would be required to submit a Part 70 Operating Permit application within 1 year of initial facility startup and meet the conditions set forth for operation, including installation of emission reduction technologies, where appropriate.

The terminal would not require an RMP under the chemical accident prevention provisions, 40 CFR Part 68. However, the facility still must comply with requirements of the general duty provisions in Section 112(r)(1) of the 1990 CAAA. This requires owners and operators of stationary sources producing, processing, handling and storing such substances to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.

Air Quality Conclusions

The project would generate air emissions from temporary construction activities. Because of their temporary nature, construction emissions would not have a long-term effect on ambient air quality. Oregon LNG would require its contractors to employ standard dust control measures during construction to reduce generation of fugitive dust due to surface disturbances.

Operation of the LNG terminal would result in direct air emissions from stationary equipment (liquefaction trains, heaters, flares, generators, pumps, etc.) and marine vessels (LNG marine carriers during loading and unloading operations). In addition to the direct air emissions described above, indirect air pollutant emissions would result from LNG marine carriers and harbor craft that would transit from the Pacific Ocean via the Columbia River to and from the terminal. Emissions from the LNG marine carriers and from harbor craft would occur during carrier and tug operations. Along the pipeline route, leaks and venting could occur at compressor stations and potentially from small leaks at flanges and valves. Emissions expected during operation of the pipeline would be relatively minor.

Operation of the LNG terminal would require Oregon LNG to comply with applicable federal and state air quality regulations, where applicable, including PSD, Title V, National Emission Standards for Hazardous Air Pollutants, Chemical Accident Prevention rules, and GHG reporting. The Oregon LNG project would not results in impacts at Federal Class I Areas.

Oregon LNG would be required to meet all federal and state air quality permitting requirements as a condition of operation. With Oregon LNG's compliance with federal and state air quality permitting rules, mitigation measures, and as indicated in the air quality modeling above, we conclude that the project would not result in significant regional air quality impacts.

4.1.12.2 Noise

Noise would be generated during construction and operation of the project. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover.

Noise Regulations

Federal agencies use two measures to relate the time-varying quality of environmental noise to its known effect on people. The equivalent sound level ($L_{eq(24)}$) is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. A second measure, the L_{dn} is calculated by adding 10 dBA to the nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for the greater sensitivity of people to sound during the nighttime hours. The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

Statistical noise level descriptors such as L_{10} and L_{50} may also be cited within state regulations. The L_{10} value represents the noise level that is exceeded during 10 percent of the measurement period. Similarly, the L_{50} represents the noise level exceeded for 50 percent of the measurement period.

Federal Noise Regulations

In 1974, the EPA published Information on *Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA, 1974). This publication evaluates

the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. An L_{dn} of 55 dBA is equivalent to an L_{50} value of 49 dBA. We have adopted this criterion for new compression and associated facilities, and it is used here to assess the potential noise impact from the terminal.

Oregon Noise Regulations

The noise program of the ODEQ is promulgated under ORS Chapter 467 and OAR 340-035-035, Noise Control Regulations for Industry and Commerce. While the noise regulations are no longer enforced by the ODEQ, the regulations still remain in effect.

The compressor station is a new source located on a previously unused site; therefore, the proposed operation of the facility would be subject to the noise limits specified in OAR 340-035-035(1)(b)(B). These limits specify that no new noise source shall increase the L_{10} or L_{50} noise levels by more than 10 dBA in any hour. This is more commonly referred to as the "ambient degradation test." In addition, the absolute levels specified in Table 8 of OAR 340-035-035 (shown below as table 4.1.12-13) must not be exceeded. This is more commonly referred to as the "Table 8 Test." For a new source located on a previously unused site, the Table 8 Test becomes the controlling noise limit in the event the existing L_{10} or L_{50} levels are within 10 dBA of the Table 8 values.

Table 4.1.12-13

New Industrial and Commercial Noise Source Standards (dBA)

Statistical Descriptor	Daytime (7 a.m. – 10 p.m.)	Nighttime (10 p.m. – 7 a.m.)
L_{50}	55	50
L_{10}	60	55
L_{1}	75	60

Source: OAR 340-35-035, Table 8.

Note that in this case, our guideline of 55 L_{dn} (equivalent to an L_{50} of 49 dBA) is more restrictive than Oregon's standard. While there is evidence of previous industrial activity at the terminal site, the project is moving forward with the more restrictive previously unused site requirements in accordance with OAR 340-035-035.

In addition to the above requirements, there are optional provisions available to the Director of the ODEQ to limit octave bands and audible discrete tones. OAR 340-035-035(5) provides exemptions for emergency equipment, warning devices not operating continuously for more than 5 minutes, sounds that originate on construction sites, and sounds created in construction or maintenance of capital equipment. Therefore, noise from such sources would not be regulated or limited. In addition, there are no quiet areas within the project vicinity. The only quiet area in the state of Oregon is The Grotto - The National Sanctuary of Our Sorrowful Mother in Portland, Oregon.

Washington Noise Regulations

Noise-generating activities in Washington would be restricted to construction of the pipeline segment. The State of Washington noise regulations (WAC Chapter 173-60) specifically exempt daytime construction activities. Nighttime construction activities in Washington are expected to be limited to HDD.

WAC 173-60 establishes maximum permissible sound levels based on the environmental designation for noise abatement (EDNA), which is defined as "an area or zone (environment) within which maximum permissible noise levels are established." There are three EDNA designations (WAC 173-60-030), which roughly correspond to residential, commercial/recreational, and industrial/agricultural uses:

- Class A: lands where people reside and sleep (such as residential);
- Class B: lands requiring protection against noise interference with speech (such as commercial/recreational); and
- Class C: lands where economic activities are of such a nature that higher noise levels are anticipated (such as industrial/agricultural).

Table 4.1.12-14 summarizes the maximum permissible levels applicable to noise received at noise-sensitive areas (Class A EDNA) from an industrial facility (Class C EDNA).

The following are exempted from the limits presented in table 4.1.12-14 (WAC 173-60-050):

- construction noise between the hours of 7 a.m. and 10 p.m.;
- motor vehicles when regulated by 173-62 WAC ("Motor Vehicle Noise Performance Standards" for vehicles operations on public highways); and
- motor vehicles operated off public highways, except when such noise affects residential receivers.

Table 4.1.12-14

Maximum Permissible Noise Levels from a Class C EDNA (dBA)

	Class A EDNA Receiver [a]	
Statistical Descriptor	**Daytime (7 a.m. – 10 p.m.)**	**Nighttime (10 p.m. – 7 a.m.)**
L_{eq}	60	50
L_{25}	65	55
$L_{16.7}$	70	60
$L_{2.5}$	75	65

[a] Standard applies at the property line of the receiving property sources.
Source: State of Washington Noise Regulations (WAC 173-60-040).

Local Noise Regulations

None of the Oregon counties the proposed pipeline would traverse have noise regulations that contain numeric noise limits. Columbia County, where the compressor station is located, discusses noise in its comprehensive plan and incorporates provisions into its zoning ordinances; however, no numeric limits or regulations concerning noise were identified for this county. No local noise regulations were identified for the City of Warrenton.

Cowlitz County, Washington, applies the provisions of the Cowlitz County Nuisance Code (Chapter 10.25) to construction noise but exempts sounds created by construction between 7:00 a.m. and 10:00 p.m.

Chapter 17 of the Woodland, Washington, Code of Ordinances would apply to operational noise and presents noise performance standards applicable to commercial and industrial development in all zones. Maximum permitted sound levels in decibels along residence and commercial district boundaries are specified according to center frequency cycles per second. Table 4.1.12-15 describes these levels. No construction noise limits are specified in the Woodland Code of Ordinances.

Table 4.1.12-15

Maximum Permissible Sound Pressure Levels in Woodland, Washington (dBA)

Center Frequency Cycles per Second	Along Residence District Boundaries	Along Commercial District Boundaries
31.5	65	72
63	67	70
125	66	68
250	59	63
500	52	57
1,000	46	52
2,000	37	45
4,000	26	38
8,000	17	32

Source: Woodland Ordinance 490 Sec. 12.02(1) 1979.

Threshold Summary

Based on a review of the current regulations, the following noise thresholds are identified for comparison with projected noise levels:

- Ldn maximum of 55 dBA for any 24-hour period;
- Noise level maximums specified in table 4.1.12-14 and table 4.1.12-15; and
- 10 dBA maximum increase to the L_{10} or L_{50} noise levels for any hour.

Terminal

Existing Noise Levels

Oregon LNG conducted a series of noise measurements at NSAs near the proposed terminal location September 26 to 27, 2007, and November 1 to 2, 2007. Additional ambient noise measurements were conducted March 19 to 21, 2012, to establish baseline ambient sound levels at NSAs in the vicinity of the compressor station and nearby HDD locations. NSAs were selected by finding the nearest representative land use in each general direction from the proposed site. The noise monitoring results at the NSAs under the existing conditions are summarized in table 4.1.12-16.

Three of the six NSAs were used to establish baseline ambient sound levels for the terminal. These sites were chosen to be generally representative of the closest noise-sensitive land uses to the terminal. Site M1 represents homes located northwest of the terminal. Site M2 represents homes located southwest of the terminal. Site M3 represents homes located south of the terminal.

Table 4.1.12-16

Monitoring Site Locations—Description and Summary

Noise Monitoring Location	Description	L_{dn} [a] (dBA)	Min Hourly L_{10} (dBA)	Min Hourly L_{50} (dBA)	Max Hourly L_{eq} (dBA) (day)	Min Hourly L_{eq} (dBA) (night)
M1—755 North Main Street; Warrenton, Oregon	Single-family residence; 0.8 mile from proposed terminal site. Represents closest residential area to the northwest of proposed terminal site. Primary noise source is Weyerhaeuser sawmill.	58*	40	37	70 [b]	38
M2—Northeast Skipanon Drive; Warrenton, Oregon	Condominium complex; 0.5 mile from proposed terminal site. Represents closest residential area to the west of proposed terminal site. Primary noise source is Weyerhaeuser sawmill.	61	55	53	56	54
M3—Northeast King Avenue and East Harbor Street; Warrenton, Oregon	Gravel road next to dentist office; 0.25 mile from proposed HDD location. Represents closest residential area south of the proposed terminal site and closest to a proposed HDD location. Primary noise source is vehicles traveling on Harbor Street and Weyerhaeuser sawmill.	56	50	42	53	49
M6—Chaney Road about 1,000 feet west from Highway 30	Plowed field. Represents closest residence to compressor station site and Columbia River HDD. Primary noise source is vehicles traveling on Highway 30 and trains traveling on railroad tracks.	55	45	38	56	42
M7—Highway 30 about 1,000 feet southeast of Chaney Road	Plowed field. Represents closest residence to compressor station site and Columbia River HDD. Primary noise sources are vehicles traveling on Highway 30 and trains traveling on railroad tracks.	69	44	37	70	53
M8—Compressor station site	Disturbed vacant land at proposed compressor station site. Primary noise sources are vehicles traveling on Highway 30 and trains traveling on adjacent railroad tracks.	65	53	47	69	51

[a] Noise measurements during the 2012 survey (locations M6, M7, and M8) were conducted over two 24-hour periods. L_{dn} was calculated for each 24-hour period and the lowest value is presented in the table.

[b] The maximum hourly L_{eq} reported at location M1 was 70 dBA. However, this value is considered potentially anomalous. If this value is not included in the analysis, the resulting L_{dn} is 53 dBA. The next highest hourly L_{eq} was 52 dBA.

Noise Impacts and Mitigation

During the scoping period, comments were received expressing concern regarding construction noise impacts on the aquatic environment, which included increased noise levels from vessel and tug boat traffic, increased noise levels during terminal facility construction, pile driving noise impacts, and dredging noise impacts. Potential impacts from the terminal could be caused by short-term noise increases during construction and long-term noise increases due to operation. These potential increases were compared with the standards for permissible noise at the NSAs.

Construction

Construction activities associated with the terminal would contribute noise in and around the project area over a 48-month construction period. Construction noise levels would vary depending on the construction phase, equipment quantities, and equipment locations.

Construction of the terminal would be similar to other energy projects in terms of the equipment used and types of activities. The noise level would vary during the construction period, depending on the construction phase. Construction of energy facilities can generally be divided into five phases that use different types of construction equipment: (1) site preparation and excavation; (2) concrete pouring; (3) steel erection; (4) mechanical installation; and (5) clean-up. Individual equipment noise levels typically experienced for similar heavy construction projects are presented in table 4.1.12-17. The loudest equipment generally emits noise in the range of 80 to 90 dBA at 50 feet.

Table 4.1.12-17

Typical Equipment Noise Levels for Heavy Construction Projects

Equipment Type	Range in Noise Level at 50 feet (dBA)
Earth Moving	
Front Loaders	72-84
Backhoes	72-93
Tractors	77-96
Scrapers	80-93
Graders	80-93
Pavers	86-89
Trucks	82-94
Materials Handling	
Concrete Mixers	75-88
Concrete Pumps	81-84
Cranes, Movable	75-88
Cranes, Derrick	86-89
Stationary	
Pumps	68-72
Generators	71-82
Compressors	74-87
Impact Equipment	
Mounted Breakers (Hoerams)	76-94
Pneumatic Wrenches	82-89
Jackhammers and Rock Drills	81-98
Impact Pile Drivers (Peak)	95-106
Other	
Vibrator	69-81
Saws	72-82

Source: ODOT, 2011.

Because construction activities would be distributed throughout the terminal site, an acoustical model was developed based on 18 pieces of heavy equipment operating at a maximum noise level of 85 dBA at 50 feet (a sound power level of about 117 dBA each) at the same time. This equates to an overall sound power level of about 130 dBA. To evaluate construction noise at the nearest NSAs, this sound power level was distributed across that site as an area source using the CADNA/A industrial source noise model developed by DataKustik GmbH of Munich, Germany. CADNA/A is a sophisticated software program that enables complete noise modeling of complex industrial plants. The sound propagation factors used in the model have been adopted from International Standards Organization (ISO) 9613. Atmospheric absorption for conditions of 10 °C and 70 percent relative humidity (conditions that

favor propagation) was computed in accordance with ISO 9613-1, *Calculation of the Absorption of Sound by the Atmosphere.*

Figure 4.1.12-1 presents the results of this analysis and expresses the results in terms of the hourly average noise level (L_{eq}). The construction equipment is modeled to be operating in the cross-hatched area. Actual levels would vary depending on the precise equipment and operational location. The predicted results are within about 3 dBA of the existing maximum daytime levels summarized in table 4.1.12-16. A 3-dBA increase is generally considered the threshold for a perceivable difference in noise levels when comparing similar sounds. Therefore, perceptible increases as a result of terminal construction activity are not predicted by the model. Noise from construction sites is exempted during daytime hours from the Oregon state noise regulations (OAR 340-035-035), and therefore noise from terminal construction activities would not exceed regulatory limits.

Pile driving equipment would be used for the tanks and process area, and offshore for marine facilities. There are two primary pile-driving methods: impact and vibratory. An impact pile driver would be used to drive piles at the terminal site, although a vibratory hammer, which is typically quieter than impact driving, may be used for a portion of the offshore piles. The primary sources of noise associated with impact driving would be the impact of the hammer on the pile/drive cap and the noise radiated from the pile. The primary sources of noise associated with vibratory driving are the engine/motor and radiated noise from the vibrating pile. The noise from a vibratory driver is more continuous or steady compared to the impact driver. Pile driving would occur during the statutory work window of November through February and during daylight hours only.

Noise levels from pile-driving activities were estimated using the FHWA's *Roadway Construction Noise Model* which contains one of the most comprehensive construction noise databases ever developed in the U.S. The *Roadway Construction Noise Model* calculates noise levels from construction equipment based upon a reference database of noise emission data combined with acoustical usage factors which simulate the fraction of time that construction equipment generates noise at the maximum level. The model calculates the total noise level at the receptor by determining the noise from each piece of equipment, taking into account the reduction of noise with distance due to geometric divergence (attenuation with distance). For the loudest pile-driving scenario, an impact pile driver with a reference noise level of 101 dBA and a usage factor of 20 percent, the contribution of each pile driver was used.

Monitoring location M2 represents the closest NSA to proposed pile-driving activities at a distance of about 2,200 feet. The expected noise level from the operation of the impact pile drivers is 61 dBA at M2. Potential noise impacts from pile-driving activities would be limited to daytime hours.

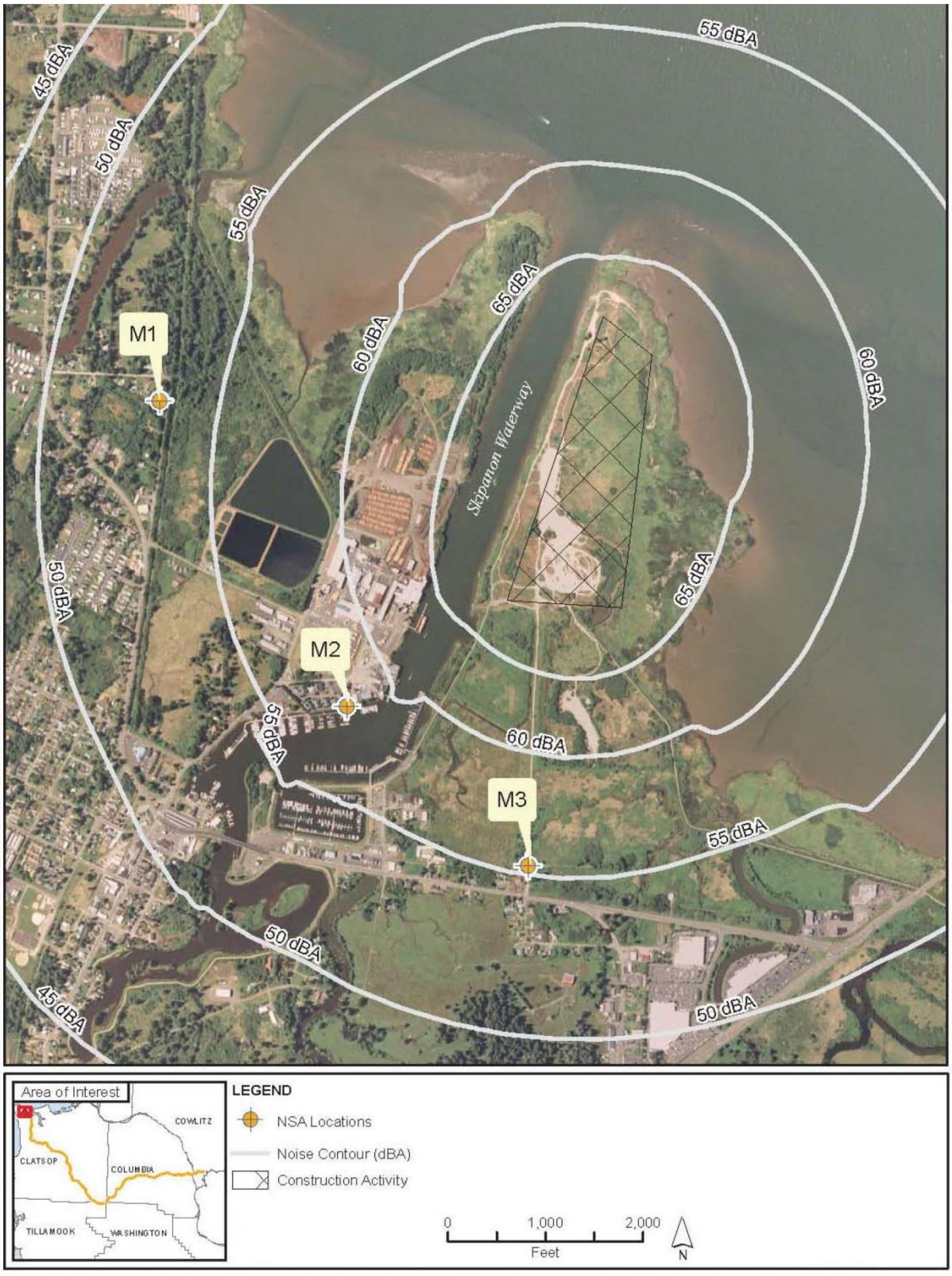


Figure 4.1.12-1: Estimated Terminal Construction Noise

Offshore pile driving is anticipated to take 2 to 3 months. To the extent possible, initial installation of steel cylinder piles would be performed using barge-based vibratory hammers which would result in reduced underwater and surface noise impacts compared to impact hammers. Final driving or "proofing" would be done with an impact hammer, the size of which would be determined at the time of construction. Expected underwater noise levels from unmitigated pile driving range from 195 dB_{rms} to 205 dB_{rms} (re: 1 µPa) depending on the pile size. These noise levels can have adverse impacts on fish and pinnipeds. Underwater noise mitigation measures include a bubble curtain capable of providing 20 dB of attenuation. A detailed discussion of impacts and mitigation associated with noise generated from offshore pile driving is provided in sections 4.1.5.2 and 4.1.8.1.

Dredging activities are expected to occur 24 hours per day during June through September of one year and would be about 1 mile from the NSAs. A simplified noise analysis of dredging activities was developed resulting in a first-order estimate of 50 dBA at the NSA. A more detailed analysis was developed based on the specific equipment proposed by Oregon LNG based derived from measurements conducted for similar dredging noise analyses.

The FHWA *Roadway Construction Noise Model* was used to calculate the combined level from the proposed dredging equipment. The resulting level of 41 dBA at the closest NSA (2,200 feet away) is about 6 to 14 dB less than the existing hourly average sound level (L_{eq}) measured at the receptors during the day or night. Neither the first order nor more detailed estimates take into account atmospheric absorption, which at 1 mile would further reduce dredging nose levels (by about 7 and 10 dBA). Dredging noise levels are expected to be below existing noise levels at the nearest NSAs.

Operation

Activities that would generate noise at the LNG terminal during typical operations include ship mooring and unloading, and the operation of equipment such as pumps, compressors, submerged combustion vaporizers, fans, and blowers. Maintenance dredging would take place every 3 years but would represent a reduced effort compared to the initial dredging as only about one-fourth of the volume would need to be removed.

Table 4.1.12-18 identifies the most substantial noise sources that would occur at the terminal. Vendor-specific noise emission data is not currently available; however, Oregon LNG would work with vendors to ensure the terminal complies with the applicable regulatory noise limits when constructed. An acoustical design analysis would be developed as part of the final design process. Mitigation measures employed may include silencers, barriers, and enclosures.

Table 4.1.12-18

Noise-Producing Equipment at the Terminal

Boil-off gas compressor	Ground flare
High-pressure pumps	Circulating water pump
Fired heaters	Water make-up pumps
Low-pressure pump	Hot oil transfer pumps
Propane compressor	Regen gas compressor
Low-pressure mixed refrigerant compressor	Heaters
Medium-pressure / high-pressure mixed refrigerant compressor	Amine process equipment
Cooling tower system	Hot oil pumps
Flare	

Tugboats and LNG marine carrier ships are expected to produce sound levels of 64 and 61 dBA, respectively, at a distance of 300 feet (FERC, 2007). The proposed dock is about 6,500 feet from the closest NSAs. Noise reductions with distance would result in levels of less than 30 dBA at the closest NSAs and, therefore, these vessels would be a minimal source of operational noise.

The State of Oregon's 10-dBA increment over existing L_{50} sound levels was determined to be the controlling regulatory noise threshold at NSA M1. The existing monitored levels at M1 were 37 dBA (minimum hourly measured L_{50}). This results in an applicable noise limit of 47 dBA L_{50} (which equates to 53 dBA Ldn). For NSAs M2 and M3, the State of Oregon limits would be higher than FERC's 55 L_{dn}/ 49 dBA continuous. Table 4.1.12-19 summarizes the controlling noise limits each NSA in the vicinity of the terminal.

Table 4.1.12-19

Summary of Regulatory Noise Limits for the Oregon LNG Terminal

NSA	FERC	Oregon	Controlling Regulation
M1	L_{dn} of 55 dBA (L_{50} of 49 dBA)	L_{50} of 47 dBA (L_{dn} of 53 dBA)	Oregon
M2	L_{dn} of 55 dBA (L_{50} of 49 dBA)	L_{50} of 50 dBA (L_{dn} of 56 dBA)	FERC
M3	L_{dn} of 55 dBA (L_{50} of 49 dBA)	L_{50} of 50 dBA (L_{dn} of 56 dBA)	FERC

For a steady noise source, the continuous level is the same as the L_{eq} or L_{50}. The L_{dn} is about 6 dBA greater than the continuous level.

Figure 4.1.12-2 presents the results of the conceptual operational noise analysis performed for the terminal. The results of the analysis show that the terminal would likely comply with the most restrictive noise limits in each case. Oregon LNG would refine the terminal operational noise analysis as the engineering design develops and include acoustical controls as necessary to ensure the terminal complies with the applicable noise limits. A detailed acoustical design would be developed as part of the final design process.

As with any large, complex project, the preliminary information available during the initial engineering phases does not allow final decisions to be made regarding specific mitigation measures. Vendor information would be incorporated into the acoustical model as it becomes available. Because the terminal operational noise levels discussed above are estimates, **we recommend that:**

- **Oregon LNG should make all reasonable efforts to ensure that predicted noise levels during operation of the LNG terminal are not exceeded at nearby NSAs and should file with the Secretary a full load noise survey no later than 60 days after each of the liquefaction trains is placed into service. If the noise attributable to the operation of the LNG terminal exceeds an L_{dn} of 55 dBA at any nearby NSAs, Oregon LNG should reduce operation of the LNG terminal or install additional noise controls until a noise level below an L_{dn} of 55 dBA at nearby NSAs is achieved. Oregon LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**
- **Oregon LNG should file a noise survey with the Secretary no later than 60 days after placing the entire LNG terminal into service. If a full load condition noise survey is not possible, Oregon LNG should provide an interim survey at the maximum possible horsepower load within 60 days of placing the LNG terminal into service and provide the full load survey within 6 months. If the noise**

attributable to the operation of all of the equipment at the LNG terminal under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Oregon LNG should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Oregon LNG should confirm compliance with the above requirement by filing an additional noise survey with the Secretary no later than 60 days after it installs the additional noise controls.

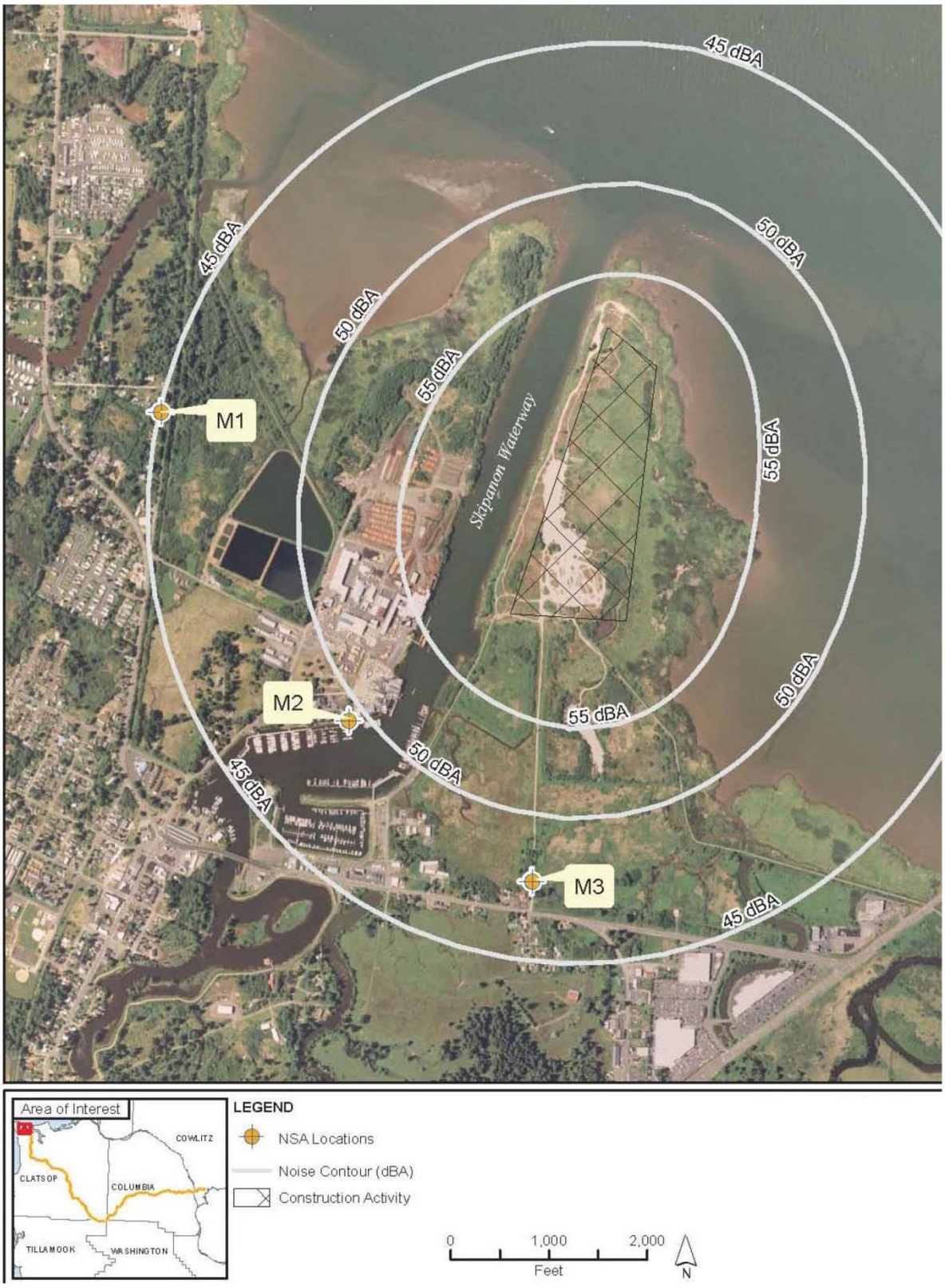


Figure 4.1.12-2: Estimated Terminal Operation Noise

Mitigation

Oregon LNG has committed to employing a combination of noise mitigation methods, including equipment noise controls and administrative measures to minimize effects of operation and construction activity noise on people living near the terminal, as described below.

- Oregon LNG would establish a telephone number for use by the public to report any significant undesirable noise conditions associated with the construction and operation of the project. If the telephone is not staffed 24 hours per day, Oregon LNG would include an automatic answering feature, with date and time stamp recording, to answer calls when the phone is unattended. This telephone number would be provided to nearby residences.
- Throughout the construction and operation of the terminal, Oregon LNG would document, investigate, evaluate, and attempt to resolve project-related noise complaints. Oregon LNG or its authorized agent would:
  - document and respond to each noise complaint;
  - contact the person(s) making the noise complaint within 24 hours; and
  - attempt to determine the source of noise related to the complaint.
- If the noise complaint is legitimate, take all feasible measures to reduce the noise at its source. Noisy construction or demolition work (that causes off-site annoyance as evidenced by the filing of a legitimate noise complaint) would be restricted to 7 a.m. to 7 p.m. Monday through Friday. Restriction of hours may not apply to dredging operations.
- Haul trucks and other engine-powered equipment would be equipped with adequate mufflers. Haul trucks would be operated in accordance with posted speed limits. Truck engine exhaust brake use would be limited to emergencies.
- Semi-permanent stationary equipment (e.g., generators and lights) may be available in "quiet" packages and would be stationed as far from sensitive areas as possible.
- Operational sound levels would be in compliance with the controlling sound limit. Design measures may include, but would not be limited to:
  - acoustically rated wall, ceiling, and door assemblies;
  - silenced building ventilation;
  - electric-drive compressor motors rather than combustion engines;
  - acoustical lagging/insulation;
  - acoustical enclosures;
  - low noise fans, blowers, motors;
  - acoustical barriers; and
  - acoustical silencers.

In addition, it may be feasible to adjust equipment locations or acquire additional property to increase distances between NSAs and primary noise-generating equipment.

Pipeline and Associated Aboveground Facilities

Existing Noise Levels

Three of the six ambient noise monitoring locations (sites M6, M7, and M8; see table 4.1.12-16) were selected to characterize baseline ambient sound levels for the preconstruction and preoperations environment in the vicinity of the compressor station and Columbia River HDD locations (see figure 4.1.13-12). Long-term (24-hour) measurements were taken at each of these three sites. The noise monitoring results are summarized in table 4.1.12-16.

Noise Impacts and Mitigation

Potential impacts from the pipeline could be caused by short-term noise increases during construction and long-term noise increases associated with aboveground facilities. These potential increases were compared with the noise standards for permissible noise at the NSAs.

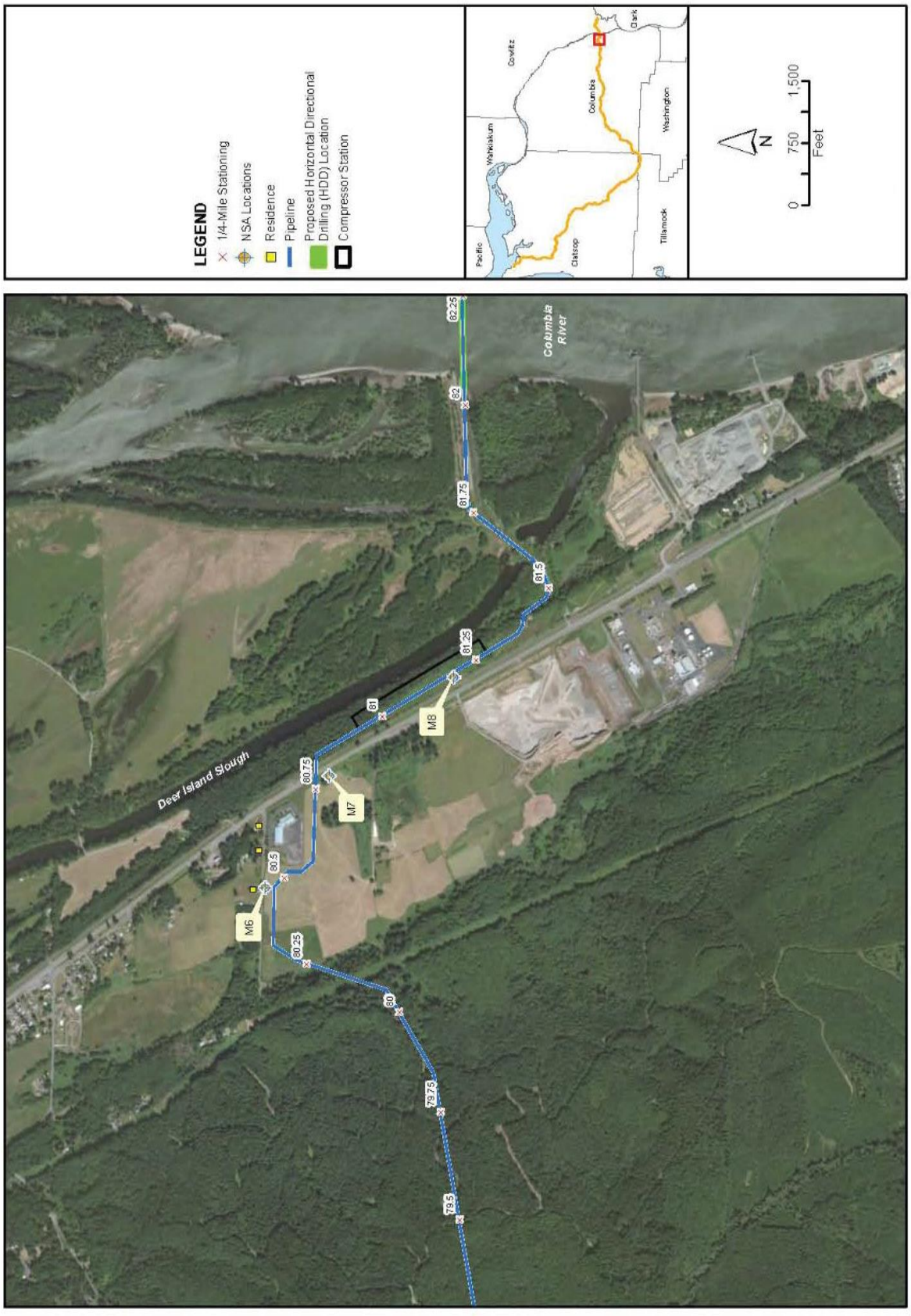


Figure 4.1.12-3: Pipeline Noise Monitoring Locations

Construction

Construction activities associated with the pipeline and aboveground facility construction would contribute temporary noise in and around the project area. Increases in noise levels during construction would be limited to areas close to the construction activity. Construction equipment would primarily include miscellaneous trucks, bulldozers, backhoes, and side-boom tractors. Noise levels from individual construction equipment would typically range from about 70 to 90 dBA at 50 feet from the source. Noise at any specific receptor would typically be dominated by the closest and loudest equipment, and the types and numbers of construction equipment near any specific receptor location would vary over time.

Pipeline construction noise levels were estimated at varying distances (see figure 4.1.12-4) based on conservative assumptions of multiple pieces of equipment operating in close proximity to each other near the edge of the pipeline easement or at the compressor station property line. In addition, the analysis included the following assumptions.

- One piece of equipment generating a reference noise level of 85 dBA (at 50 feet with a 40 percent usage factor) would be within the pipeline construction right-of-way or compressor station property line.
- Two pieces of equipment generating reference 85-dBA noise levels would be 50 feet farther away on the pipeline construction right-of-way or the compressor station property line.
- Two more pieces of equipment generating reference 85-dBA noise levels would be 100 feet farther away on the pipeline construction right-of-way or the compressor station property line.

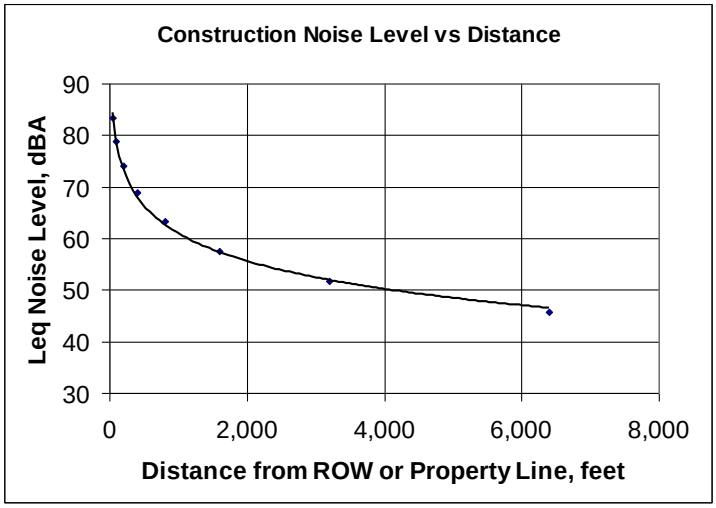


Figure 4.1.12-4: Estimated Construction Noise Levels vs. Distance

With the possible exception of HDD activities (discussed below), construction work would be restricted to times between 7 a.m. and 7 p.m., Monday through Friday. Haul trucks and other engine-powered equipment would be equipped with adequate mufflers. Haul trucks would be operated in accordance with posted speed limits. Truck engine exhaust brake use would be limited to emergencies. Semi-permanent stationary equipment (e.g., generators and lights) may be available in "quiet" packages and would be stationed as far from sensitive areas as is practical.

Oregon LNG proposes to install the pipeline using HDD at 11 locations to avoid direct impacts on sensitive areas, such as waterbodies and wetlands. HDD activities would generate noise impacts on the surrounding area. Each drill would take from several days to weeks to complete. Although Oregon LNG currently proposes to limit HDD activities to daytime hours, site and soil conditions may require HDD activities at some locations to operate on a 24-hour basis. As such, noise from HDD activities is analyzed separately from general pipeline construction activities. Anticipated equipment at the HDD entry point may include the following:

- a DD-330 American Augers trailer-mounted drill rig or equivalent (625 hp);
- a mud pump and rig (425 hp);
- two centrifugal pumps (40 to 60 hp);
- an excavator; and
- pumps with hospital-grade exhaust mufflers.

Equipment at the exit location may include the following:

- an excavator;
- centrifugal pumps (40 to 60 hp); and
- a mud pump and rig (425 hp).

The estimated sound power level for the HDD equipment operating at the entry and exit point is 121 dBA and 116 dBA, respectively. With mitigation measures such as barriers, enhanced mufflers, or engine enclosures, a 10 dBA reduction should be reasonably achievable.

Table 4.1.12-20 summarizes the predicted general unmitigated noise levels during HDD activities.

Table 4.1.12-20

Predicted Unmitigated Noise Levels During HDD Activities

Distance (feet)	Entry Location Noise (L_{eq}, dBA)	Exit Location Noise (L_{eq}, dBA)	Combined Exit and Entry Point (L_{eq}, dBA)
100	83	78	85
200	77	72	78
400	71	66	72
600	68	63	69
800	65	60	66
1,000	63	58	65
1,500	60	55	61
2,000	57	52	58
4,000	51	46	52
8,000	45	40	46

Oregon LNG also conducted a conservative site-specific noise analysis to predict noise levels at the nearest NSAs to each HDD entry and exit point. Table 4.1.12-21 summarizes the site-specific HDD noise analysis results.

Table 4.1.12-21

Site-specific Horizontal Directional Drilling Noise Levels (dBA)

Drilling Location	Milepost Begin	Milepost End	HDD Site Type	Distance from HDD Site to NSA (feet) [a]	NSA Type	Unmitigated L_{eq}	Unmitigated L_{dn}
Highway 101 and Adair Slough at MP 1.0	0.9		Entry	513	Com	70	76
		1.1	Exit	1,165	Com	61	68
Lewis and Clark River at MP 3.0	2.8		Entry	1,082	Res	57	64
		3.4	Exit	1,161	Res	61	68
Lewis and Clark River at MP 5.0	5.0		Entry	703	Res	67	73
		5.5	Exit	1,029	Res	63	69
Lewis and Clark River at MP 5.5	5.6		Entry	1,218	Res	61	67
		6.0	Exit	1,211	Res	61	67
Lewis and Clark River at MP 11.0	10.9		Entry	187	Res	64	70
		11.2	Exit	900	Res	66	72
Nehalem River at MP 33.5	33.3		Entry	5,117	Res	76	83
		33.7	Exit	345	Res	67	74
Highway 26 at MP 41.0	40.9		Entry	4,749	RA	44	50
		41.3	Exit	3,916	RA	47	53
Highway 26 at MP 43.5	43.1		Entry	5,606	RA	41	48
		43.6	Exit	8,197	RA	34	40
Rock Creek at MP 57.5	57.5		Entry	945	Res	64	70
		58.1	Exit	1,250	Res	61	67
Nehalem River at MP 64.0	63.6		Entry	1,081	Res	62	69
		64.3	Exit	2,519	Res	53	59
Columbia River at MP 82.5	81.8		Entry	3,276	Res	49	56
		83.0	Exit	1,928	Res	56	62

Com = commercial land use
Res = residential land use
RA = rest area
[a] All NSA estimated or measured ambient noise levels less than 55 dBA L_{dn}.

Oregon LNG proposes to limit HDD to daytime hours and monitor noise levels during the first HDD activities. These data would be used to update the analysis to reflect actual HDD noise emissions from project-specific equipment, and allow for more precise identification of NSAs where the 55 dBA L_{dn} may be exceeded in the event that 24-hour HDD activities are necessary.

The results of the analysis show that unmitigated noise levels would exceed the applicable noise standards at the nearest NSA at 17 of the 22 entry/exit points listed in table 4.1.12-21. Therefore, **we recommend that**:

> **Prior to construction of any HDD crossings, Oregon LNG should file with the Secretary, for the review and written approval by the Director of OEP, an HDD noise mitigation plan to reduce the projected noise level attributable to the proposed drilling operations at NSAs *with predicted noise levels above 55 dBA L_{dn}*. During drilling operations, Oregon LNG should implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSAs.**

Operation

No noise from operation of the pipeline is anticipated. The primary source of aboveground facility operational noise would be the compressor station. Secondary sources of operational noise would be the metering station at the Northwest Pipeline interconnect. Vendor-specific noise information is not currently available.

The compressor station would be a new noise source on a previously unused site. Table 4.1.12-22 shows the applicable noise limits at the M6 and M7 NSAs. The State of Oregon limits are less than FERC's limit of 55 dBA L_{dn} and so would be the controlling regulation. Oregon LNG has committed to incorporate acoustical controls to ensure the compressor station would comply with the applicable noise limits. A suitable acoustical design would be developed as part of the final design process.

Table 4.1.12-22

Summary of Regulatory Noise Limits for the Compressor Station—Previously Unused Site

NSA	FERC	Oregon	Controlling Regulation
M6	Ldn of 55 dBA (L50 of 49 dBA)	L50 of 48 dBA (Ldn of 54 dBA)	Oregon
M7	Ldn of 55 dBA (L50 of 49 dBA)	L50 of 47 dBA (Ldn of 53 dBA)	Oregon

For a steady noise source, the continuous level is the same as the Leq or L50. The Ldn is about 6 dBA greater than the continuous level.

Table 4.1.12-23 presents an evaluation of the changes in the unmitigated L_{dn} at the monitoring locations based on operation of the facility in compliance with the State of Oregon's sound limits.

Table 4.1.12-23

Noise Analysis Results for the Compressor Station

NSA	Distance to Closest NSA (feet)	Measured Existing Noise (dBA) L_{eq} (day)	Measured Existing Noise (dBA) L_{eq} (night)	Measured Existing Noise (dBA) L_{dn}	Allowable Facility Contribution (dBA, L_{dn})	Total Post-Construction Level (dBA, L_{dn})	Increase dBA (L_{dn})
M6	3,300	56	42	55	54	58	3
M7	2,800	70	53	69	53	69	0

Oregon LNG has committed to incorporate acoustical controls to ensure the compressor station would comply with the applicable noise limits. A suitable acoustical design would be developed as part of the final design process. The compressors would be electrically driven; therefore, engine combustion air inlet and exhaust noise would not be present. The use of electrically driven compression is a significant noise mitigation measure. The compressor station would include acoustically rated wall, ceiling, and door assemblies in addition to silenced building ventilation. Precast concrete buildings or other acoustically rated structures have been successfully installed around gas compressors located near noise-sensitive areas. Air coolers downstream of the compressor may be fitted with noise reducing devices such as low-noise fans, barriers, or silencers.

At other aboveground facilities, piping and valving may need to be acoustically lagged (materials applied to the surface to reduce noise) or enclosed.

To ensure that the closest residents to the compressor station do not experience significant noise impacts, **we recommend that:**

- **Oregon LNG should file a noise survey with the Secretary no later than 60 days after placing the compressor station in service. If a full load condition noise survey is not possible, Oregon LNG should provide an interim survey at the maximum possible horsepower load and provide the full load survey within 6 months. If the noise attributable to the operation of all of the equipment at the compressor station under interim or full horsepower load conditions exceeds existing noise levels at any nearby NSA, Oregon LNG should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Oregon LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Mitigation

Oregon LNG has committed to employing a combination of noise mitigation methods, including equipment noise controls and administrative measures to minimize effects of operation and construction activity noise on people living near the compressor station and pipeline. Mitigation to minimize disturbance from noise would include the measures listed above for the terminal as well as the following measures specific to the pipeline construction.

- With possible exception of HDD, noisy construction or demolition work (that causes off-site annoyance as evidenced by the filing of a legitimate noise complaint) would be restricted to 7 a.m. to 7 p.m. Monday through Friday.
- For HDD activities near noise-sensitive areas, Oregon LNG would evaluate the feasibility and effectiveness of erecting temporary barriers utilizing materials such as intermodal containers or frac tanks, plywood walls, mass-loaded vinyl (vinyl impregnated with metal), or hay bales. For HDD activities that would operate beyond 7 a.m. to 7 p.m. and exceed 55 L_{dn}, Oregon LNG would offer alternative temporary accommodations to those adversely impacted.

Noise Conclusions

Potential changes in the noise environment would be caused by temporary noise increases during construction and long-term noise increases during operation of the project. With the exception of dredging at the terminal and possible exception of HDD activities for the pipeline, construction work would be restricted to daytime hours (7 a.m. and 7 p.m., Monday through Friday). During construction, Oregon LNG would employ a combination of noise mitigation methods, including equipment noise controls and administrative measures, to minimize the effects of construction activity at NSAs near the terminal, pipeline, and compressor station.

Construction activities associated with the terminal would contribute noise in and around the project area over a 48-month construction period. Construction noise levels would vary depending on the construction phase, equipment quantities, and equipment locations. Pile driving would potentially be the most significant sources of terminal construction noise and would result in noise levels of 61 dBA at the nearest NSA. Oregon LNG would apply mitigation measures such as using vibratory hammers and bubble curtains to reduce noise during pile driving.

Oregon LNG proposes to limit pipeline HDD construction activity to daytime hours and monitor noise levels during the first HDD activities. If 24-hour HDD activities are required, Oregon LNG would make reasonable efforts to limit HDD to 55 dBA Ldn, including the use of barriers, enhanced mufflers, or engine enclosures for HDD operations.

Tugboats and LNG marine carrier operations at the terminal are expected to be a minimal source of operational noise. Oregon LNG would refine the terminal operational noise analysis as the engineering design develops and include acoustical controls as necessary to ensure the onshore terminal facilities comply with applicable noise limits. The primary source of pipeline operational noise would be the compressor station and a secondary source would be the metering station at the Northwest Pipeline interconnect. Oregon LNG has committed to incorporate acoustical controls to ensure the compressor station would comply with the applicable noise limits. At other aboveground facilities, piping and valving may need to be acoustically lagged or enclosed. Noise monitoring would be conducted after the project facilities are placed into operation to ensure compliance with applicable noise limits.

With Oregon LNG's proposed mitigation measures and our recommendations, we conclude that the project would not result in significant long-term noise or vibration impacts at the nearest NSAs.

4.1.13 Reliability and Safety

4.1.13.1 LNG Facility Regulatory Oversight

Three federal agencies share regulatory authority over the siting, design, construction and operation of LNG import and export terminals: the Coast Guard, DOT, and FERC. The Coast Guard has authority over the safety of an LNG facility's marine transfer area and LNG marine traffic, as well as over security plans for the entire LNG facility and LNG marine traffic. Those standards are codified in 33 CFR Parts 105 and 127. The DOT establishes federal safety standards for siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG plants. Those standards are codified in 49 CFR 193 (Part 193). Under the NGA and delegated authority from the DOE, FERC authorizes the siting and construction of LNG import and export facilities.

In 1985, FERC and DOT entered into a MOU regarding the execution of each agency's respective statutory responsibilities to ensure the safe siting and operation of LNG facilities. In addition to FERC's existing ability to impose requirements to ensure or enhance the operational reliability of LNG facilities, the MOU specified that FERC may, with appropriate consultation with DOT, impose more stringent safety requirements than those in Part 193.

In February 2004, the Coast Guard, DOT, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and tanker operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The DOT and Coast Guard participate as cooperating agencies.

As part of the review required for a FERC authorization, FERC staff must evaluate the safety and reliability engineering of all proposed facilities. The safety and reliability engineering information that must be filed in the application to the Commission is specified by 18 CFR 380.12 (m) and (o). The level of detail necessary for this submittal requires the project sponsor to perform substantial front-end

engineering of the complete facility. The design information is required to be site-specific and developed to the extent that further detailed design would not result in changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which we considered during our review process.

The FERC's filing regulations also require each applicant to identify how its proposed design would comply with DOT's siting requirements of 49 CFR 193, with special emphasis on the siting requirements in Subpart B. As part of our NEPA review, we use this information from the applicant as part of our safety and reliability engineering review to assess whether or not the facility would have a public safety impact. As a cooperating agency, DOT assists FERC staff in evaluating whether an applicant's proposed siting meets the DOT requirements. If a facility is constructed and becomes operational, the facility would be subject to DOT's inspection program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

In accordance with 33 CFR 127, the Coast Guard previously provided FERC with a Letter of Recommendation dated April 24, 2009, regarding the suitability of the waterway for the type and frequency of the planned LNG marine carrier traffic.[8] Coast Guard's most recent correspondence regarding the annual review of the waterway was provided by Oregon LNG on March 18, 2014.[9]

4.1.13.2 LNG Facility Hazards

Before liquefaction, Oregon LNG would pre-treat the feed gas for removal of mercury, CO_2, and hydrogen sulfide (H_2S). The removal of these substances from the feed gas stream can be hazardous as a result of the physical, chemical, flammable, and/or toxic properties of the substances used or produced during the pretreatment process. Oregon LNG proposes a design capacity to handle up to 1.4 mole percent CO_2, 4 parts per million by volume (ppm-v) H_2S, and 1 parts per billion by volume (ppb-v) mercury. However, lower quantities and concentrations of these substances would be expected in the natural gas feed stream, similar to the natural gas in pipelines throughout the United States.

The CO_2 and H_2S would be removed using a diethanolamine (DEA or amine) solution in the amine gas sweetening trains. Amine is commonly used to remove CO_2 and H_2S in natural gas. The amine solution would be clear or pale yellow with a slight ammonia odor and is completely soluble in water. The amine solution could result in eye and skin irritation or burns if contacted, upper respiratory tract irritation or death if inhaled, and can be toxic if swallowed. Amine vapor is also flammable in concentrations between approximately 1.7 and 6.4 percent, but would be handled at temperatures below the point at which it could produce enough vapors to form a flammable mixture. As CO_2 and H_2S are removed, these substances would accumulate within the amine solution. Therefore the amine solution would be regenerated to maintain the effectiveness of the system. The piping and equipment containing amine would be located within a curbed area with impoundment for potential spills as discussed under "Impoundment Sizing" in section 4.1.13.6.

In the Amine Stripper, an acid gas stream with concentrations up to 93 mole percent CO_2 and 0.11 mole percent H_2S would be separated from the contaminated amine solution and would be routed to be burned in the Thermal Oxidizer. Carbon dioxide is a common component of natural gas. The CO_2 would be in its gaseous state and would be colorless and odorless. Carbon dioxide could result in eye and

[8] April 24, 2009 Letter "Letter of Recommendation (LOR) Analysis for Oregon LNG" from US Coast Guard to FERC. Filed in Docket Number CP09-6-000 under Accession Number: 20090424-4011

[9] March 18, 2014 Letter "Re: LNG Development Company, LLC (d/b/a Oregon LNG) and Oregon Pipeline Company, LLC Docket No. CP09-6-0001" from LNG Development Company to FERC. Filed in Docket Number CP09-6-001 under Accession Number: 20140318-5074

skin irritation if contacted, and respiratory irritation or death if inhaled. Due to the limited amount of CO_2 processed and high concentrations needed to cause asphyxiation, safety hazards associated with the release of CO_2 would be localized and therefore, the CO_2 would not pose a significant safety hazard to the public, which would have no access to the on-site areas. Hydrogen sulfide may also exist in the natural gas stream. Hydrogen sulfide would be in its gaseous state and would be colorless with a rotten egg odor. Hydrogen sulfide could result in eye and skin irritation if contacted, and is toxic and can result in death if inhaled. In the case of a release of H_2S, Oregon LNG has provided hazard modeling, as described under "Dispersion of Toxic Components" in section 4.1.13.6.

Mercury may exist in the natural gas stream, but is not expected to be present. Mercury would be in a liquid state and would be a metallic silver color and is odorless and could result in toxic effects, including death, if contacted, ingested, or inhaled in certain doses. Mercury would be removed by adsorption into carbon beds. The bed media is not regenerable and would be replaced after a design life of several years. The saturated carbon would be taken off site to an appropriate disposal facility. The use, handling, and transportation of mercury would be in coordination with the Oregon Department of Environmental Quality as necessary, and in compliance with applicable regulations for hazardous waste including Oregon Revised Statutes, Chapters 465 (Hazardous Waste and Hazardous Materials I) and 466 (Hazardous Waste and Hazardous Materials II).

In addition to the removal of CO_2, H_2S, and mercury, Oregon LNG would also install a Scrubber Column upstream of the liquefaction facility to remove heavy hydrocarbons, mercaptans, and benzene, toluene, and xylenes from the feed gas. These components are removed to prevent them from freezing and plugging the Main Cryogenic Heat Exchanger. Most of the hydrocarbons heavier than methane would be separated out and leave the bottom of the Scrubber Column as Natural Gas Liquids (NGL). The NGLs are flammable, can present overpressure hazards if ignited, and some components are toxic. Any liquid spill would be contained in impoundments, as discussed under "Impoundment Sizing" in section 4.1.13.6. Oregon LNG has modeled the vapor dispersion from an accidental release of NGLs, as discussed under "Flammable Vapor Dispersion Analysis" and "Dispersion of Toxic Components" in section 4.1.13.6.

After pre-treatment, the treated natural gas would then be liquefied into LNG through a series of heat exchangers using nitrogen, ethane, and propane as refrigerants. The LNG would then be stored on-site in atmospheric storage tanks before being transferred to LNG marine carriers for export. The refrigerants would also be stored on-site and periodically re-filled as needed. The LNG and refrigerants are not toxic, but are flammable and some can present overpressure hazards if ignited. Any liquid spill would be contained in impoundments, as discussed under "Impoundment Sizing" in section 4.1.13.6. Oregon LNG has provided modeling for the case of an accidental release of LNG or refrigerants, as described under "Flammable Vapor Dispersion Analysis" in section 4.1.13.6.

Hazardous Releases

A loss of containment is the initial event that results in other potential hazards. The initial loss of containment can result in a liquid and/or gaseous release with the formation of vapor at the release location, as well as from any liquid that pools. The fluid released may present low or high temperature hazards, and may result in the formation of flammable and/or toxic vapors. The extent of the hazard will depend on the material released, the storage and process conditions, and the volumes released.

Oregon LNG would store and transfer the following liquefied gases on site: LNG at pressures ranging from atmospheric in storage tanks to 1,080 psi in the process area and at cryogenic temperatures down to approximately -260°F; liquid nitrogen at approximately 110 to 120 psi and temperatures down to

approximately -320°F; liquid ethane at approximately 120 psi and a temperature ranging from -50°F to 50°F; and liquid propane between approximately 215 and 420 psi and a temperature ranging from 80°F to 95°F. The mixed refrigerant process stream would consist of methane, ethane, propane, and nitrogen, and would be transferred at pressures including approximately 850 psi. In addition, NGLs would be stored and transferred at pressures between approximately 200 and 760 psi and a temperature ranging from 60°F to 70°F.

Due to the temperature and pressure conditions under which these liquids would be handled on-site, loss of containment of these liquids could lead to the release of both liquid and vapor into the immediate area. Contact with either cold liquid or vapor could cause freeze burns or frostbite for personnel in the immediate area or more serious injury or death depending on the length of exposure. However, spills would be contained to on-site areas and the cold state of these releases would be greatly limited due to the continuous mixing with the warmer air. The cold temperatures from the release would not present a safety hazard to the public, which would not have access to on-site areas.

These releases may also quickly cool any materials contacted by the liquid on release, causing extreme thermal stress in materials not specifically designed for such conditions. These thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These temperatures, however, would be accounted for in the design of equipment and structural supports, and would not be substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296ºF) or several other cryogenic liquids that have been routinely produced and transported in the United States.

A rapid phase transition (RPT) can occur when a cryogenic liquid is spilled onto water and changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are not expected to cause significant damage. The average overpressures recorded at the source of the RPTs during the Coyote tests have ranged from 0.2 psi to 11 psi.[10] These events are typically limited to the area within the spill and are not expected to cause damage outside of the area engulfed by the LNG pool. However, an RPT may affect the rate of pool spreading and the rate of vaporization for a spill on water.

Vapor Dispersion

In the event of a loss of containment, LNG, ethane, propane, nitrogen and NGL would vaporize on release from any storage or process facilities. Depending on the size of the release, a liquid pool may also form and vaporize. Additional vaporization would result from exposure to ambient heat sources, such as water or soil. When released from a containment vessel or transfer system, LNG and liquid nitrogen will generally produce about 620 to 630 and 500 to 700 cubic feet of gas for each cubic foot (ft^3) of liquid, respectively. Ethane will produce about 330 to 450 ft^3 of gas for each cubic foot of liquid. Propane will produce about 230 to 300 ft^3 of gas for each cubic foot of liquid. The composition of NGL would vary throughout the heavy hydrocarbon removal process but would be expected to produce similar or lower volumes of gas than the above fluids.

[10] The Lawrence Livermore National Laboratory conducted seven tests (the Coyote series) on vapor cloud dispersion, vapor cloud ignition, and RPTs at the Naval Weapons Center in China Lake, California in 1981.

The vapor may form a toxic or flammable cloud depending on the material released. The dispersion of the vapor cloud will depend on the physical properties of the cloud, the ambient conditions, and the surrounding terrain and structures. Generally, a denser-than-air vapor cloud would sink to the ground due to the relative density of the vapor to the air and would travel with the prevailing wind, while a lighter-than-air vapor cloud would rise and travel with the prevailing wind. The density will depend on the material releases and the temperature of the material. For example, an LNG release would initially form a denser-than-air vapor cloud and transition to lighter-than-air vapor cloud as the vapor disperses downwind and mixes with the warm surrounding air; a liquid ethane or liquid nitrogen release would form a denser-than-air vapor cloud and transition to a neutrally buoyant vapor cloud as it mixes with the warm surrounding air; and a propane or NGL release would form a denser-than-air vapor cloud and would remain denser than the surrounding air, even after warming to ambient temperatures. However, experimental observations and vapor dispersion modeling indicate an LNG vapor cloud would not typically be warm, or buoyant, enough to lift off from the ground before the LNG vapor cloud disperses below its lower flammable limit (LFL).

A vapor cloud would continue to be hazardous until it dispersed below toxic levels and/or flammable limits. Toxicity is primarily dependent on the concentration of the vapor cloud in the air and the exposure duration, while flammability of the vapor cloud is primarily dependent just on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind. Flammable vapor dispersion distances and dispersion of toxic components are evaluated in section 4.1.13.6.

Toxicity is defined by a number of different agencies for different purposes. Acute Exposure Guideline Levels (AEGLs) and Emergency Response Planning Guidelines (ERPGs) are recommended for use by federal, state, and local agencies, as well as the private sector for emergency planning, prevention, and response activities related to the accidental release of hazardous substances (EPA, 2013b). Other federal agencies, such as the Department of Energy, EPA, and NOAA, use AEGLs and ERPGs as the primary measure of toxicity (DOE, 2008; NOAA, 2013; EPA, 1996).

There are three AEGLs and ERPGs which are distinguished by varying degrees of severity of toxic effects with AEGL-1 and ERPG-1 (level 1) being the least severe to AEGL-3 and ERPG-3 (level 3) being the most severe. AEGL-1 is the airborne concentration of a substance that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of the exposure. AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death. ERPG levels have similar definitions, but are based on the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing similar effects defined in each of the AEGLs. The EPA provides ERPGs (1 hour) and AEGLs at varying exposure times (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours) for a list of chemicals. FERC staff uses AEGLs preferentially as they are more inclusive and provide toxicity levels at various exposure times. The preferential use of AEGLs is also done by DOE and NOAA. The toxic properties for the various material components stored and processed on-site are tabulated in table 4.1.13-1.

In addition, methane, nitrogen, and heavier hydrocarbons are classified as simple asphyxiants and may pose extreme health hazards, including death, if inhaled in significant quantities within a limited

time. Very cold methane, nitrogen and heavier hydrocarbons vapors may also cause freeze burns. However, the locations of concentrations where cold temperatures and oxygen-deprivation effects could occur are greatly limited due to the continuous mixing with the warmer air surrounding the spill site. For that reason, exposure injuries from contact with releases of methane, nitrogen and heavier hydrocarbons normally represent negligible risks to the public.

Table 4.1.13-1

Toxicity Levels (in ppm)

Compound	AEGL Level	10 min	30 min	60 min	4 hr	8 hr
H2S	AEGL 1	0.75	0.60	0.51	0.36	0.33
	AEGL 2	41	32	27	20	17
	AEGL 3	76	59	50	37	31
n-Hexane	AEGL 1	-	-	-	-	-
	AEGL 2	4,000 [a]	2,900 [a]	2,900 [a]	2,900 [a]	2,900 [a]
	AEGL 3	12,000 [c]	8,600 [b]	8,600 [b]	8,600 [b]	8,600 [b]
Mercaptans[d]	AEGL 1	-	-	-	-	-
	AEGL 2	40	29	23	14	7.3
	AEGL 3	120	86	68	43	22
Benzene	AEGL 1	130	73	52	18	9
	AEGL 2	2,000 [a]	1,100	800	[b]/	200
	AEGL 3	9,700 [b]	5,600 [a]	4,000 [a]	2,000 [a]	990
Toluene	AEGL 1	200	200	200	200	200
	AEGL 2	3,100 [a]	1,600	1,200	790	650
	AEGL 3	13,000 [b]	6,100 [a]	4,500 [a]	3,000 [a]	2,500 [a]
Xylenes	AEGL 1	130	130	130	130	130
	AEGL 2	2,500 [a]	1,300 [a]	920 [a]	500	400
	AEGL 3	7,200 [b]	3,600 [a]	2,500 [a]	1,300 [a]	1,000 [a]

[a] =≥ 10% LFL
[b] =≥ 50% LFL
[c] =≥ 100% LFL
[d] => Values represent methyl mercaptans, which would have the most conservative AEGL levels.
Sources: EPA, 2013c; American Industrial Hygiene Association, 2013

Flammable Vapor Ignition

Flammability of a vapor cloud would be dependent on the concentration of the vapor when mixed with the surrounding air. In general, higher concentrations within the vapor cloud would exist near the spill, and lower concentrations would exist near the edge of the cloud as it disperses downwind. Mixtures occurring between the LFL and the upper flammability limit (UFL) could be ignited. Concentrations above the UFL or below the LFL would not ignite.

The LFL and UFL for methane are approximately 5 percent-vol and 15 percent-vol in air, respectively. Propane has a narrower flammability range, but has a lower LFL of approximately 2.1 percent-vol and a UFL of 9.5 percent-vol in air, respectively. Ethane has an LFL of approximately 3 percent-vol and a UFL of 13 percent-vol in air. Both the mixed refrigerant and the NGLs would have an LFL and UFL range of approximately 3 to 15 percent.

If the flammable portion of a vapor cloud encounters an ignition source, a flame would propagate through the flammable portions of the cloud. In most circumstances, the flame would be driven by the heat it generates. This process is known as a deflagration, or a flash fire because of its relatively short duration. However, exposure to a deflagration, or flash fire, can cause severe burns and death, and can ignite combustible materials within the cloud. Flammable vapor dispersion is evaluated in section 4.1.13.6.

If the deflagration in a flammable vapor cloud accelerates to a sufficiently high rate of speed, pressure waves that can cause damage would be generated. As a deflagration accelerates to super-sonic speeds, the large shock waves produced, rather than the heat, would begin to drive the flame, resulting in a detonation. The flame speeds are primarily dependent on the reactivity of the fuel, the ignition strength and location, the degree of congestion and confinement of the area occupied by the vapor cloud, and the flame travel distance. The overpressure hazards from potential vapor clouds at the terminal site are evaluated in section 4.1.13.6.

Once a vapor cloud is ignited, the flame front may propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. When the flame reaches vapor concentrations above the UFL, the deflagration could transition to a fireball and result in a pool or jet fire back at the source. A fireball would occur near the source of the release and would be of a relatively short duration compared to an ensuing jet or pool fire. The extent of the affected area and the severity of the impacts on objects in the vicinity of a fire would primarily be dependent on the material, quantity, and duration of the fire, the surrounding terrain, and the environmental conditions present during the fire. Radiant heat modeling for the proposed terminal design is presented under "Thermal Radiation Analysis" in section 4.1.13.6.

Fires and overpressures may also cause failures of nearby storage vessels, piping, and equipment if not properly mitigated. These failures are often termed cascading events or domino effects and can exceed the consequences of the initial hazard.

The failure of a pressurized vessel could cause fragments of material to fly through the air at high velocities, posing damage to surrounding structures and a hazard for operating staff, emergency personnel, or other individuals in proximity to the event. In addition, failure of a pressurized vessel when the liquid is at a temperature significantly above its normal boiling point could result in a boiling-liquid-expanding-vapor explosion (BLEVE). BLEVEs can produce overpressures when the superheated liquid rapidly changes from a liquid to a vapor upon the release from the vessel. BLEVEs of flammable fluids may also ignite upon release and cause a subsequent fireball. The potential for failure of pressurized vessels is addressed under "Thermal Radiation Analysis" in section 4.1.13.6.

4.1.13.3 Past Incidents at LNG Plants

With the exception of the October 20, 1944, failure at an LNG facility in Cleveland, Ohio, the operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 people.[11] The failure of the LNG storage tank was due to the use of materials inadequately suited for cryogenic temperatures. LNG migrating through streets and into underground sewers due to the lack of adequate spill impoundments at the site was also a contributing

[11] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

factor. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used and that spill impoundments are designed and constructed properly to contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland. A pump seal failure resulted in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, causing heavy damage to the building and a worker fatality. With the participation of FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to ensure that the situation would not occur again.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction facility, which killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for the proposed project, all combustion and ventilation air intake equipment would be provided with hazard detection devices that would alarm and enable isolation and deactivation of any combustion equipment whose continued operation could add to or sustain an emergency.

On March 31, 2014, an explosion and fire occurred at Northwest Pipeline Corporation's LNG peak-shaving facility in Plymouth, Washington. The facility was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured. The accident investigation is still in progress. Once developed, measures to address any causal factors which led to this incident will be applied to all facilities under Commission jurisdiction.

4.1.13.4 Technical Review of the Preliminary Engineering Designs

Operation of the proposed facilities poses a potential hazard that could affect the public safety if strict design and operational measures to control potential accidents are not applied. The primary concerns are those events that could lead to a spill of sufficient magnitude to create an off-site hazard, as discussed in section 4.1.13.2. However, it is important to recognize the stringent requirements in place for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems proposed to detect and control potential hazards.

In general, we consider an acceptable design to include various layers of protection or safeguards in the facility design to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public. These layers of protection are independent of one another so that any one layer would perform its function regardless of the action or failure of any other protection layer or initiating event. Such design features and safeguards typically include:

- a facility design that prevents hazardous events through the use of inherently safer designs; suitable materials of construction; operating and design limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;

- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure the facility stays within the established operating and design limits;
- safety-instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and structural fire protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the facility, including security inspections and patrols; response procedures to any breach of security and liaison with local law enforcement officials; and
- on-site and off-site emergency response, including hazard detection and control equipment, firewater systems, fire-fighting personnel and equipment, and coordination with local first responders to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The inclusion of such protection systems or safeguards in a facility design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. In addition, siting of the facility with regard to potential off-site consequences can be further used to minimize impacts on public safety. As discussed in section 4.1.13.1, DOT's regulations in 49 CFR 193, Subpart B require a siting analysis to be performed by Oregon LNG.

As part of the preliminary safety reviews for the project, Oregon LNG's design development team conducted a hazard identification (HAZID) study of the FEED to identify potential hazards in the preliminary design. This study was based on the project plot plans and process flow diagrams. The HAZID identified potential hazards for the process area, operating area, and adjacent spaces and considered the consequences of these hazards. The study also identified the safeguards that would be in place to prevent or mitigate the hazard and proposed recommendations as needed to eliminate, prevent, control, or mitigate the hazards.

The objectives of our FEED review focused on the engineering design and safety concepts of the various protection layers, as well as the projected operational reliability of the proposed facilities. The design would use materials of construction suited to the pressure and temperature conditions of the process design. Piping would be designed in accordance with American Society of Mechanical Engineers (ASME) B31.3. Pressure vessels would be designed in accordance with ASME Section VIII and the storage tanks would be designed in accordance with API Standard 620, per 49 CFR 193 and the National Fire Protection Association's Standard 59A (NFPA 59A). All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A for an inherently safer design. Valves and other equipment would be designed to recommended and generally accepted good engineering practices, and current UL standards would be used.

In accordance with 49 CFR 193.2067, all LNG facilities, including the LNG storage tanks, vapor retention fences, and process equipment containing LNG and refrigerants would be designed to withstand a sustained wind speed of 150 mph. This sustained wind speed is equivalent to a 3 second wind gust at 183 mph.

The process areas would be elevated to approximately 18 NAVD of 1988, while the base of the LNG storage tanks would be at approximately 0 NAVD, behind a tsunami wall reaching elevations of

over 22 feet NAVD. Because the groundwater level would be at 5 to 7 feet NAVD, the LNG tank foundation piles would be designed to resist any uplift pressure from ground water. A base slab heating system would also be installed in the base mat of the LNG storage tanks to prevent frost heave formations under the foundations. As discussed in section 4.1.13.1, FERC staff also examined the seismic and structural design of the facility.

To determine if the proposed LNG storage tanks would pose a hazard to aircraft, the FAA conducted an aeronautical study in accordance with the provisions of 49 U.S.C. Section 44718 and 14 CFR 77 concerning the heights of the proposed LNG storage tanks. The study indicated that the LNG storage tanks would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Although the LNG storage tanks are not above 200-feet tall, which is the obstruction standard contained in 14 CFR 77, Oregon LNG has agreed to mark and/or light the tanks in accordance with FAA Advisory Circular 70/7460-1K Change 2, "Obstruction Marking and Lighting". Oregon LNG also consulted with the Federal Aviation Administration on several tall pieces of equipment at the facility, such as the main cryogenic heat exchanger. All tall equipment was also found to have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Oregon LNG indicates that the minimum legal flying altitude over the proposed facility is 1,000 feet, and the facility would not be located in an approach zone for a runway where lower altitude flight would be warranted.

Oregon LNG would install process control valves and instrumentation to safely operate and monitor the facility. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset.

Oregon LNG would develop facility operation and maintenance procedures after completion of the final design. We have made recommendations for Oregon LNG to provide more information on the operating and maintenance procedures as they are developed, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training. In addition, we have recommended measures, such as labeling of instrumentation and valves, piping, and equipment and car-seals/locks, to address human factor considerations and improve facility safety. An alarm management program would also be in place to ensure effectiveness of the alarms.

Safety valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. Safety instrumented systems would comply with International Society for Automation Standard 84.01 and other recommended and generally accepted good engineering practices. As listed below, we are also including recommendations on the design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause and effect alarm or shutdown logic. This would ensure that the design includes sufficient safeguards to react to process upsets and hazardous conditions.

Safety relief valves and flares would be installed to protect the process equipment and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping per NFPA 59A and would be designed based on API 520, 521, 526, 527, and other recommended and generally accepted good engineering practices. Relief valves for piping would be in accordance with ASME B31.3, and relief valves for pressure vessels would be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. As listed below, we are including recommendations to ensure the pressure and vacuum relief devices would be sufficiently sized for major process equipment, vessels, and storage tanks.

In the event of a release, drainage systems from LNG storage and liquefaction process facilities would direct a spill away from equipment in order to minimize flammable vapors from dispersing to confined, occupied, or public areas and to minimize heat from impacting adjacent equipment and public areas if ignition occurs. The spacing of vessels and equipment between each other, from ignition sources, and to the property line would comply with NFPA 59A and NFPA 30. Our analysis of the impoundment systems is discussed in section 4.1.13.6.

Oregon LNG provided a preliminary fire protection evaluation to demonstrate that adequate hazard detection, hazard control, and firewater coverage would be installed to detect and address any upset conditions. The hazard detection systems would detect, alarm, and alert personnel in the area and control room to initiate an emergency shutdown and/or initiate appropriate procedures. These systems would meet NFPA 72 and other recommended and generally accepted good engineering practices. Passive fire proofing, in accordance with API 2218, and cold service insulation would be installed to protect plant components. Hazard control devices would be installed to extinguish or control incipient fires and releases and would meet NFPA 10, 11, and 17 and other recommended and generally accepted good engineering practices. Automatic firewater systems and monitors would be provided for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire and would meet NFPA 59A, 13, 15, 20, 22, 24 and 25 requirements. We also are including a recommendation for Oregon LNG to provide a finalized fire protection evaluation of the final design. In addition, we are recommending that Oregon LNG provide more information on the design, installation, and commissioning of hazard detection, hazard control, and firewater systems as Oregon LNG would further develop this information during the final design phase. We would review this information to confirm that the final design, installation, and capabilities of the hazard detection and control equipment would be consistent with the equipment proposed in the application.

Oregon LNG would also have emergency procedures in accordance with 49 CFR 193 and 33 CFR 127. The emergency procedures would provide for protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the facility. Oregon LNG would also be required to develop an ERP in accordance with the EPAct of 2005, as discussed further in section 4.1.13.6.

In order to minimize the risk of an intentional event, Oregon LNG would install security fencing, lighting, security personnel and cameras, monitored and controlled access points, and intrusion detection to deter, monitor, and detect intruders into the facility. In addition, as discussed in section 4.1.13.10, Oregon LNG must develop the Facility Security Plan in accordance with the Coast Guard's regulations in 33 CFR 105, Subpart D as well as the security requirements governed by 49 CFR 193, Subpart J. We also made recommendations to provide incident reporting during operation.

The use of these protection layers would minimize the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. As a result of our technical review of the information provided by Oregon LNG in its submittal documents, we identified a number of concerns in an information data request issued on February 18, 2014. Oregon LNG provided written responses on March 18, 2014. Some of these responses indicated that Oregon LNG would correct or modify its design in order to address the identified issues. As a result, **we recommend that:**

- **Prior to construction of the final design, Oregon LNG should file information/revisions with the Secretary, for review and written approval by the Director of OEP, pertaining to Oregon LNG's response numbers 3 through 8, 12, 18, 20 through 23, 27 through 36, 38 through 50, 54, 57 through 60, 63, 73, 74, 76 through 79, 81, 83 through 85, 96, 99, 100, 102, 105, 107, 108, and 109 of its**

March 18, 2014 filing, which indicated features to be included or considered in the final design.

The FEED and specifications submitted for the proposed facilities to date are preliminary, but would serve as the basis for any detailed design to follow. If authorization is granted by the Commission, the next phase of the project would include development of the final design, including final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues. We do not expect that the detailed design information to be developed would result in changes to the basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs which were presented to FERC as part of Oregon LNG's FEED.

A more detailed and thorough hazard and operability (HAZOP) analysis would also be performed by Oregon LNG during the final design phase to identify the major hazards that may be encountered during the operation of the facilities. The HAZOP study would address hazards of the process, engineering, and administrative controls, and would provide a qualitative evaluation of a range of possible safety, health and environmental effects which may result from the design or operation of the facility. Recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review.

Once the design has been subjected to a HAZOP review, the design development team would track changes to the facility design, operations, documentation, and personnel. Oregon LNG would evaluate these changes to ensure that the safety, health and environmental risks arising from these changes are addressed and controlled. Resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We have included a recommendation that Oregon LNG should file a HAZOP study on the completed final design.

Information regarding the development of the final design, as detailed below, would need to be filed with the Secretary for review and written approval by the Director of OEP before equipment construction at the site would be authorized. To ensure that the concerns we've identified relating to the reliability, operability, and safety of the proposed design are addressed by Oregon LNG, and to ensure that the facility is subject to the Commission's construction and operational inspection program, **we recommend that the following measures should apply to this project. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; prior to introduction of hazardous fluids; or prior to commencement of service, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). Information pertaining to items such as: off-site emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.**

- **Prior to initial site preparation, Oregon LNG should provide procedures for controlling access during construction.**
- **Prior to initial site preparation, Oregon LNG should file an overall project schedule, which includes the proposed stages of the commissioning plan.**

- **Prior to initial site preparation, Oregon LNG should file the quality assurance and quality control procedures for construction activities.**
- **Prior to initial site preparation, Oregon LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**
- **The final design should include change logs that list and explain any changes made from the Front-End Engineering Design provided in Oregon LNG's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**
- **The final design should provide up-to-date Process Flow Diagrams with heat and material balances and P&IDs, which include the following information:**
  - **a. equipment tag number, name, size, duty, capacity, and design conditions;**
  - **b. equipment insulation type and thickness;**
  - **c. storage tank pipe penetration size and nozzle schedule;**
  - **d. valve high pressure side and internal and external vent locations;**
  - **e. piping with line number, piping class specification, size, and insulation type and thickness;**
  - **f. piping specification breaks and insulation limits;**
  - **g. all control and manual valves numbered;**
  - **h. relief valves with set points and sizes; and**
  - **i. drawing revision number and date.**
- **The final design should provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications.**
- **The final design should provide complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**
- **The final design should provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.**
- **The final design should provide facility plans and drawings that show the location of the firewater and foam systems. Drawings should clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater and foam system.**
- **The final design should include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A**

2001, chapter 9.1.2 as required by 49 CFR Part 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.

- **The final design should provide detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.**
- **The final design shall specify that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are to be no less than schedule 160 for carbon steel and no less than schedule 80 for stainless steel, or are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**
- **The final design should include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A.**
- **The final design should provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; should alarm the hazardous condition; and should shutdown the appropriate systems.**
- **The final design should provide electrical area classification drawings.**
- **The final design should provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments, as well as the sizing and design of the down-comer that would transfer spills from the tank top to the ground level impoundment system.**
- **The final design of the hazard detectors should account for the calibration gas when determining the LFL and toxic setpoints.**
- **The final design should provide an analysis of the localized hazards to operators from a potential liquid nitrogen release and should also provide consideration of any mitigation that may be prudent. The analysis should include an account of the nitrogen vapor dispersion from the release, in addition to the nitrogen content already in the air.**
- **The final design should include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, should be filed.**
- **The final design should include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**
- **The final design should include a drawing showing the location of the ESD buttons. ESD buttons should be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency.**
- **The final design should include a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas**

Association's Purging Principles and Practice required by 49 CFR 193, and should provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing.

- **The final design should include the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels and storage tanks, as well as for vent stacks.**
- **The final design should provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193.**
- **The final design should provide the results of consultation with DOT regarding whether the edition of ASME VIII being used for the facility design is in accordance with 49 CFR Part 193.**
- **The final design should equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record should be reported in the semi-annual operational reports.**
- **The final design should include a thermal relief valve between the car-sealed-open valve in line LNG-100-32-01SS-8CC and failed-close valve XV-100.**
- **The final design should include consideration for reverse flow of the feed gas to the Amine Contactor in the event valve XV-1200 fails to close.**
- **The final design should include a thermal relief valve in line LNG-2111A, upstream of valve FV-2016.**
- **The final design should include a thermal relief valve downstream of the check valve in line MR-2628-16-06SS.**
- **The final design should include a thermal relief valve upstream of valve FV-2728 in line MR-2628-16-06SS.**
- **The final design of the refrigerant storage system should allow the isolation of individual pressure relief valves while providing full relief capacity, during pressure relief valve maintenance or testing.**
- **The final design should include a shutoff valve at the suction of each high pressure LNG sendout pump.**
- **The final design should require review of the check valve location with respect to the recycle line connection at the discharge of the high pressure LNG sendout pumps.**
- **The final design should specify that nitrogen purge connections to equipment and piping containing flammable fluids should be equipped with double isolation.**
- **The final design should direct the discharge from the LNG vaporizer rupture discs to a safe location for containment and vapor dispersion that is uncongested and away from personnel.**
- **The final design should include a pilot relief valve or operated vent valve sized for thermal relief at the discharge of each vaporizers, upstream of the isolation valves.**
- **The final design should include plant shutdown due to low, low instrument air pressure.**

- **The final design should include provisions to isolate the Dry Flare Knock-out Drum Heater.**
- **The final design should include provisions to isolate the Wet Flare Knock-out Drum Heater.**
- **The final design of the firewater system should use piping specifications that have a pressure limit not less than the maximum operating pressure of the system.**
- **Prior to commissioning, Oregon LNG should file plans and detailed procedures for: testing the integrity of on-site mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**
- **Prior to commissioning, Oregon LNG should provide a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Oregon LNG should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**
- **Prior to commissioning, Oregon LNG should provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually.**
- **Prior to commissioning, Oregon LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**
- **Prior to commissioning, Oregon LNG should file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list should include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings should show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers.**
- **Prior to commissioning, Oregon LNG should file the operation and maintenance procedures and manuals, as well as safety procedures.**
- **Prior to commissioning, Oregon LNG should maintain a detailed training log to demonstrate that operating staff has completed the required training.**
- **Prior to introduction of hazardous fluids, Oregon LNG should complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**
- **Prior to introduction of hazardous fluids, Oregon LNG should complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system.**
- **Prior to commencement of service, progress on the construction of the proposed systems should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project**

schedule. Problems of significant magnitude should be reported to FERC within 24 hours.

- **Prior to commencement of service, Oregon LNG should notify FERC staff of any proposed revisions to the security plan and physical security of the facility.**
- **Prior to commencement of service, Oregon LNG should develop procedures for off-site contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Oregon LNG staff.**
- **Prior to commencement of service, Oregon LNG should label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A.**

The following recommendations should apply throughout the life of the Oregon LNG facility:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Oregon LNG should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**
- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also should be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**
- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to FERC staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:**

  a. fire;

  b. explosion;

  c. estimated property damage of $50,000 or more;

  d. death or personal injury necessitating in-patient hospitalization;

  e. release of hazardous fluids for five minutes or more;

  f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

  h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

  i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

  j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

  k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

  l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

  m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

In addition to the final design review, we would conduct inspections during construction and would review additional materials, including quality assurance and quality control plans, non-conformance reports, and cool down and commissioning plans, to ensure that the installed design would be consistent with the safety and operability characteristics of the FEED. We would also conduct inspections during operation to ensure that the facility would be operated and maintained in accordance with the filed design throughout the life of the facility. Based on our analysis and recommendations presented above, the FEED presented by Oregon LNG would include acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

4.1.13.5 Siting Requirements

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; BLEVEs; and overpressures. As discussed in section 4.1.13.4, our FEED review indicates that sufficient layers of protection would be incorporated into the facility design to mitigate the potential for an initiating event to develop into an incident that could impact the safety of the off-site public. A siting analysis with regard to potential off-site consequences is also required by DOT's regulations in 49 CFR 193, Subpart B, to ensure that impacts on the public would be minimized. The Commission's regulations under 18 CFR 380.12(o)(14) require Oregon LNG to identify how the proposed design complies with the siting requirements of 49 CFR 193, Subpart B. As part of our review, we use Oregon LNG's information, provided to show compliance with DOT's regulations, to assess whether or not the facility would have a public safety impact.

The requirements in 49 CFR 193 state that an operator or government agency must exercise control over the activities that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of natural gas. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements of the 2001 edition of NFPA 59A, an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193, Subpart B by reference, with regulatory preemption in the event of conflict.

The following sections of Part 193 specifically address siting requirements for each LNG container and LNG transfer system:

- Part 193.2001, Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank.
- Part 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in

accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.

- Part 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with Section 2.2.3.2 of NFPA 59A (2001).
- Part 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).

The above LNG siting requirements would be applicable to the following equipment items that are proposed for this project:

- Two 160,000 m^3 LNG full containment storage tanks and appurtenances;
- All LNG piping, including the 32-inch ship transfer line and 24-inch liquefaction rundown line;
- Three 2,300-gpm high pressure LNG transfer pumps;
- Four 11,007-gpm LNG in-tank pumps; and
- Various process vessels, exchangers, vaporizers and other equipment.

Previous FERC environmental assessments and impact statements for past projects have identified inconsistencies and areas of potential conflict between the requirements in Part 193 and NFPA 59A (2001). Sections 193.2057 and 193.2059 require exclusion zones for each LNG container and LNG transfer system, and an LNG transfer system is defined in Section 193.2007 to include cargo transfer systems and transfer piping (whether permanent or temporary). However, NFPA 59A (2001) requires exclusion zones only for "transfer areas," which is defined as the part of the plant where the facility introduces or removes the liquids, such as truck loading or ship-unloading areas. The NFPA 59A (2001) definition does not include permanent plant piping, such as cargo transfer lines. Section 2.2.3.1 of NFPA 59A (2001) also states that transfer areas at the water edge of marine terminals are not subject to the siting requirements in that standard.

The DOT has addressed some of these issues in a March 2010 letter of interpretation (DOT, 2010). In that letter, DOT stated that: (1) the requirements in the NFPA 59A (2001) for transfer areas for LNG apply to the marine cargo transfer system at a proposed waterfront LNG facility, except where preempted by the regulations in Part 193; (2) the regulations in Part 193 for LNG transfer systems conflict with NFPA 59A (2001) on whether an exclusion zone analysis is required for transfer piping or permanent plant piping; and (3) the regulations in Part 193 prevailed as a result of that conflict. The DOT has determined that an exclusion zone analysis of the marine cargo transfer system is required.

In FERC environmental assessments and impact statements for past projects, we have also noted that when the DOT incorporated NFPA 59A into its regulations, it removed the regulation that required impounding systems around transfer piping. As a result of that change, it is unclear whether Part 193 or the adopted sections of NFPA 59A (2001) require impoundments for LNG transfer systems. We note that Part 193 requires exclusion zones for LNG transfer systems, and that those zones were historically calculated based on impoundment systems. We also note that the omission of containment for transfer piping is not a sound engineering practice. For these reasons, we generally recommend containment for all LNG transfer piping within the plant's property lines.

Federal regulations issued by the Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.119 (*Process Safety Management of Highly Hazardous Chemicals; Explosives and Blasting Agents* (PSM)), and the EPA under 40 CFR 68 (*Risk Management Plans*) cover hazardous substances, such as methane, propane and ethylene at many facilities in the U.S. However, on October 30, 1992, shortly after the promulgation of the OSHA Process Safety Management regulations, OSHA issued a letter of interpretation that precluded the enforcement of PSM regulations over gas transmission and distribution facilities. In a subsequent letter on December 9, 1998, OSHA further clarified that this letter of interpretation applies to LNG distribution and transmission facilities.

In addition, EPA's preamble to its final rule in the Federal Register, Volume 63, Number 3, 639-645, clarified that exemption from the requirements in 40 CFR 68 for regulated substances in transportation, including storage incident to transportation, is not limited to pipelines. The preamble further clarified that the transportation exemption applies to LNG facilities subject to oversight or regulation under 49 CFR 193, including facilities used to liquefy natural gas or used to transfer, store, or vaporize LNG in conjunction with pipeline transportation. Therefore, the above OSHA and EPA regulations are not applicable to facilities regulated under 49 CFR 193. As stated in Part 193.2051, LNG facilities must be provided with the siting requirements of NFPA 59A (2001 edition). The siting requirements for flammable liquids within an LNG facility are contained in NFPA 59A, Chapter 2:

- NFPA 59A Section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.
- NFPA 59A Section 2.2.2.2 requires impoundments serving flammable refrigerants or flammable liquids to contain a 10-minute spill of a single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. In addition, NFPA Section 2.2.2.5 requires impoundments and drainage channels for flammable liquid containment to conform to NFPA 30, Flammable and Combustible Liquids Code.
- NFPA 59A Section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per cubic foot per hour (Btu/ft^2-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that are acceptable to DOT.
- NFPA 59A Section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion. Alternative models must have been validated by experimental test data appropriate for the hazard to be evaluated and must be acceptable to DOT. Section 2.2.3.5 requires the design spill for impounding areas serving vaporization and process areas to be based on the flow from any single accidental leakage source.

For this project, FERC staff identified that the siting requirements from 49 CFR 193 and NFPA 59A (2001) would be applicable to the following facilities:

- One 12,000-gallon ethane storage tank and associated piping and equipment;
- Two 9,600-gallon propane storage tanks and associated piping and equipment;
- One 40,000-gallon NGL storage tank and associated piping and equipment;
- Piping and equipment in the two liquefaction process trains; and
- Piping and equipment in the feed gas pre-treatment area.

4.1.13.6 Siting Analysis for Facilities at the Terminal

Impoundment Sizing

Suitable sizing of impoundment systems and selection of spills on which to base hazard analyses are critical for establishing an appropriate siting analysis. Although impoundment capacity and design spill scenarios for storage tank impoundments are well described by 49 CFR 193, a clear definition for other impoundments is not provided either directly by the regulations or by the adopted sections of NFPA 59A (2001). Under NFPA 59A (2001) Section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT.

We recommend impoundments to be sized based on the greater of the largest flow capacity from a single transfer pipe for 10 minutes or the capacity of the largest vessel served, while recognizing that different spill scenarios may be used for the single accidental leakage sources for the hazard calculations required by 49 CFR 193.

Part 193.2181 specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank. We also consider it prudent design practice to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property) in the event that the full containment storage tank primary and secondary containers have a common cause failure. The purpose of the barrier is to prevent liquid from flowing off the plant property and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site.

Oregon LNG proposes two full containment LNG storage tanks for which the outer tank wall would serve as the impoundment system. The proposed LNG storage tanks would have a high liquid volume of 45,676,843 gallons with a maximum potential inner tank capacity of 50,868,896 gallons. The outer tank would have a volumetric capacity of 58,154,259 gallons, which exceeds the 110 percent requirement. The outer tank would contain 127 percent of the design maximum volume and 114 percent of the maximum potential capacity of the inner tank, meeting the Part 193 requirements. Oregon LNG would install a berm around the storage tank area, which would serve to limit liquid from flowing off the plant property in the case of a common cause failure of the existing full containment storage tank primary and secondary containers. The berm surrounding the proposed LNG storage tanks would meet our recommendation that a barrier be provided to prevent liquid from flowing off plant property.

In addition, Oregon LNG proposes to construct four spill impoundment basins for process fluids. Each of these impoundment systems and its sizing spill are discussed below.

A Transfer Area Spill Containment Basin would serve the LNG marine transfer and LNG storage tank areas. This impoundment would be 80 feet long by 80 feet wide and 11.1 feet deep below the bottom of the trench that directs liquid into it. These dimensions result in a volumetric capacity of about 531,420 gallons. Oregon LNG designed the LNG Transfer Area Spill Containment Basin to contain a 10-minute spill from a full rupture of the 32-inch-diameter LNG ship transfer line, which would produce 530,280 gallons, including the potential increased flow due to loss of back pressure on the pumps. Therefore, this proposed impoundment system would be sized to contain the largest volume of LNG that could be discharged into the impoundment from the full rupture of a single transfer pipe for a 10-minute spill.

Additionally, a Liquefaction Area Spill Containment Basin would collect potential LNG and refrigerant spills from the liquefaction trains, and a Process Area Spill Containment Basin would collect LNG spills from the vaporization area. Both of these sumps would be 40 feet long by 40 feet wide by 10 feet deep below the bottom of their trenches, resulting in a volumetric capacity of 119,680 gallons. The 24-inch diameter liquefier LNG rundown line would be the largest process line that could drain into either of these impoundments, depending on the release location. The volume of a 10-minute spill from a full rupture of this line would be 106,850 gallons, which could be completely contained by either basin. Oregon LNG indicated that the release flow rate in this release scenario would not increase due to the loss of back pressure in the upstream piping, because the LNG flow rate would be limited by the liquefaction rate.

All of the LNG spill containment basins have been designed using insulated concrete. To reach the containment basins, potential spills would flow along insulated concrete troughs that are a minimum of 5 feet wide and 5 feet tall.

Any potential spill from the propane or NGL transfer piping or trucks would be directed by sloped terrain to the Propane Swale Containment Basin, which would be 80 feet long by 80 feet wide and 2.5 feet deep, having a volumetric capacity of 120,300 gallons. This basin would contain a 10-minute release from the 30-inch propane line from the subcooler, which is the line that would provide the greatest liquid flow rate that could drain to this basin. Oregon LNG performed calculations using PROii software to determine that this scenario would release 78,300 gallons of liquid propane into the impoundment system, and this volume exceeds the amount of liquid propane calculated by PHAST to be released in this scenario. Oregon LNG indicated that the release flow rate in this release scenario would not increase due to loss of back pressure in the upstream piping, because the flow would be driven by compressors upstream of the propane becoming a liquid, rather than by pumps.

The NGL and refrigerant storage tanks would be mounded underground, but the Propane Swale Containment Basin would easily accommodate the total liquid release of the contents of a refrigerant or NGL truck.

Table 4.1.13-2 summarizes the process fluid impoundments and their sizing spills.

Table 4.1.13-2

Process Impoundment Sizing Spills

Spill Source	Sizing Spill (gallons)	Impoundment System	Impoundment Size (gallons)
32- inch diameter LNG Loading Line	530,280	LNG Transfer Area Spill Containment Basin	531,420
24-inch-diameter Liquefier Rundown Line	106,850	Liquefaction Area Spill Containment Basin	119,680
24-inch-diameter Liquefier Rundown Line	106,850	Process Area Spill Containment Basin	119,680
30-inch line from the Propane Subcooler	78,300	Propane Swale Containment Basin	120,300

In addition, each of the vessels in the pretreatment area, which contain fluids such as amine, hot oil, and slop liquids, would be installed in a curbed area with impoundment to contain at least 110 percent of the vessel capacity.

Design Spills

Design spills are used in the determination of the hazard distances required to be calculated by Part 193. Prior to the incorporation of NFPA 59A in 2000, the design spill in Part 193 assumed the full rupture of "a single transfer pipe which has the greatest overall flow capacity" for not less than 10 minutes (old Part 193.2059(d)). With the adoption of NFPA 59A, the basis for the design spill for impounding areas serving only vaporization, process, or LNG transfer areas became the flow from any single accidental leakage source. Neither Part 193 nor NFPA 59A (2001) defines "single accidental leakage source."

In a letter to FERC staff, dated August 6, 2013, DOT requested that LNG facility applicants contact the Office of Pipeline Safety's Engineering and Research Division regarding the Part 193 siting requirements. Specifically, the letter stated that DOT required a technical review of the applicant's design spill criteria for single accidental leakage sources on a case-by-case basis to determine compliance with Part 193. In response, Oregon LNG provided DOT with its design spill criteria and identified leakage scenarios for the proposed equipment. After a review of component failure rates, piping connections, process conditions, and leak locations, Oregon LNG selected the following single accidental leakage sources as design spills for this project (see table 4.1.13-3).

Table 4.1.13-3

Design Spills

Fluid	Hole Dia. (inch)	Area of Plant	Pressure (psig)	Temp. (°F)	Release Height (ft)	Release Rate (lb/hr)
LNG	10.7	Marine – *shrouded line**	45	-260	3	4,457,330
LNG	3	Marine	45	-260	31	352,322
LNG	10.7	LNG storage – *shrouded line**	45	-260	15	4,457,330
LNG	6	LNG storage	50	-262	12.5	1,489,350
LNG	2	Vaporization	1069	-257	8	761,777
LNG	4	Liquefaction	549	-256	12.5	1,121,420
LNG	8	Liquefaction – *shrouded line**	50	-262	12.5	2,368,200
Ethane	1	Refrigerant storage	120	-50	16	70,293
Propane	3	Liquefaction	82.5	53.3	11	544,857
Mixed Refrig.	2	Liquefaction	847	-30	8	612,854
NGL	2	Liquefaction – *higher dispersible content*	704	-92	12.5	132,088
NGL	4	Liquefaction – *higher benzene content*	770	210	10	4,634

Table 4.1.13-3

Design Spills

Fluid	Hole Dia. (inch)	Area of Plant	Pressure (psig)	Temp. (°F)	Release Height (ft)	Release Rate (lb/hr)
NGL	3	Liquefaction – *higher benzene content*	770	210	10	5,166
Acid gas (H_2S)	2	Pretreatment	12.3	120	10	5,875

** Impingement shrouds would be installed around this line.*

Impingement shrouds would be installed around certain lines to mitigate the high momentum jetting and flashing releases by inducing liquid rainout. The impingement shrouds would be designed to direct the releases downward as liquid spills into the LNG spill containment system. However, the liquid rainout fraction has not been fully confirmed for FERC staff, and therefore we recommend that:

- **Prior to the end of the comment period on the draft EIS, Oregon should file with the Secretary a computational fluid dynamic analysis of the mechanical fragmentation of the liquid into droplets, heat transfer effects and vaporization, liquid and vapor fractions, trajectories, velocities, and turbulence within and exiting the shroud.**

In addition, the mechanical forces and thermal effects have not been fully confirmed for FERC staff, therefore we recommend that:

- **Prior to construction of the final design, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, the details of the impingement shrouds final design as well as procedures to maintain and inspect the impingement shrouds. This information should be filed a minimum of 30 days before approval to proceed is requested.**

In general, higher design spill flow rates would result in larger releases and longer dispersion distances, and higher pressures would result in higher rates of jetting and aerosol formation.

For projects that have an impoundment located a long distance from the leakage source, a depressurized release may also be considered in order to produce the highest rate of liquid flow to the impoundment for vapor dispersion analysis in that area of the plant. However, for this project, the impoundments would be located in the same area of the plant as the leakage source releases. Oregon LNG provided vapor dispersion modeling for liquid spills into the impoundments. This modeling confirmed that the liquid spills would produce less significant vapor dispersion than the flashing and jetting cases.

NFPA 59A Table 2.2.3.5, as adopted by 49 CFR 193, requires the design spill duration to be 10 minutes or less based on demonstrable surveillance and shutdown provisions that are acceptable to the DOT. Oregon LNG assumed a constant release rate for 10 minutes for all of the identified design spill scenarios.

DOT reviewed the data and methodology Oregon LNG used to determine the design spills, considering plant components including piping, containers, and equipment containing LNG, refrigerants, and flammable fluids. On October 2, 2014, DOT provided a letter to FERC staff stating that DOT had no objection to Oregon LNG's methodology for determining the single accidental leakage sources to be used

in establishing the Part 193 siting requirements for the proposed LNG facilities at the terminal site.[12] DOT further provided an email communication to FERC on April 1, 2015 to clarify the details of the design spills determined from those leakage sources.[13] All of the design spills that were clarified in this email are listed in table 4.1.13-3.

DOT's conclusions on the candidate design spills used in the siting calculations required by Part 193 were based on preliminary design information which may be revised as the engineering design progresses. If Oregon LNG's design or operation of the proposed facilities differs from the details provided in the documents on which DOT based its review, then the facilities may not comply with the siting requirements of Part 193. As a result, **we recommend that:**

- **Prior to construction of the final design, Oregon LNG should file with the Secretary for review and approval by the Director of OEP, certification that the final design of the facilities at the terminal is consistent with the information provided to DOT as described in the design spill determination letter dated October 2, 2014 (FERC eLibrary Accession Number 20141002-4005) as well as in the related email communication from DOT to FERC on April 1, 2015 (FERC eLibrary Accession Number 20150403-4010). In the event that any modifications to the design alters the candidate design spills on which the Title 49 CFR Part 193 siting analysis was based, Oregon LNG should consult with DOT on any actions necessary to comply with Part 193.**

Flammable Vapor Dispersion Analysis

As discussed in section 4.1.13.2, a large quantity of flammable material released without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limit or encountered an ignition source. In order to address this hazard, 49 CFR Part 193.2051 and 193.2059 require the evaluation of flammable vapor dispersion in accordance with applicable sections of NFPA 59A (2001). Taken together, Part 193 and NFPA 59A (2001) require that flammable vapors either from an LNG tank withdrawal impoundment or a single accidental leakage source do not extend beyond a facility property line that can be built upon.

Title 49 CFR Part 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. For other flammable fluids, similar parameters have been specified, and the calculation of the dispersion distances to the one-half LFL level has been recommended to account for uncertainty in the computer models currently approved by DOT.

The regulations in Part 193 specifically approve the use of two models for performing these dispersion calculations, DEGADIS and FEM3A, but also allow the use of alternative models approved by the DOT. Although Part 193 does not require the use of a particular source term model, modeling of the spill and resulting vapor production is necessary prior to the use of vapor dispersion models. In August 2010, the DOT issued Advisory Bulletin ADB-10-07 to provide guidance on obtaining approval of alternative vapor-gas dispersion models under Subpart B of 49 CFR 193. In October 2011, two

[12] October 2, 2014 Letter "Re: LNG Development Company, LLC (d/b/a Oregon LNG), FERC Docket CP09-06-001, Design Spill Determination" from Kenneth Lee to Rich McGuire. Filed in Docket Number CP09-6-001 under Accession Number 20141002-4005.

[13] April 1, 2015 email communication "Oregon LNG Design Spill Evaluation - FERC Docket CP09-06" from Meredith Secor at DOT to Andrew Kohout at FERC. Filed in Docket Number CP09-6-001 under Accession Number 20150403-4010.

dispersion models were approved by DOT for use in vapor dispersion exclusion zone calculations: PHAST-UDM Version 6.6 and Version 6.7 (submitted by Det Norske Veritas) and FLACS Version 9.1 Release 2 (submitted by GexCon). PHAST 6.7 and FLACS 9.1, with their built-in source term models, were used by Oregon LNG in its vapor dispersion analyses.

For all the project dispersion scenarios, Oregon LNG used the following conditions: average regional temperature of 51.5°F, relative humidity of 50 percent, wind speeds of 1 to 2 m/s, Pasquill-Gifford Atmospheric Stability Class F. The average regional temperature was determined considering local weather data from 2000 to 2014. A ground surface roughness of 0.03 meter was used for all scenarios, except for releases from the dock and trestle area, which were simulated using a ground roughness of 0.01 meter.

Oregon LNG accounted for the facility geometry in the vapor dispersion model, including the impoundments, trenches, tanks and equipment geometry details. The plant geometry accounts for any on-site wind channeling that could occur. The model also included vapor barriers that are proposed to be installed at specific locations along the western and southern plant property boundaries as well as inside the plant. The vapor fences would be either 12, 20, 30, or 40 feet tall, as shown in figure 4.1.13-1 below, and impermeable. All vapor fences would be designed to withstand a sustained wind speed of 150 mph.

The liquefaction trains would use numerous water coolers to extract and dissipate heat from the refrigerant cycle. The water coolers consist of axial fans distributed in two arrays located on top of the eastern and western berms. The cooling tower fans would pull air from near ground level, through cascading water and then discharging upwards into the environment. The water cooler fans were assumed not to be in operation during the accidental release scenarios simulated in this study. This is a conservative assumption, as the updraft induced by the fans would entrain part of the flammable cloud and project the vapors into the air, reducing the vapor dispersion hazard footprint.

The releases were initiated in the model simulations after sufficient time had passed to allow the wind profile to stabilize from effects due to the presence of on-site obstructions.

Vapor dispersion was first evaluated from the long straight trench for the LNG ship transfer line because of the potential for a long vapor cloud to form when the wind direction would be parallel to the trench. Oregon LNG considered a full guillotine of the loading line for assessing vapor generation from a liquid release into the jetty trough system. This spill produced a flow rate of about 9,300,000 lb/hr.

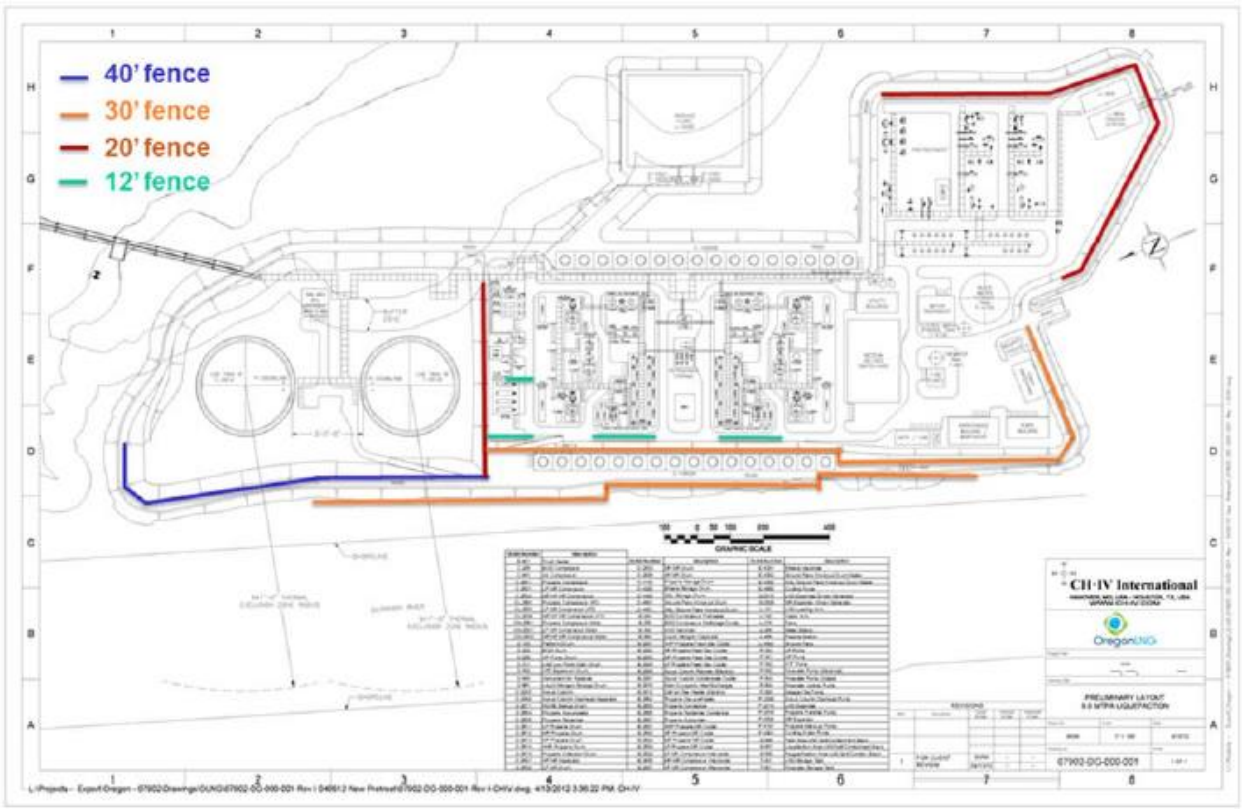


Figure 4.1.13-1: Vapor Fence Placement

As seen in figure 4.1.13-2 below, the ½ LFL vapor cloud for this liquid release scenario with 1 m/s parallel winds would not produce flammable vapor that would reach a property line that could be built upon. The same case modeled with 2 m/s winds produced even less flammable vapor dispersion distances.



Figure 4.1.13-2: Flammable Vapor Dispersion from the LNG Ship Transfer Trough with Parallel Wind
(Shown as Shaded Area)

For the north-south trough for LNG rundown line in the process area, Oregon LNG modeled an LNG liquid spill that approximated the 8-inch diameter design spill flow rate from the LNG rundown line listed in table 4.1.13-3 with parallel winds. This resulted in a very insignificant amount of vapor dispersion that remained well within the property line.

As discussed, DOT has no objections to Oregon LNG using the selection methodology that resulted in the design spills listed in table 4.1.13-3. Various wind speeds and orientations were used in modeling flammable vapor dispersion from all of the design spills.

Using PHAST, Oregon found that dispersion from the 3-inch LNG design spill at the dock resulted in a maximum dispersion distance to the ½ LFL that did not reach a property line, as shown in figure 4.1.13-3.

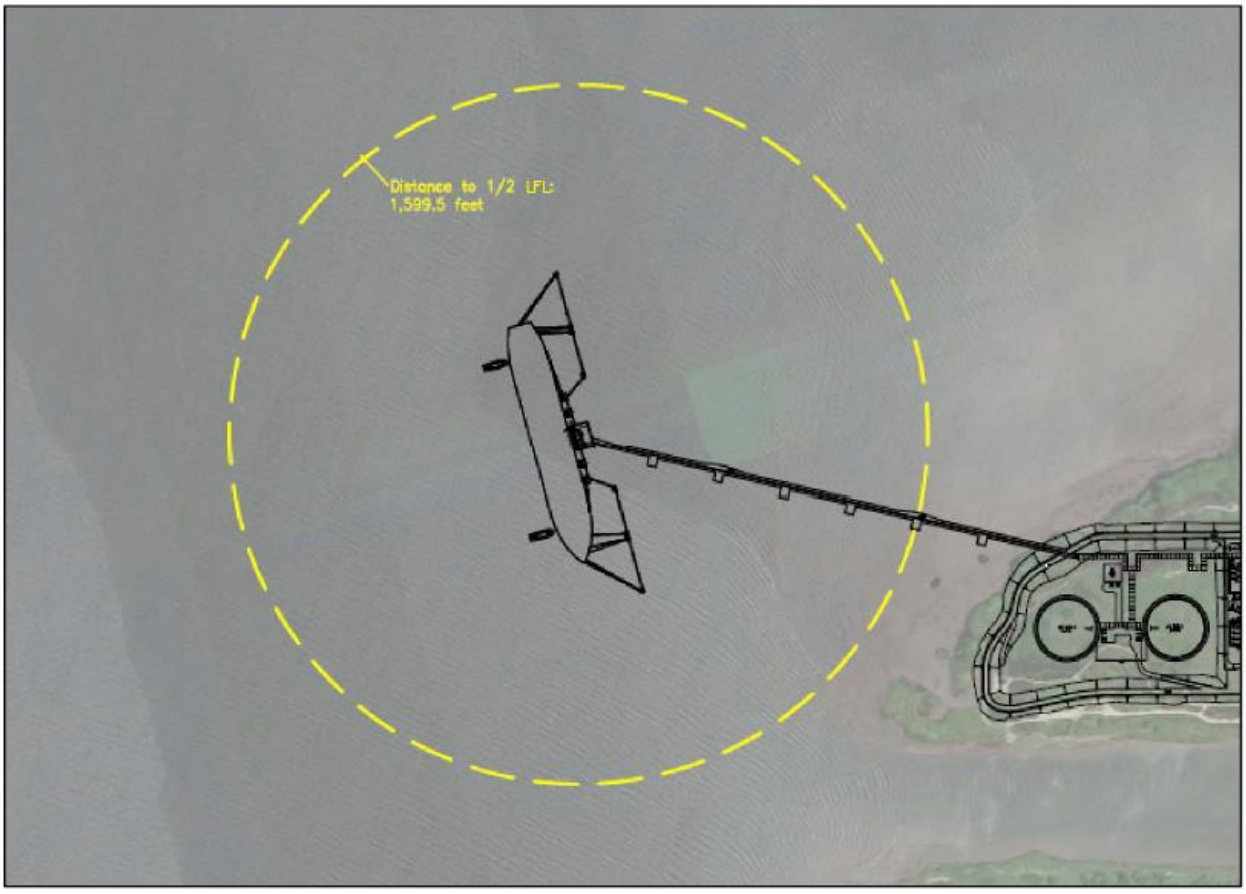


Figure 4.1.13-3: Flammable Vapor Dispersion Distance from the 3-inch LNG Design Spill with Winds from Any Direction

Oregon LNG used FLACS to determine that the design spill creating the most significant vapor dispersion from the LNG storage area would be the 6-inch diameter LNG release toward the west, as shown in figure 4.1.13-4.



Figure 4.1.13-4: Flammable Vapor Dispersion from the 6-inch Diameter LNG Design Spill with Release and Wind Directions toward the West
Shown as shaded area

Oregon LNG also found that the design spill case producing the most significant flammable vapor dispersion from the process area would be the 4-inch LNG design spill released with 1 m/s winds. Figure 4.1.13-5 and figure 4.1.13-6 illustrate the extent of this flammable vapor dispersion toward property lines to the west and to the south.

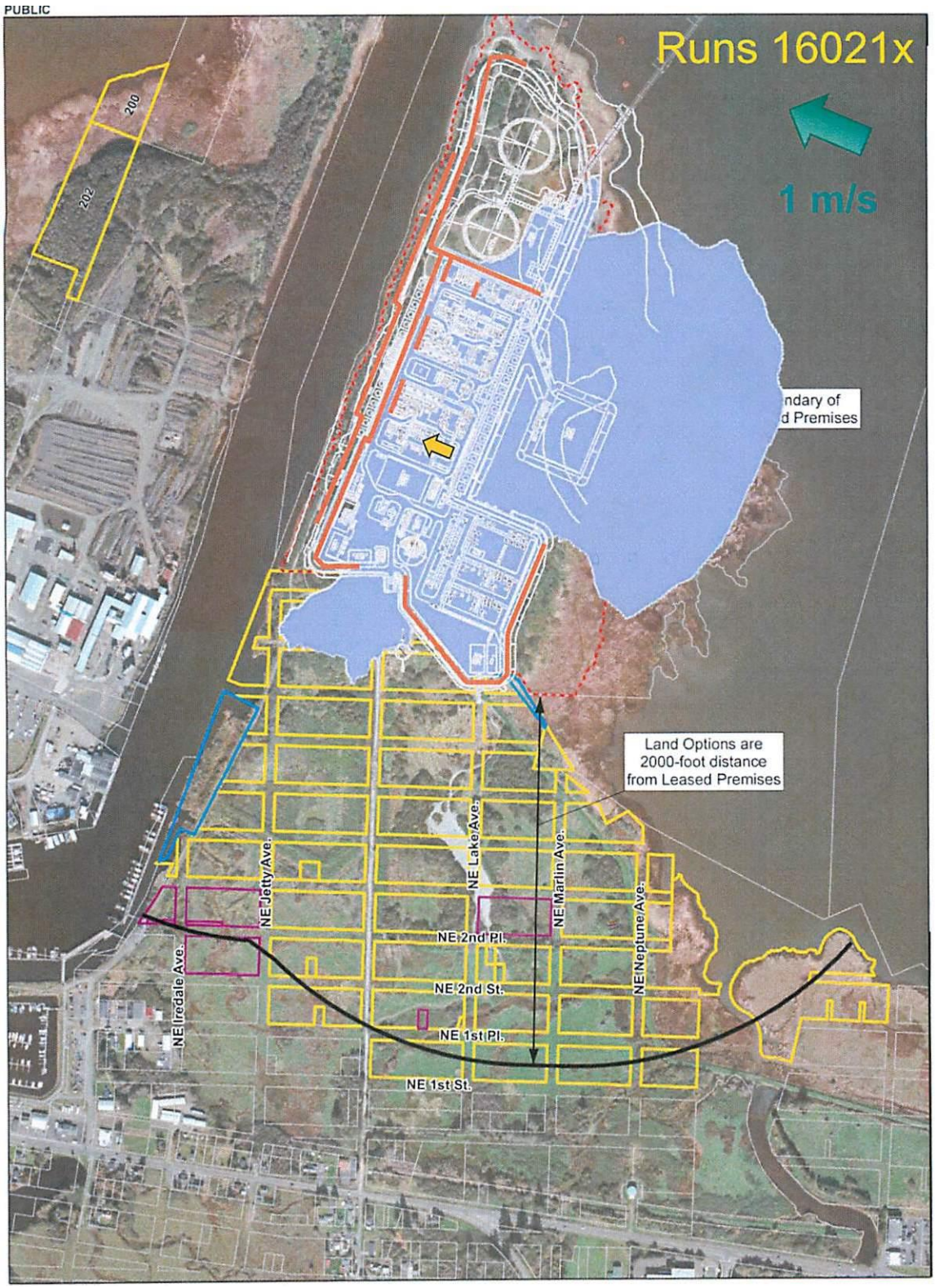


Figure 4.1.13-5: Flammable Vapor Dispersion from the 4-inch Diameter LNG Design Spill with Release and Wind Directions toward the West

Shown as shaded area

Oregon LNG would retain all the land parcels shown within the black arc in figure 4.1.13-4 and figure 4.1.13-5, except the purple outlined parcels.



Figure 4.1.13-6: Flammable Vapor Dispersion from the 4-inch-diameter LNG Design Spill with Release and Wind Directions toward the South

Shown as shaded area

The computer model simulations showed that, due to the proposed vapor fences within the plant and near the property lines, none of the design spills would result in the ½ LFL vapor dispersion extending over a property line that could be built upon. Oregon LNG indicated that the vapor fences

would be subject to routine inspections on at least a monthly basis, and all vapor fences would be inspected following a major weather event to ensure no damage had occurred.

As a result, we conclude that the siting of the proposed project would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program. All vapor fences would be required to meet the regulations in 49 CFR 193.

Vapor Cloud Overpressure Considerations

As discussed in section 4.1.13.2, the propensity of a vapor cloud to detonate or produce damaging overpressures is influenced by the reactivity of the material, the level of confinement and congestion surrounding the vapor cloud, and the flame travel distance. It is possible that the prevailing wind direction may cause the vapor cloud to travel into a partially confined or congested area.

LNG Vapor Clouds

As adopted by Part 193, Section 2.1.1 of NFPA 59A (2001) requires an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility be considered. As discussed under "Flammable Vapor Ignition" in section 4.1.13.2, ignition of unconfined LNG vapor clouds would not be expected to produce damaging overpressures.

The potential for unconfined LNG vapor cloud detonations was investigated by the Coast Guard in the late 1970s at the Naval Weapons Center in China Lake, California. Using methane, the primary component of natural gas, several experiments were conducted to determine whether unconfined LNG vapor clouds would detonate. Unconfined methane vapor clouds ignited with low-energy ignition sources (13.5 joules), produced flame speeds ranging from 12 to 20 mph. These flame speeds are much lower than the flame speeds associated with a deflagration with damaging overpressures or a detonation.

To examine the potential for detonation of an unconfined natural gas cloud containing heavier hydrocarbons that are more reactive, such as ethane and propane, the Coast Guard conducted further tests on ambient-temperature fuel mixtures of methane-ethane and methane-propane. The tests indicated that the addition of heavier hydrocarbons influenced the tendency of an unconfined natural gas vapor cloud to detonate. Less processed natural gas with greater amounts of heavier hydrocarbons would be more sensitive to detonation.

The Coast Guard indicated overpressures of 4 bar and flame speeds of 78 mph were produced from vapor clouds of 86 percent to 96 percent methane in near stoichiometric proportions using exploding charges as the ignition source. The 4 bar overpressure was the same overpressure produced during the calibration test involving exploding the charge ignition source alone, so it remains unclear that the overpressure was able to be attributed to the vapor deflagration.

Additional tests were conducted to study the influence of confinement and congestion on the propensity of a vapor cloud to detonate or produce damaging overpressures. The tests used obstacles to create a partially confined and turbulent scenario, but found that flame speeds developed for methane were not significantly higher than the unconfined case and were not in the range associated with detonations.

Although it has been possible to produce damaging overpressures and detonations of unconfined LNG vapor clouds, the substantial amount of initiating explosives needed to create the shock initiation

during the limited range of vapor-air concentrations also renders the possibility of detonation of these vapors at an LNG plant as unrealistic.

Ignition of a confined LNG vapor cloud could result in higher overpressures. In order to prevent such an occurrence, combustible gas detectors would be located in building ventilation air supply ducts. These detectors would provide capability to automatically isolate the supply air on high gas concentrations to minimize gas ingress. Combustible gas detectors would also be located in combustion air intakes for fired equipment. These detectors will provide capability to alarm (for standby emergency equipment) or automatically trip the fired equipment on high gas concentrations to minimize gas ingress. The combustible gas detectors would be capable of sensing methane, ethane and propane. In general, the primary hazards to the public from an LNG spill that disperses to an unconfined area, either on land or water, would be from dispersion of the flammable vapors or from radiant heat generated by a pool fire.

Vapor Clouds from Other Flammable Fluids

In comparison with LNG vapor clouds, there is a higher potential for unconfined propane, ethane, mixed refrigerant and NGL clouds to produce damaging overpressures. In order to address this hazard, Oregon LNG modeled overpressures based on the proposed tank, equipment and pipe rack layouts using FLACS software.

In the event of a vapor cloud deflagration, the largest overpressures would typically be produced by flame acceleration within the regions of the vapor cloud with the largest degrees of congestion and/or confinement. The proposed facilities would include two liquefaction units containing areas of congestion. The most important unit to be evaluated for overpressure hazards is the northern liquefaction train, which would be a similar distance from the western shoreline of the Skipanon River as the southern train but would be closer to the LNG storage tanks.

Initially, Oregon LNG modeled the distances to the 1 psi overpressure threshold using the ½ psi level to account for uncertainty in the model, as a result of previous validation studies and peak-pressure averaging (Hansen et al., 2010). In revised modeling, the company applied a Hansen and Johnson method to correct the uncertainty associated with blast wave smearing (Hansen and Johnson, 2014), and then conducted modeling using the 1 psi level, rather than using the ½ psi level. However, adequate validation was not provided to FERC staff prior to the draft EIS for the final model used. Both sets of modeling, along with recommendations, are discussed below.

Initial Overpressure Modeling in a Liquefaction Train

Each liquefaction unit includes two significant refrigerant process streams: propane and mixed refrigerant. A stoichiometric cloud of each was separately inserted into the congested east-west pipe rack area of the northern liquefaction train in the FLACS model and ignited at a location that would allow the most flame acceleration toward the western shore of the Skipanon. The propane and mixed refrigerant produced very similar overpressures. As shown in figure 4.1.13-7, these results demonstrated that an overpressure of 1 psi, which was actually modeled to the ½ psi to account for any uncertainty in the model, would extend partially over the Skipanon River, including part of the navigation channel, but would not reach the opposite bank.

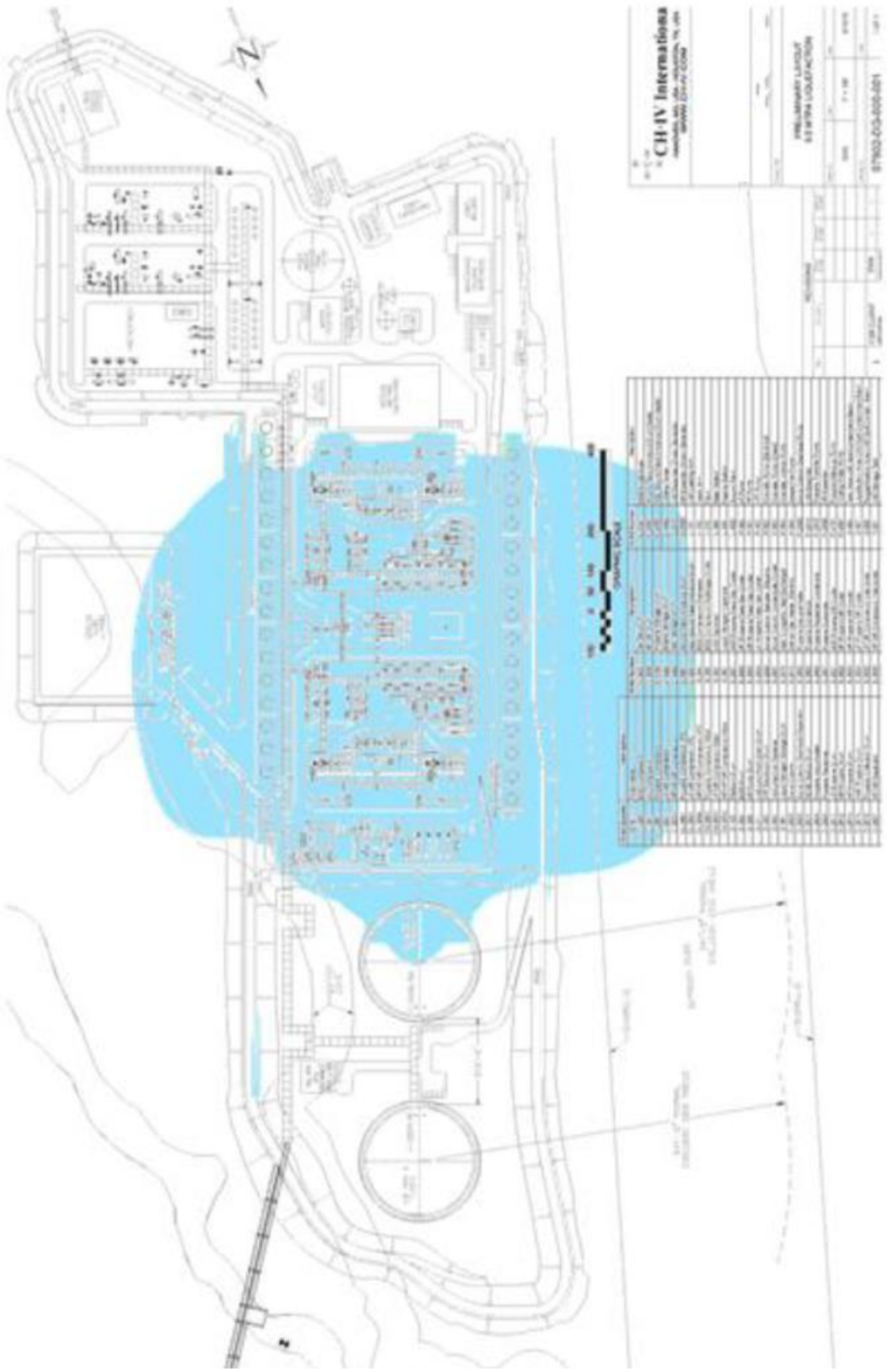


Figure 4.1.13-7: Overpressures Produced by Ignition of a Stoichiometric Box of Propane Vapor Around a Congested Area of a Liquefaction Train

(modeled to the ½ psig to account for uncertainty in the mode)

Ignition of refrigerant vapors in a compressor building was also simulated, but the 1 psi zone from this scenario, modeled to the ½ psi level, did not extend significantly beyond the process area within the terminal.

Revised Overpressure Modeling in a Liquefaction Train

In revised modeling, Oregon LNG used a smaller stoichiometric cloud within the liquefaction train that more realistically approximated the amount of flammable vapor that could be present due to a design spill, as modeled in the "Flammable Vapor Dispersion Analysis," section 4.1.13.6. Oregon LNG also modeled to the 1 psig overpressure level, rather than using the ½ psig level to account for uncertainty, because of its application of a Hansen and Johnson correction method. As shown in figure 4.1.13-8, this revised modeling approach produces a 1 psi zone that would not extend off site.

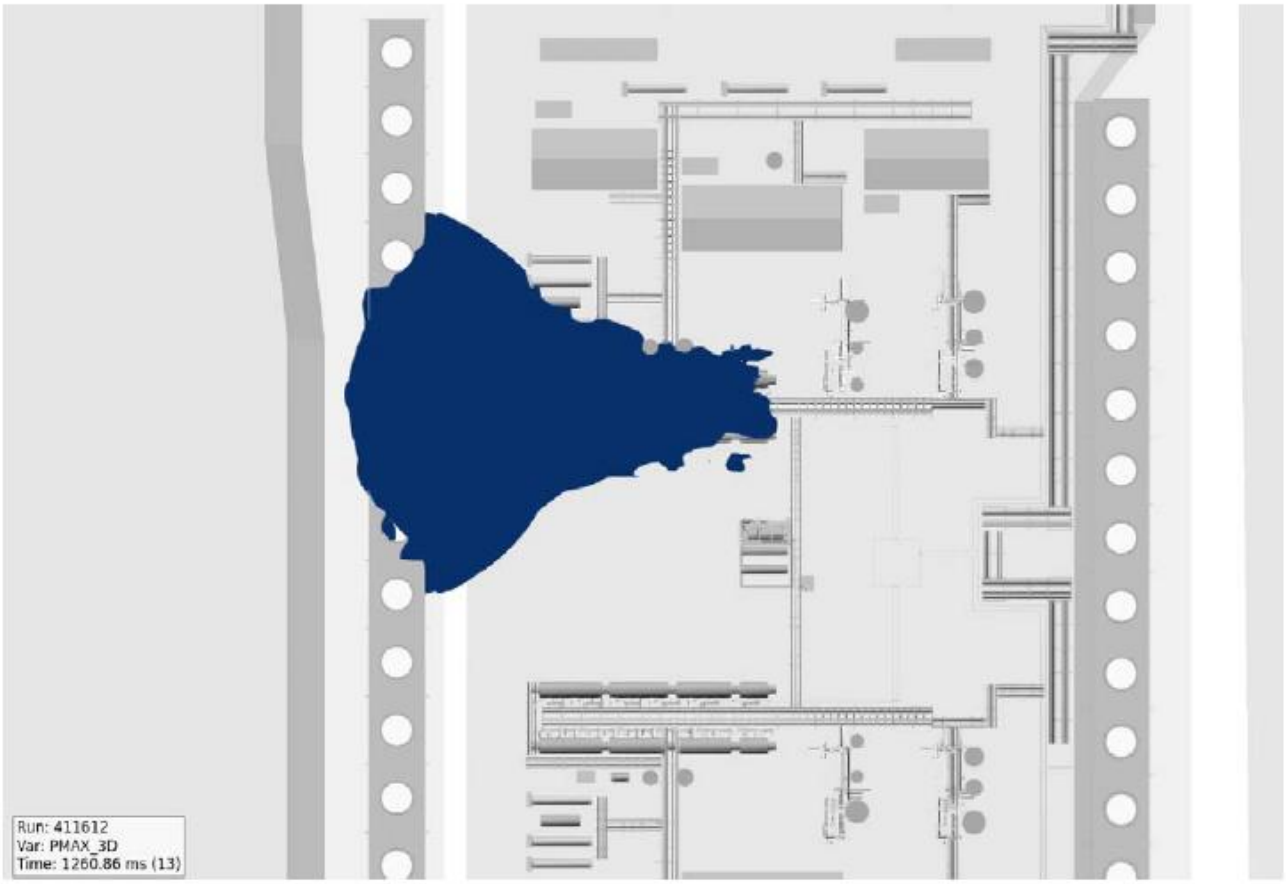


Figure 4.1.13-8: Revised Overpressure Modeling
(using the 1 psig level and an "equivalent" stoichiometric cloud inside a liquefaction train)

Similar modeling, using the revised method, was also performed to demonstrate that ignition of flammable vapor from within the western water coolers would remain on site.

Although it is acceptable to analyze a stoichiometric cloud equivalent to the amount of flammable vapor that could be in the area due to a design spill, adequate validation has not been provided for the final model used after the application of the Hansen and Johnson correction. Therefore, FERC staff does not consider these results to be confirmed. We recommend that:

- **Prior to the end of the comment period on the draft EIS, Oregon should file with the Secretary adequate validation for the revised model that was used to analyze overpressures. Alternatively, Oregon LNG should provide acceptable mitigation to prevent public impacts due to 1 psig overpressures that are modeled to the ½ psig to account for uncertainty in the model.**

In addition, Oregon LNG has indicated that the concrete outer walls of the LNG storage tanks would be designed to withstand these possible overpressures. Accordingly, we recommend that:

- **The final design should provide details of LNG storage tank structural design that demonstrates the tanks can withstand overpressures from ignition of design spills. These details should be filed with the Secretary for review and approval by the Director of OEP.**

We conclude that the siting of the proposed project, as conditioned, would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program. The overpressure analyses were based on the preliminary information contained in the FEED submitted by Oregon LNG. Piping and equipment arrangements may differ in final design, potentially resulting in increased congestion or confinement in the liquefaction area and an increase in the overpressure distance. Therefore, **we recommend that:**

- **Prior to construction of the final design, Oregon LNG should file with the Secretary, for review and written approval by the Director of OEP, plant geometry models or drawings that verify the confinement and congestion represented in the front-end-engineering design or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public. This information should be filed a minimum of 30 days before approval to proceed is requested.**

Dispersion of Toxic Components

As discussed in section 4.1.13.2, a release of NGL or gas containing accumulated H_2S may form a toxic cloud. In order to address these hazards, 49 CFR 193.2051 requires a vapor dispersion evaluation of potential incidents in accordance with applicable sections of NFPA 59A (2001). NFPA 59A, Section 2.1.1 requires consideration of clearances between flammable refrigerant storage tanks, flammable liquid storage tanks, structures and plant equipment, both with respect to plant property lines and each other. This section also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility. Taken together, Part 193 and NFPA 59A (2001) require that potential incidents (e.g., toxic releases) must be considered.

For the flammable vapor dispersion analysis, Title 49 CFR 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the LFL of LNG vapor) under meteorological conditions that result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. Similar uncertainty factors (i.e., one half the LFL of other flammable materials and one half the AEGL of toxic materials) and

similar parameters (i.e., F stability, 2 meters per second wind speed, 50 percent relative humidity, average regional temperature, and 0.03 meter surface roughness) have also been specified for other hazardous fluids.

The NGLs would contain potentially toxic products: benzene, toluene and xylene (BTX), as well as smaller amounts of hexane and mercaptans. Hydrogen sulfide would also be present in the acid gas stream. Oregon LNG calculated the dispersion distances for these substances to toxic threshold exposure limits based on the AEGLs. AEGLs are recommended for use by federal, state, and local agencies, as well as the private sector for emergency planning, prevention, and response activities related to the accidental release of hazardous substances. Other federal agencies, such as the Department of Energy, use AEGLs as the primary measure of toxicity.

PHAST Version 6.7 was used to perform the toxic dispersion modeling. PHAST is an industry standard model for performing various hazard modeling and is validated against numerous experiments. Similar to the flammable vapor dispersion modeling, the ½ AEGL dispersion results were used to approximate the AEGL levels in order to account for uncertainty in the model. The averaging times used in the modeling were based on an exposure duration of 10 minutes. However, this exposure duration was not fully confirmed for FERC staff, therefore we recommend that:

- **Prior to the end of the comment period on the draft EIS, Oregon should file with the Secretary technical substantiation for the use of 10 minute exposure times for the toxic releases. If any exposure times would exceed 10 minutes, the AEGL durations should be at least the exposure duration.**

The dispersion of gas containing accumulated H_2S was evaluated using the design spill identified in table 4.1.13-3. The maximum distances to each AEGL level are listed in table 4.1.13-4below and plotted in figure 4.1.13-9. No credit was taken for vapor fencing that would be installed at the site.

Table 4.1.13-4

H_2S Vapor Dispersion Distances

½ AEGL-1 10 minutes Distance (feet)	½ AEGL-2 10 minutes Distance (feet)	½ AEGL-3 10 minutes Distance (feet)
1,823	155	86

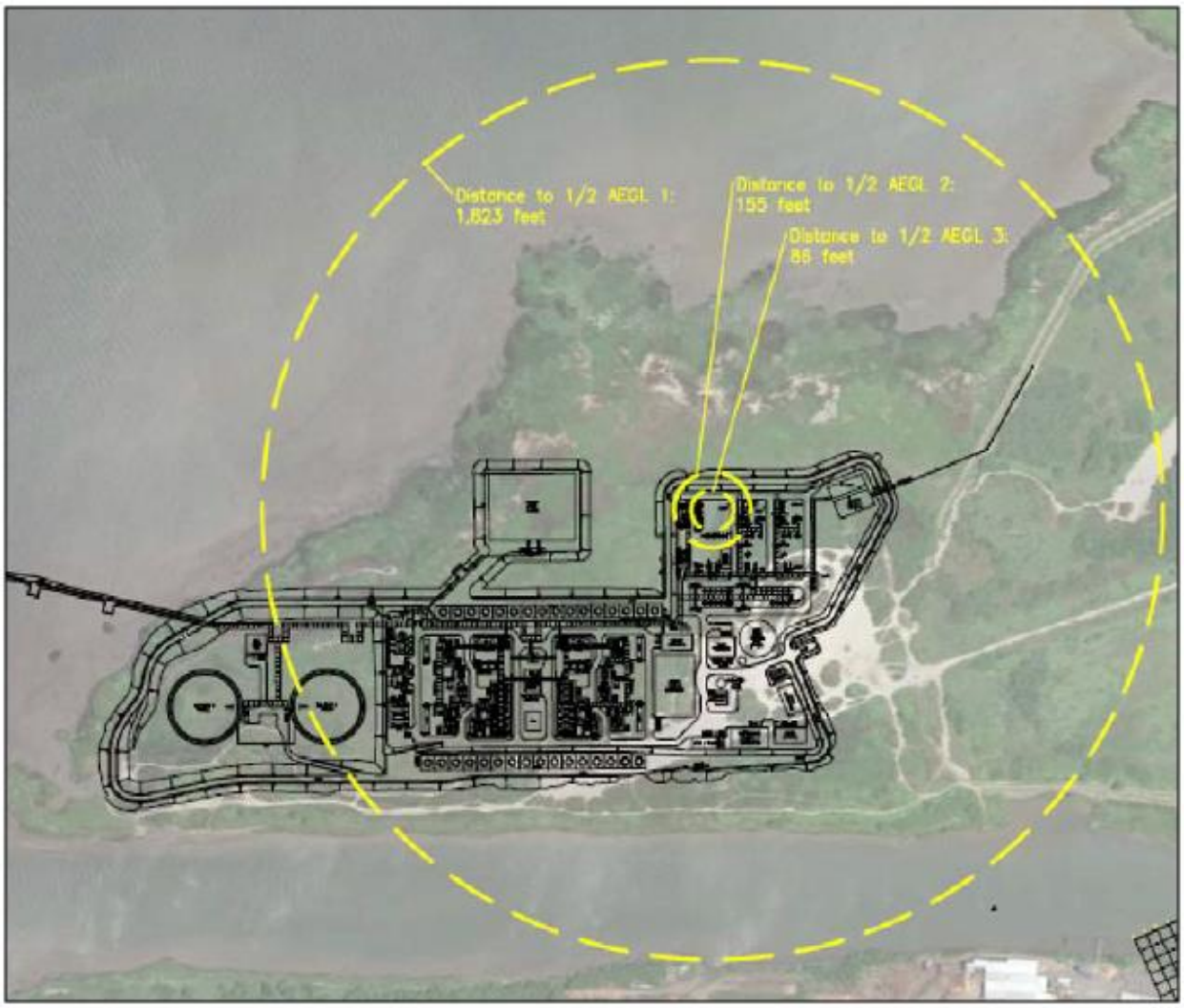


Figure 4.1.13-9: H_2S Dispersion from the Acid Gas Design Spill

The three NGL releases identified as design spills in table 4.1.13-3 were determined to be the worst case scenarios for this analysis as they contain significant concentrations and mass flow rates of BTX. Because the specific amounts of benzene, toluene and xylene in the BTX mixture had not been specified at this stage by Northwest Pipeline Company, Oregon LNG modeled dispersion of the entire BTX volume as each component individually. The results indicated that benzene produces the greatest ½ AEGL-1 and ½ AEGL-2 distances, and a greater or similar ½ AEGL-3 distance, in comparison to toluene and xylene. Therefore, modeling the entire BTX volume as benzene would be conservative. In addition, no credit was taken in this analysis for the vapor fencing that would be installed at the site. The maximum distances calculated by PHAST to each AEGL level are listed in table 4.1.13-5 below and plotted in figure 4.1.13-10.

Table 4.1.13-5

Benzene Vapor Dispersion Distances

½ AEGL-1 10 Minutes Distance (feet)	½ AEGL-2 10 Minutes Distance (feet)	½ AEGL-3 10 Minutes Distance (feet)
2,118	376	180

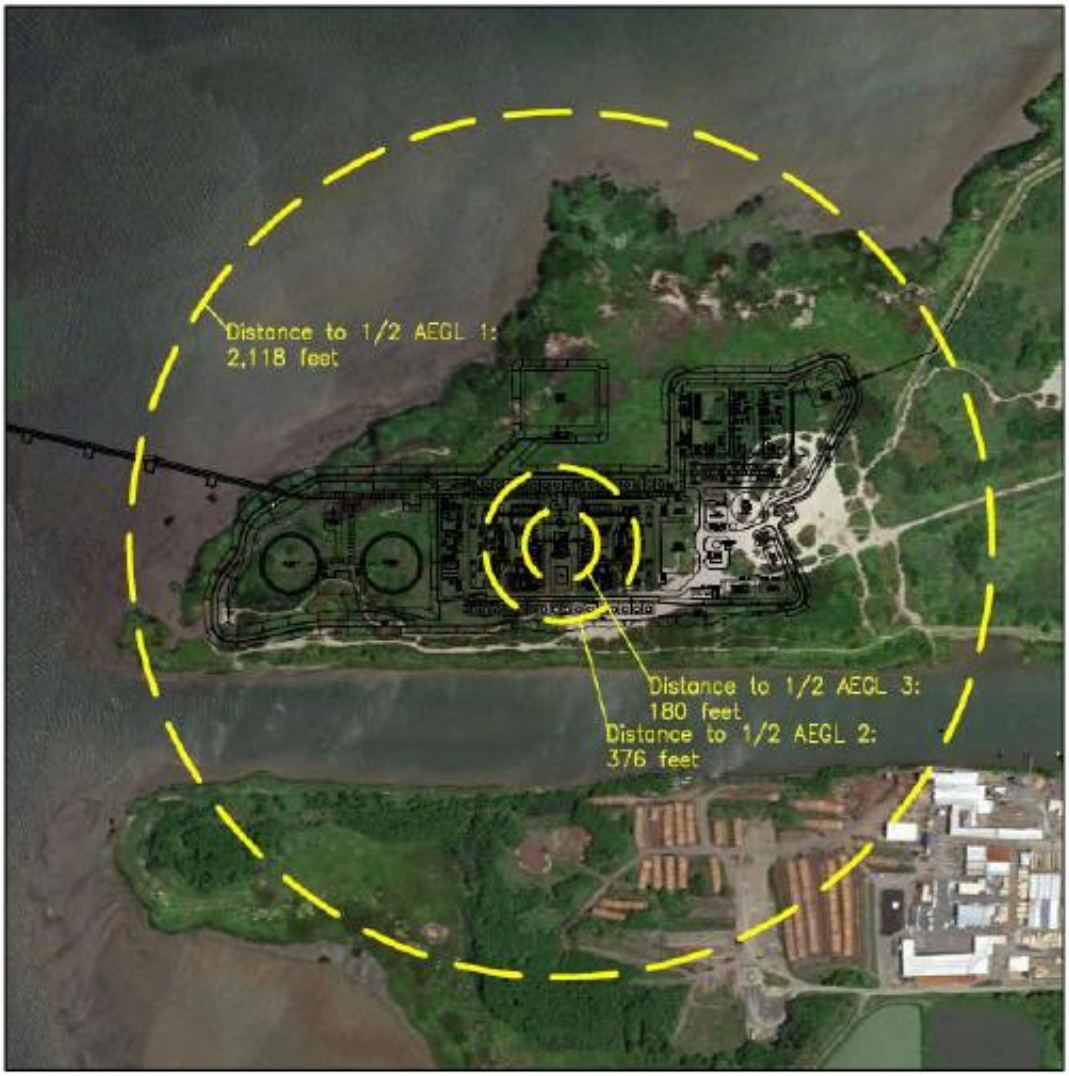


Figure 4.1.13-10: Dispersion of Benzene Resulting from the NGL Design Spills

Oregon LNG indicated that all of the toxic dispersion distances remained outside of areas containing residences, parks, hospitals, churches or other sensitive areas. As the effects associated with an AEGL-1 concentration are not disabling and are transient and reversible upon cessation of exposure, this release scenario would not be considered a significant impact on public receptors. However, because hexane and mercaptans were not included or addressed in the NGL analysis, we recommend that:

- **Prior to the end of the comment period on the draft EIS, Oregon should file with the Secretary a toxic dispersion analysis for the NGL design spills that accounts for hexane and mercaptans, in addition to the benzene, toluene and xylene content.**

Thermal Radiation Analysis

As discussed in section 4.1.13.2, if flammable vapors are ignited, the deflagration could propagate back to the spill source and result in a pool fire causing high levels of thermal radiation (i.e., heat from a fire). In order to address this, 49 CFR Sections 193.2051 and 193.2057 require evaluation of

thermal radiation hazards of potential incidents and exclusion zones in accordance with applicable sections of NFPA 59A (2001). Together, Part 193 and NFPA 59A (2001) specify different hazard endpoints for spills into LNG storage tank containment and spills into impoundments for process or transfer areas. For LNG storage tank spills, there are three radiant heat flux levels which must be considered:

- 1,600 Btu/ft^2-hr - This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of facility siting, are used for outdoor assembly by groups of 50 or more persons;
- 3,000 Btu/ft^2-hr - This level can extend beyond the facility's property line that can be built upon but cannot include areas that, at the time of facility siting, contain assembly, educational, health care, detention or residential buildings or structures; and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the facility's property line that can be built upon.

The requirements for spills from process or transfer areas are more stringent. For these impoundments, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the facility's property line onto a property that can be built upon. The 1,600 Btu/ft^2-hr flux level is associated with producing second degree burns in approximately 30-40 seconds, assuming no shielding from the pool fire. For distances farther away from the pool fire, the flux levels would be lower. Other potential incidents that could have a bearing on the safety of plant personnel or surrounding public are also required to be evaluated under NFPA 59A, Section 2.1.1.

Part 193 requires the use of the LNGFIRE3 computer program model developed by the Gas Research Institute or other approval model to determine the thermal radiation distances, and also allows the use of alternative models approved by the DOT. Part 193 also stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area. Oregon LNG selected the following ambient conditions to produce the maximum exclusion distances: wind speeds up to 16 mph, an ambient temperature of 37°F; and a relative humidity of 58.2 percent. These selections considered climate data from the Astoria Clatsop County Airport. The data set included hourly-collected data from a period beginning December 31, 2000 and ending December 31, 2005, as the review of this terminal site began many years ago. Oregon LNG has since reviewed the climate data for 2006 to 2014 and determined that only the relative humidity level would change. The new relative humidity of 65 percent would cause a slight decrease in thermal radiation distances that were calculated at 58.2 percent. Therefore, the modeling presented in this section is considered to be conservative. We agree with Oregon LNG's selection of atmospheric conditions.

In May 2012, the Department of Energy released a Report to Congress, *Liquefied Natural Gas Safety Research*, on the findings of new experimental data on large LNG pool fires conducted over water by Sandia National Laboratories. Using data gathered from these tests and earlier methane gas burner tests, Sandia developed recommendations on parameters, including mass burning rate, pool fire flame height, surface emissive power, and atmospheric transmissivity, appropriate for use in solid flame models for pool fires over water. We examined the effect of altering the LNGFIRE3 model to incorporate Sandia's recommendations regarding LNG pool fire modeling over water and on data provided by the largest LNG pool fire tests on land (Gaz de France Montoir tests) or water (Phoenix tests).[14] Our

[14] "Recommended Parameters for Solid Flame Models for Land Based Liquefied Natural Gas Spills," Issued January 23, 2013 in Docket AD13-4-000 (eLibrary Accession Number: 20130123-4002).

conclusions were that LNGFIRE3, as currently prescribed by 49 CFR 193, is appropriate for modeling thermal radiation from LNG pool fires on land and is suitable for use in siting onshore LNG facilities.

In accordance with the thermal radiation siting regulations in Part 193.2051 and 193.2057, Oregon LNG used LNGFIRE3 to predict the maximum distance to a thermal radiation level of 1,600 Btu/ft^2-hr for fires from the design spills in the sumps. Although LNGFIRE3 is specifically designed to calculate thermal radiation flux levels for LNG pool fires, LNGFIRE3 can also be used to provide over-predictive thermal radiation flux levels for other flammable hydrocarbons such as ethane, propane, mixed refrigerant and NGL.

LNGFIRE3 calculates thermal radiation flux using parameters that include the mass burning rate of the fuel and the surface emissive power (SEP) of the flame, which is an average value of the thermal radiation flux emitted by the fire. Both the mass burning rate and SEP of an ethane, propane, mixed refrigerant or NGL fire would be less than that of an equally sized LNG fire. Since the thermal radiation from a pool fire is dependent on the mass burning rate and the SEP, the distances required for propane, ethane, mixed refrigerant, hot oil and NGL fires would not extend as far as the distance calculated for an LNG fire in the same sump.

The maximum distance calculated from a fire over the full surface area of each process spill impoundment to the 1,600 Btu/ft^2-hr level is listed in table 4.1.13-6 below.

Table 4.1.13-6

Thermal Radiation from Design Spill Impoundments

Impoundment	Distance from Center to 1,600 Btu/ft^2-hr (feet)	Distance from Center to Nearest Property Line that Could be Built Upon (feet)
LNG Transfer Area Containment Basin	400	1240
Liquefaction Area Containment Basin	230	1050
Process Area Containment Basin	230	1110
Propane Swale Containment Basin	400	850

In addition, hot oil may be handled in the pre-treatment area at temperatures above its flash point. Oregon LNG used LNGFIREIII to estimate that the 1,600 Btu/ft^2-hr zone from the 15-foot square impoundment for the hot oil would extend 103 feet from the center of the impoundment, which would remain well within property controlled by Oregon LNG.

In accordance with the thermal radiation siting regulations in Part 193.2057, Oregon LNG also used LNGFIRE3 to predict the maximum distance to the three thermal radiation levels required for fires from the concrete outer tank walls that would serve as impoundment for the inner LNG storage tank. The concrete wall inner diameter of 264 feet was entered as the pool diameter. The flame base height was set to the height of the concrete wall, 151 feet above the surrounding terrain, while target heights were set at the ground level. The results of this analysis are listed in table 4.1.13-7 below.

Table 4.1.13-7

Thermal Radiation from the LNG Storage Tank Outer Concrete Wall Impoundment

Thermal flux level (Btu/ft^2-hr)	Distance from Center to 1,600 Btu/ft^2-hr (feet)	Distance from Center to Nearest Property Line that Could be Built Upon (feet)
10,000	360	980
3,000	730	N/A
1,600	940	N/A

As shown in figure 4.1.13-11 below, which was provided by Oregon LNG, none of the thermal radiation zones would extend onto off-site property that could be built upon or used for assembly. In addition, Oregon LNG provided the results of consultation with DOT regarding land easements. DOT staff indicated that, based on information provided by Oregon LNG to DOT, it appears that Oregon LNG would have sufficient control over its property to comply with the exclusion zone requirements in 49 CFR Sections 193.2057 and 193.2059.

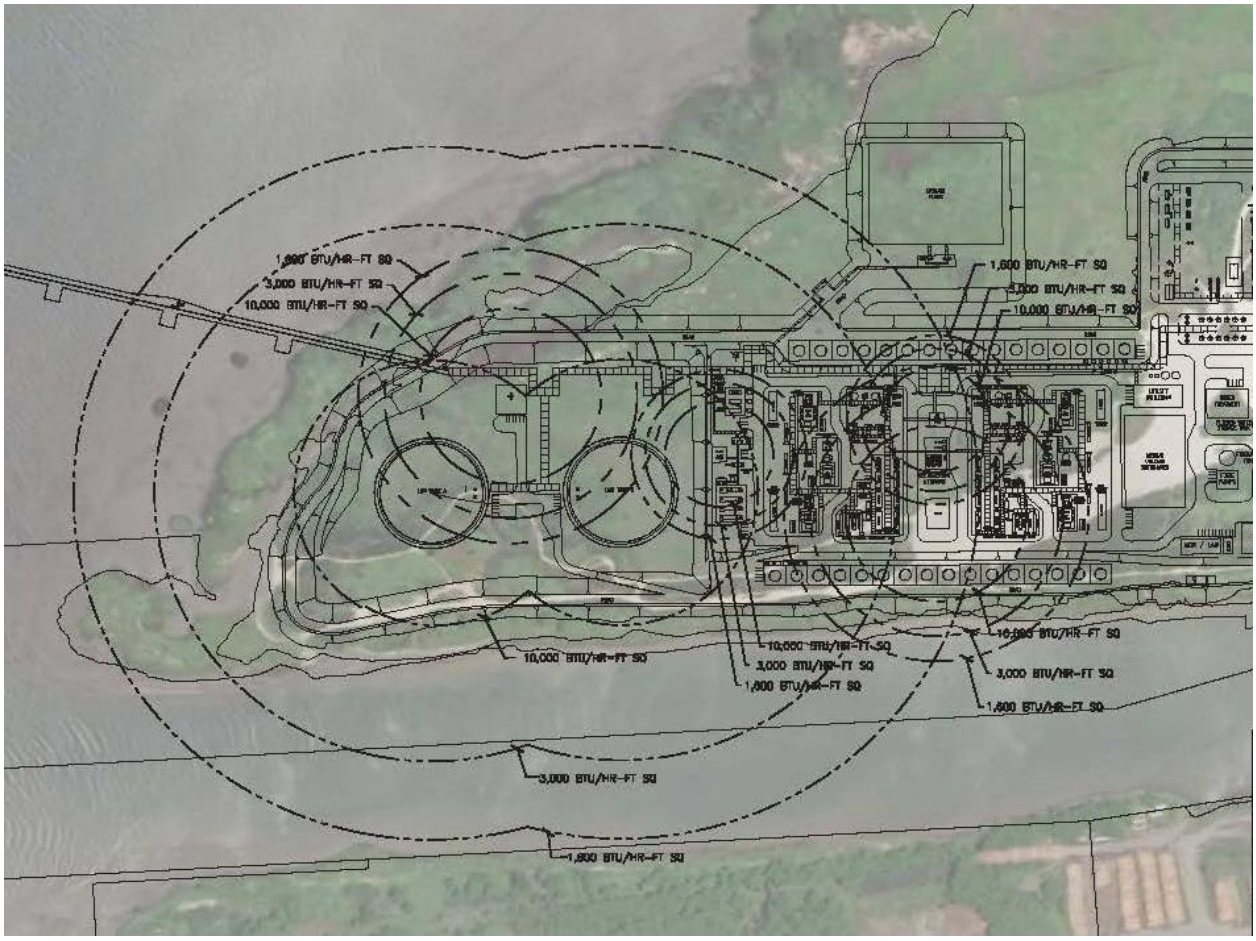


Figure 4.1.13-11: Thermal Radiation Isopleths from Process Fluid Impoundments

Thermal radiation isopleths from impoundments, including two round LNG storage outer concrete tanks and four square spill impoundments for process fluids. The outer to inner isopleths represent the extent of 1,600 Btu/ft^2-hr, 3,000 Btu/ft^2-hr, and 10,000 Btu/ft^2-hr for each impoundment.

Thermal radiation from a potential fire in the trench system leading to the spill impoundments would be less significant than the thermal radiation from the impoundment fires. Thermal radiation was also analyzed for jet fires from the design spills listed in table 4.1.13-3. Without taking into account any shielding provided by the 12 to 40 foot tall vapor barriers, the 1,600 Btu/ft^2-hr thermal flux level would not reach a property line that could be built upon due to a jet fire from any of the design spill releases.

The refrigerant and NGL storage tanks would be mounded under at least 1 foot of soil, as recommended in NFPA 58, to prevent thermal radiation from impacting the tanks. However, many

process vessels and other components would be located above ground in high thermal radiation areas from a potential fire in a spill impoundment. In addition, the truck transfer station, which would receive about 2,000 to 3,000 NGL trucks and approximately 12 refrigerant delivery trucks per year, would also be located within high thermal radiation zones.

To prevent significant thermal impacts on these components and trucks, as well as the LNG storage tanks, Oregon LNG proposes to include protective measures, such as fireproofing insulation, foam systems, and cooling water sprays. In order to ensure that thermal protection measures would be applied in a way that adequately protects all significant components from the impacts of a potential impoundment fire, we recommend that:

- **The final design should provide a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 3,000 Btu/ft^2-hr zone from an impoundment. This analysis should be filed with the Secretary for review and approval by the Director of OEP. Refrigerant and NGL trucks at the truck station should be included in the analysis. The flow rates and durations of any cooling water used in high thermal radiation areas should be justified with calculations.**

We conclude that the siting of the proposed project, as conditioned, would not have a significant impact on public safety. If the facility is constructed and operated, compliance with the requirements of 49 CFR 193 would be addressed as part of DOT's inspection and enforcement program.

4.1.13.7 LNG Marine Carriers

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG marine carrier. There are more than 370 LNG marine carriers in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been more than 2,600 individual LNG marine carrier arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

Design and Operating Requirements

The LNG marine carriers used to import and export LNG to and from the United States are constructed and operated in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, the *International Convention for the Safety of Life at Sea*, and 46 CFR 154, which contains the United States safety standards for vessels carrying liquefied natural gas in bulk.

As required by the IMO's conventions and design standards, hold spaces and insulation areas on an LNG marine carrier must be equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems must also be provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

In 1993, amendments to the IMO's *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* required all vessels to have monitoring equipment with an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a cargo tank. In addition, cargo tanks must be heavily instrumented, with gas detection equipment in the hold and inter-

barrier spaces, temperature sensors, and pressure gauges. LNG marine carriers are to be equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of LNG marine carriers are fitted with dry chemical powder-type extinguishing systems and carbon dioxide smothering systems for fighting fires. Fire protection must include the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the vessel;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a carbon dioxide system for protecting machinery including the ballast pump room, emergency generators, and compressors.

All LNG vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection (for U.S. flag vessels) or a Coast Guard Certificate of Compliance (for foreign flag vessels). These documents certify that the vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG marine carriers under 46 CFR 154.

The LNG marine carriers which would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2003. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG vessels, as well as other cargo vessels 500 gross tons and larger, and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- ships must develop security plans and have a Vessel Security Officer;
- ships must have a ship security alert system. These alarms transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;
- ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- ships may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the Maritime Transportation Security Act (MTSA) was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code* and the *International Convention for the Safety of Life at Sea*. The resulting Coast Guard regulations, contained in 33 CFR 104, require vessels to conduct vulnerability assessments and develop corresponding security plans. All LNG marine carriers servicing the facility comply with the MTSA requirements and associated regulations while in U.S. waters.

Columbia River

At the mouth of the Columbia River, where the current dissipates into the Pacific Ocean, depositing sediments form the "Columbia River Bar." Characterized by the frequent presence of large, standing waves, the Columbia River Bar is exposed to the full force of storm-generated swells and wind waves from winter weather off the Pacific Ocean. These swells present several dangers to ship traffic. If they are too large they can overpower the steering ability of the ship, making it impossible to control. In some circumstances the heavy seas that roll on deck create a hazard to structures and equipment. A deeply loaded ship can pitch and roll heavily; therefore, striking the bottom in a trough becomes a concern. During storm conditions, the Columbia River Bar Pilots will not transit a vessel across the bar if conditions are unsafe.

Natural hazards characterizing the local marine environment include shallows and shoaling in way of the approaches and vicinity of Lower and Upper Desdemona Shoals, Harrington Point Range, Miller Sands Range, Pillar Rock (Lower and Upper), Welch Island Reach, Skamokawa Channel, Steamboat Reach, and Puget Island Range and Turn. Characteristics that contribute to natural hazards are largely a function of channel width and natural constraints (i.e., sand, rock, and depth) defining the lateral edges of the channel.

The ports along the Columbia River are primarily protected from the high seas by topographical features and characteristics of the mouth of the river. Key features include Clatsop Spit on the south side of the mouth and Cape Disappointment on the north. Additional protection is offered on the south by the South Jetty, which runs westerly from Clatsop Spit for about 2 miles. Protection on the north side is provided by the North Jetty, which runs westerly from the southwestern tip of Cape Disappointment for about 0.5 mile.

Between 2003 and 2011 there was an average of 276 ship transits (round trip equals two transits) per month past the Columbia River Bar (Columbia River Bar Pilots, 2012). This number was lower than in the past, in part due to the use of larger ships. The additional two to three ship visits per week proposed for the Oregon LNG Project would add less than one transit, either inbound or outbound, per day on average.

LNG Marine Carrier Routes

The Columbia River federal navigation channel extends from approximately 2 miles outside the entrance jetties at RM -2 to RM 106.5 at Vancouver, Washington. From the U.S. territorial sea, LNG marine carriers would enter the Columbia River navigation channel and would transit approximately 13.5 miles up the Columbia River navigation channel to the proposed Oregon LNG terminal at approximately RM 11.5. LNG marine carriers would normally enter the mouth of the Columbia River about 3 hours before high tide.

The channel between RM -2 and RM 3 is 2,640 feet wide and is presently authorized and maintained to a depth of 55 feet within the northerly 2,000 feet, while the remaining 640 feet is maintained to a depth of 48 feet. From RM 3 to the proposed Oregon LNG terminal site at approximately RM 11.5, the channel is at least 600 feet wide and 40 to 43 feet in depth. The USACE's Columbia River Channel Improvement Project, which includes deepening of the navigation channel to 43 feet, has been completed for this stretch of the river.

There are a number of major ports along the lower Columbia River, including Astoria, St. Helens, and Portland on the Oregon side of the river; Longview, Kalama, and Vancouver on the Washington side.

All of these ports are upstream from the project site at RM 11.5. The only bridge across the lower river below Longview, Washington (RM 66) is the Astoria-Megler Bridge at Astoria (RM 13.5). The LNG marine carriers would not cross under the Astoria-Megler Bridge.

All ships are required to have on board a Columbia River Bar Pilot while transiting between the sea buoy and Astoria, and a Columbia River Pilot while upstream of Astoria. The pilots, supervised by the Oregon Board of Pilot Commissioners, are responsible for scheduling, monitoring of weather conditions, and establishing working conditions. The pilots maintain bridge-to-bridge radio communication and coordinate vessel passing operations through a vessel information system allowing pilots to ascertain probable passing points with other ships in the river.

The LNG marine carriers would dock at a specially constructed ship berth and maneuvering basin north of the LNG terminal site. The berth would be over 1,800 feet from the main navigation channel, providing a safe distance from the main channel for passing vessels. All maneuvering and docking of the LNG marine carriers at the berth would be carried out under tug assistance and pilot supervision. Docking, LNG transfer, and undocking would take about 24 hours.

The PMI developed and conducted a vessel maneuvering simulation study for the project between the Columbia River Sea Buoy and the proposed Oregon LNG terminal location on the East Skipanon Peninsula near the confluence of the Skipanon and Columbia Rivers in Warrenton, and for the ship berth and maneuvering area at the Oregon LNG terminal (PMI, 2008). The study included the transit of ships with capacities of between 140,000 m^3 and 266,000 m^3 through the Columbia River navigation channel at its current depth and width. The study indicated that LNG marine carriers could safely maneuver the approach to the LNG terminal and ship berth with the assistance of three to four tugs, depending on the size of the carrier (PMI, 2008).

The PMI study also found that for inbound carriers, the simulator hydrodynamic models used became difficult to handle going over the bar, with winds in excess of 25 knots and waves up to 16 feet. This indicated the upper operational range for inbound carriers. For outbound carriers, the upper operational limits were winds in excess of 2 knots and seas up to 2 feet. In addition, the general consensus among the pilots who participated in the study was that they should not meet other vessels while transiting between Buoy 8 and the terminal. This is because during river transits with winds of 2 knots, the swept path of these carriers took up much of the available channel.

Hazards Resulting from Accidents

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG vessel and delivered to its U.S. destination.

- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.
- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts. The ship crew extinguished the fire and the ship completed unloading.
- **Khannur** had a cargo tank overfill into the vessel's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.
- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The vessel was refloated, repaired, and returned to service.
- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.
- **Suez Matthew** grounded on the reef off Cayo Maria Langa, near Guayanilla, Puerto Rico on December 19, 2009. The ship was refloated and no damage was found to the hull.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG, fatalities, or injuries were reported.

Although the history of LNG shipping has been free of major incidents, and no incidents have resulted in significant quantities of cargo being released, the possibility of an LNG spill from a vessel over the duration of the proposed project must be considered. If an LNG spill were to occur, the primary hazard to the public would be from radiant heat from a pool fire. If an LNG release were to occur without

ignition, an ignitable gas cloud could form and also present a hazard. Historically, the events most likely to cause a significant release of LNG were a vessel casualty such as:

- a grounding sufficiently severe to puncture an LNG cargo tank;
- a vessel colliding with an LNG vessel in transit;
- an LNG vessel alliding[15] with the terminal or a structure in the waterway; or
- a vessel alliding with an LNG vessel while moored at the terminal.

To result in a spill of LNG, any of the above events would need to occur with sufficient impact to breach an LNG vessel's double hull and cargo tanks. All LNG vessels used to deliver LNG to the proposed project would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick.

As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG vessel. Previous incidents with LNG vessels have primarily involved grounding, and none of these have resulted in the breach of the double hull and subsequent release of LNG cargo. The likelihood of an LNG vessel sustaining cargo tank damage in a collision would depend on several factors:

- the displacement and construction of both the struck and striking vessels;
- the velocity of the striking vessel and its angle of impact with the struck vessel; and
- the location of the point of impact.

In December 2004, the DOE released a study on the potential for an LNG vessel breach. At the request of the DOE, Sandia conducted the research and wrote the 2004 Sandia Report. The 2004 Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for both credible accidental and intentional LNG spill events. Accidental breaching evaluations were based on finite element modeling of collisions of double-hulled oil tankers similar in size and design to LNG ships. The analysis of accidental events found that groundings, collisions with small vessels, and low-speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor vessel damage but would not result in a cargo spill. This is due to the protection provided by the double-hull structure, the insulation layer, and the primary cargo tank of an LNG vessel. High-speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of from 0.5 to 1.5 meters squared (m^2).

The possibility of an LNG release due to an accident, such as a collision or grounding, is considered minimal. In addition, current operational procedures in use by the Coast Guard, such as managing ship traffic, and coordinating ship speeds, would also further reduce the potential of LNG spill from accidental causes. Sections 4.1.5 and 4.1.8 address impacts on water and aquatic resources if an LNG spill were to occur.

[15] "Allision" is the action of dashing against or striking upon a stationary object (for example, the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

Hazards Resulting from Intentional Acts

The 2004 Sandia Report also analyzed credible intentional breaches on LNG marine carriers up to 145,000 m^3 in capacity using modern finite element modeling and explosive shock physics modeling. The events considered for credible intentional acts were based on intelligence and historical data ranging from sabotage and hijacking to other types of physical attacks. Physical attacks included those documented to have occurred to several types of international shipping vessels, including attacks with small missiles and rockets, and attacks with bulk explosives.

For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole area of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The 2004 Sandia Report evaluated cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation. While possible under certain conditions, the cascading damage was found to not likely involve more than two or three cargo tanks. Cascading events were expected to increase the fire duration but not to significantly increase the overall fire hazard.

The 2004 Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts on public safety and property exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 meters (approximately 1 mile). Large un-ignited LNG vapor releases were found to be unlikely, but could extend from nominally 2,500 meters (8,200 feet) to a conservative maximum distance of 3,500 meters (2.2 miles) for an intentional spill.

In 2008, the DOE released another study prepared by Sandia, entitled *Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers, May 2008* (2008 Sandia Report). The 2008 Sandia Report assessed the scale of possible hazards for newer LNG vessels with capacities up to 265,000 m^3. Using the same methodology as the 2004 Sandia Report, the 2008 Sandia Report concluded thermal hazard distances would be only 7 - 8 percent greater than those from vessels carrying 145,000 m^3 of LNG, due primarily to the slightly greater height of LNG above the waterline. The 2008 Sandia Report also noted the general design of the larger vessels was similar to the previously analyzed ship designs and, for near-shore facilities; the calculated breach size for intentional scenarios would remain the same. Overall, the 2008 Sandia Report maintained the same impact zones as with the smaller vessels that were analyzed in the 2004 Sandia Report.

In February 2007, the U.S. Government Accountability Office (GAO) published a report assessing several studies, including the 2004 Sandia Report, which had been conducted on the consequences of an LNG spill resulting from a terrorist attack on an LNG vessel (GAO, 2007). The GAO's panel of experts agreed that the most likely public safety impact of an LNG spill would be the radiant heat from a pool fire and suggested that further study was needed to eliminate uncertainties in the assumptions used in modeling large LNG spills on water. After the GAO report, Congress requested the DOE to further address these research needs. In May 2012, a report entitled *Liquefied Natural Gas Safety Research Report to Congress* was released and is summarized below.

DOE contracted Sandia to conduct a series of large-scale LNG fire and cryogenic damage tests to investigate the larger classes of LNG marine carriers with capacities up to 260,000 m^3, representative of the largest LNG vessels in operation. Sandia conducted the largest LNG pool fire tests done to date and

performed advanced computational modeling and ship simulations between 2008 and 2011. As in the earlier studies, Sandia worked with marine safety, law enforcement, and intelligence agencies to assess threats and credible intentional acts. Scenarios included attacks with shoulder-fired weapons, explosives, and attacks by aircraft and other boats. Sandia identified several ranges of possible hull breaches ranging from 0.005 m^2 (Very Small) to 15 m^2 (Very Large). Based on the collected pool fire test data and the ship simulations, Sandia concluded that thermal hazard distances to the public from a large LNG pool fire was smaller, by at least 2 to 7 percent, than the results listed in the 2004 and 2008 Sandia Reports.

In order to more robustly analyze the potential for cascading failure of LNG marine carrier cargo tanks, Sandia use detailed vessel structural and thermal damage models to simulate the effects to an LNG marine carrier from a spill. For the large breaches considered, Sandia predicts that as much as 40 percent of the LNG released from the cargo tank would remain within the ship's structure. Due to both the cold temperature of the LNG and the heat from a pool fire, the LNG marine carrier's structural steel would be degraded. The effects could be significant enough to cause the ship to be disabled, severely damaged, and at risk of sinking.

Although LNG ship design and construction practices render simultaneous, multiple tank failures as extremely unlikely, Sandia concluded that sequential multi-tank spills may be possible. If sequential failures were to occur, they would not increase the size of the area impacted by the pool fire but could increase the duration of the fire hazards. Based on this research, Sandia concluded that use of a nominal one-tank spill, with a maximum of a three-tank spill, as was recommended in the 2004 Sandia report, is still appropriate for estimating hazard distances.

Hazard Zones

On June 14, 2005, the Coast Guard published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 05-05). The purpose of NVIC 05-05 was to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic. Since 2005, the Coast Guard updated this guidance twice, publishing NVIC 05-08 and NVIC 01-11. The current guidance from the Coast Guard is contained in NVIC 01-11.

All three NVICs direct the use of the 2004 Sandia Report as the best available information on LNG spills. NVIC 05-08 and NVIC 01-11 also include use of the 2008 Sandia Report. Three concentric Zones of Concern, based on LNG marine carriers with a cargo carrying capacity up to 265,000 m^3, are used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – The area within 500 m (1,640 feet) of an LNG marine carrier where an LNG spill could pose a severe public safety and property hazard and could damage or significantly disrupt key assets located within that area. The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kW/m^2 (12,000 Btu/ft^2-hr) from a pool fire.
- Zone 2 – Is the area from 500 m (1,640 feet) to 1,600 m (5,250 feet) of an LNG marine carrier where an LNG spill would have less severe consequences for public safety, property, and key assets. The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- Zone 3 – The area from 1,600 m (5,250 feet) to 3,500 m (11,500 feet or 2.2 miles) from an LNG marine carrier where an LNG spill would have the least likelihood of severe

consequences in the event that three cargo tanks are breached and a vapor cloud disperses with initial ignition at the source. The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the LFL from a worst case un-ignited release. Impacts on people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

LNG marine carriers would traverse primarily offshore waters with the exception of approximately 13.5 miles of the Columbia River navigation channel to the LNG terminal. The areas located within the Zones of Concern for this project are portions of Clatsop County, Oregon, and Pacific County, Washington. Communities located within the Zones of Concern include portions of the communities of Hammond, Warrenton, and Astoria. Waterfront areas of Hammond and Warrenton are overlapped by Zone 1. Other portions of Hammond and Warrenton are overlapped by Zones 2 and 3. Portions of Astoria are also overlapped by Zone 3. The areas impacted by the three different hazard zones are illustrated for both accidental and intentional events in figure 4.1.13-12and figure 4.1.13-13.

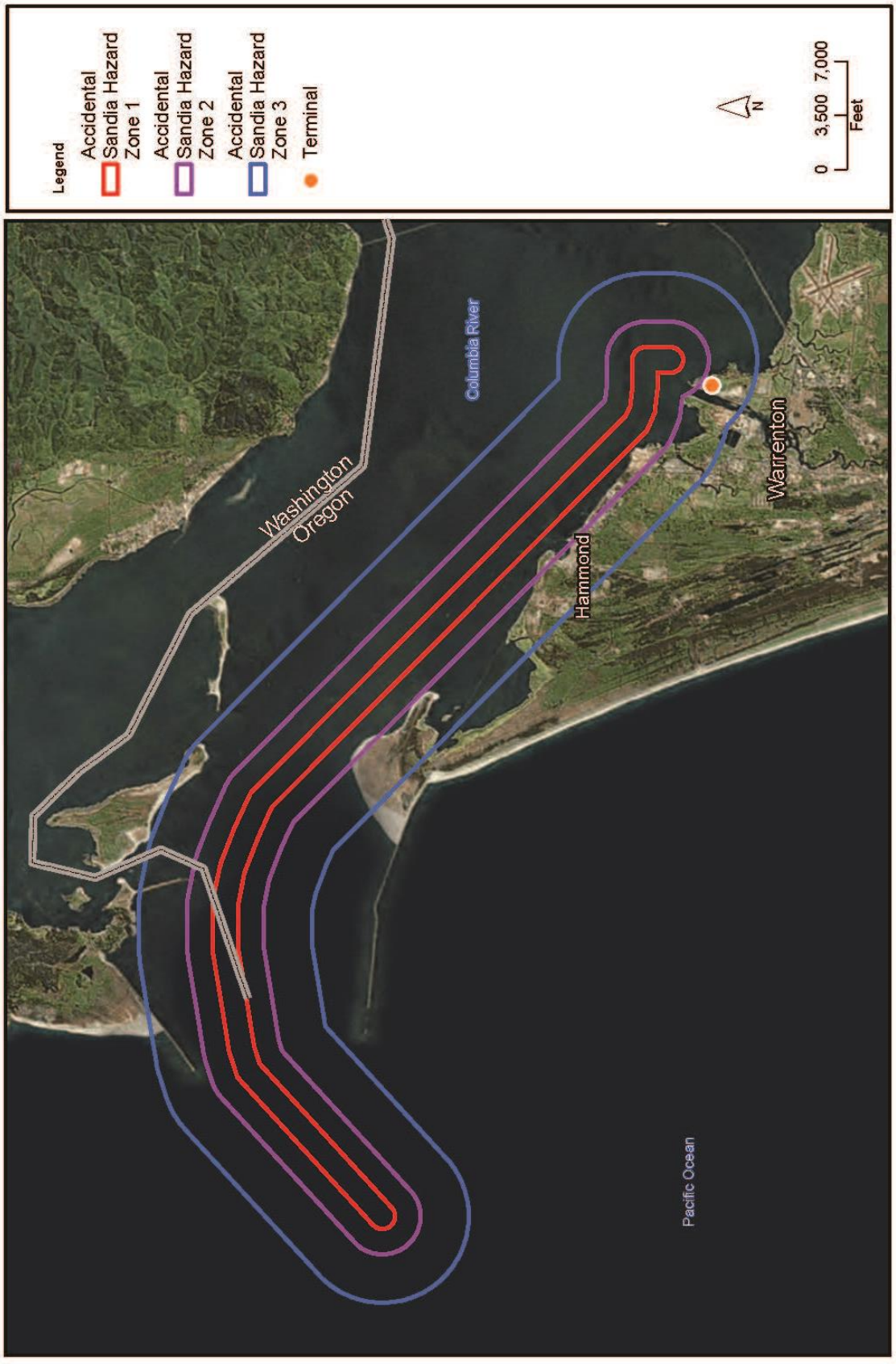


Figure 4.1.13-12: Sandia Zones of Interest for Accidental Events

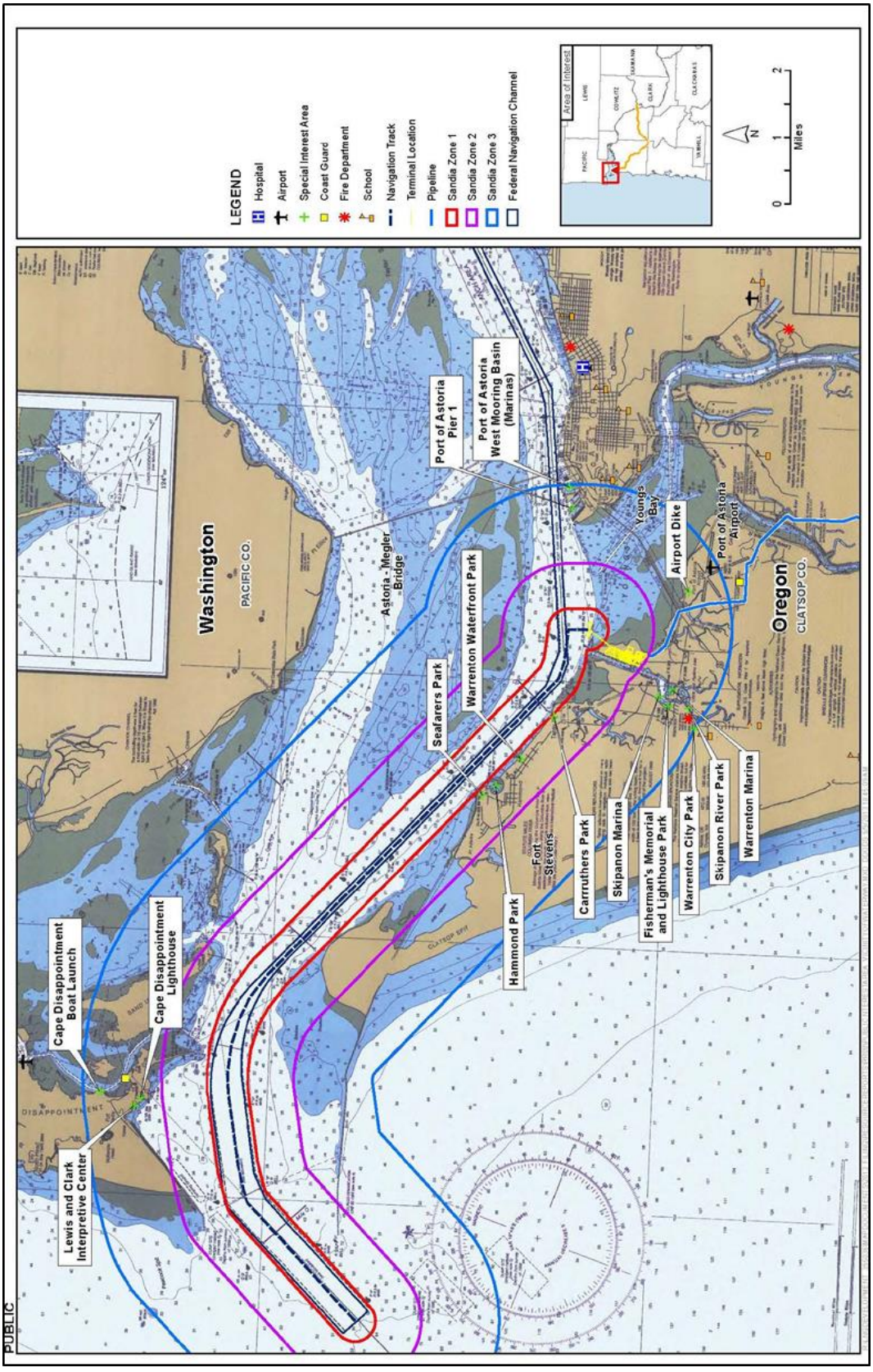


Figure 4.1.13-13: Sandia Zones of Concern for Intentional Events

4.1.13.8 Regulatory Requirements for LNG Marine Carrier Operations

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 U.S.C. Section 191); the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. Section 1221, et seq.); and the MTSA of 2002 (46 U.S.C. Section 701). The Coast Guard is responsible for matters related to navigation safety, carrier engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG vessel and the first manifold or valve located inside the containment. 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Oregon LNG would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard COTP for examination at least 30 days prior to the first LNG transfer.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG terminal facility to submit an LOI to the Coast Guard at the same time the pre-filing process is initiated with the Commission. Consequently, Oregon LNG notified the Coast Guard that it proposed to construct a waterfront facility handling LNG on the Skipanon Peninsula in Warrenton, Oregon and submitted an LOI to the COTP, Sector Portland, on May 23, 2007.

In addition to the LOI, 33 CFR 127 and FERC regulations require each LNG project applicant to submit a WSA to the cognizant COTP no later than the start of FERC's pre-filing process. Until a facility begins operation, applicants must annually review their WSAs and submit a report to the COTP as to whether changes are required. The WSA must include the following information:

- port characterization;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

As described in 33 CFR 127 and in NVIC 01-11, the applicant develops the WSA in two phases. The first phase is the submittal of the Preliminary WSA, which begins the Coast Guard's review process to determine the suitability of the waterway for LNG marine traffic. The second phase is the submittal of the Follow-On WSA. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's LOR to FERC.

The Preliminary WSA provides an outline which characterizes the port community and the proposed facility and transit routes. It provides an overview of the expected major impacts LNG operations may have on the port, but does not contain detailed studies or conclusions. This document is used to start the Coast Guard's scoping process for evaluating the suitability of the waterway for LNG marine traffic. Oregon LNG submitted the Preliminary WSA with its LOI to the Coast Guard on May 23, 2007.

A Follow-On WSA is required to provide a detailed and accurate characterization of the LNG facility, the LNG tanker route, and the port area. The assessment is to identify appropriate risk mitigation measures for credible security threats and safety hazards. According to NVIC 01-11, the Follow-on WSA should provide a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine traffic, along with appropriate risk management measures and the resources (federal, state, local, and private sector) needed to carry out those measures. Based on feedback from the Coast Guard and other stakeholders, Oregon LNG prepared and submitted the Follow-on WSA to the Coast Guard in March 2008.

As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR to FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed vessels from the channel and the width of the channel.

Once the applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic in the port. Finally, the Coast Guard issues a LOR. The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic. On April 24, 2009, the COTP issued an LOR and an LOR Analysis which summarized the Coast Guard's recommended risk mitigation measures. Furthermore, Coast Guard's annual WSA review letter issued on February 24, 2014, recognized that the project had changed from an import facility to an import/export facility and that the waterway impacts associated with export operations should not exceed those envisioned in the original WSA. The Coast Guard also had no objection to Oregon LNG's conclusion that an update to the WSA would not be necessary at this time.

Based on the results of the assessment of potential risks to navigation safety and maritime security associated with the proposed facility, the Coast Guard has determined that the Columbia River and its approaches are not currently suitable, but could be made suitable for the type and frequency of LNG marine traffic associated with this project. The following is a list of specific risk mitigation measures that are recommended by the Coast Guard to responsibly manage the safety and security risks of

this project. Details of each measure, including adequate support infrastructure, will need further development through the creation of an Emergency Response Plan as well as a Transit Management Plan that clearly spell out the roles, responsibilities, and specific procedures for the LNG vessel and all agencies responsible for security and safety during the operation.

Navigational Measures

- Safety/Security Zone: A moving safety/security zone will be established around the LNG vessel extending 500-yards around the vessel but ending at the shoreline. No vessel may enter the safety/security zone without first obtaining permission from the Coast Guard COTP. The expectation is that the COTP's Representative will work with the Pilots and patrol assets to control traffic, and will allow vessels to transit the Safety/Security zone based on a case-by-case assessment conducted on the scene. Escort resources will be used to contact and control vessel movements such that the LNG marine carrier is protected.

While the vessel is moored at the facility there will be a 200 yard-security zone around the vessel. In addition, there will be a 50 yard security zone around the LNG Terminal when there is not a vessel at the dock.

- Vessel Traffic Management: Due to a narrow shipping channel and navigational hazards, it is recommended that LNG vessels meet the following additional traffic management measures:
  - A Transit Management Plan be developed in coordination with River Pilots, Bar Pilots, Escort Tug Operators, Security Assets and the Coast Guard prior to the first transit.
  - Due to the sudden weather changes on the Oregon coast and the relatively exposed location of the proposed terminal, a weather matrix must be a part of the recommended Transit Management Plan. This matrix would be prepared by the applicant and would consider the entire duration of the planned port call by the LNG vessel. Where sustained winds are forecast to exceed 25 knots at any time during the port call, the LNG vessel would be required to remain at least 50 nautical miles from the coast. Additional considerations would include the weather conditions that require calling a Pilot to attend an LNG vessel that is at the terminal, when a Pilot must remain on board during the transfer of LNG to the facility, and the weather considerations that would call for a suspension of the transfer operation and the subsequent departure from port of the LNG vessel. Once prepared, this matrix would be submitted to the Coast Guard for review and inclusion in the overall Transit Management Plan. Additional simulation studies may be required to validate the proposed weather matrix.
  - The Transit Management Plan will be reviewed within six months of the first arrival, and followed by an annual review to ensure that it reflects the most current conditions and procedures.
  - For at least the first six months, that there be at least two Pilots abroad the LNG vessel throughout the transit.
  - For at least the first six months, that all transits be completed during daylight hours only, unless approved in advance by the COTP. After the first six months, it is anticipated that night transits may be recommended at certain times of the

year to minimize disruptions to the waterway from the CR buoy to buoy 12. These times include the busiest fishing seasons from June through September.

- The LNG Vessel board Pilots at least 5 miles seaward of the CR Buoy.
- Overtaking by or of the LNG Vessel is prohibited without COTP approval.
- Meeting situations of commercial vessels will be closely controlled. All meetings to be pre-arranged via Channel 13 VHF Bridge-to-Bridge and would be limited to the following areas:
  - Commercial piloted vessels avoid meeting in all turns (excluding fishing vessels under 200 feet).
  - Weather and bar conditions permitting, vessels may arrange for meetings to occur between the CR buoy and buoy 12, and between buoy 25 and buoy 27.
- 24 hours prior to arrival, the Coast Guard, FBI, Bar Pilots and River Pilots, Escort Tug Masters, and other Escort assets would meet to coordinate inbound and outbound transit details. Subsequent coordination meetings or phone call confirmation would be required 4 hours prior to arrival and 1 hour prior to arrival.
- Vessel transits and bar crossings would be coordinated so as to minimize conflicts with other deep draft vessels, recreational boaters, seasonal fisheries, and other Marine Events.

- Vessel Traffic Information System: The current Vessel Traffic Information System on the Columbia River is limited to AIS receivers and a handful of cameras. In order to ensure vessel safety and security, this capability would need to be augmented with a robust camera system capable of monitoring the entire transit route. Due to weather concerns, these cameras would be equipped with detectors capable of monitoring vessel traffic in wind, rain and fog conditions common on the river.
- Tug Escort and Docking Assist: Due to the confined channel and high wind conditions, each LNG marine carrier would be escorted by two tractor tugs, which would join the vessel as soon as safe to do so. Both tugs would be tethered at the direction of the Pilot. A third and fourth tractor tug would be required to assist the turning and mooring.
  - All four tugs will be at least 75 Ton Astern Bollard Pull or larger and equipped with Class 1 Fire Fighting equipment.
  - Based on the Maneuvering Simulation Study of January 3, 2008, LNG vessels would be limited to transiting during periods of 25 knots of wind or less. Additionally, extreme wind and weather conditions may require a third escort tug for any LNG vessel.
  - While unloading, all four tugs would remain on station to assist with emergency departure procedures. Two of the standby tugs would remain at the ready in the terminal basin, monitoring passing vessel traffic and immediately available to assist if maneuverability casualties of a passing vessel occurs. Whenever these tugs are utilized to assist a passing vessel, the Coast Guard would be notified as soon as it is safe to do so.
  - Tug escorts would be made in accordance with recognized industry standards, practices, or port guidelines that are developed specifically for "Tug Escorts."

  - "Best Achievable Protection" must be incorporated into tug and facility best practices. "Best Achievable Protection" means the highest level of protection which can be achieved through both the use of the best achievable technology and those manpower levels, training, procedures, and operational methods which provide the greatest degree of protection achievable.

- Navigational Aids: Any additional aids to navigation would be privately funded and maintained by the applicant, and the location and permitting would be accomplished in accordance with current Coast Guard and Corps of Engineers procedures:
  - PORTS (Physical Oceanographic Real-Time System) station at the terminal site contracted with NOAA to provide real time river level, current and WX data
  - A telemetric wind speed meter sited at the proposed terminal. In addition to providing the terminal and Operation Centers with current wind speeds, this meter would transmit data to the National Weather Service in accordance with NWS procedures.
  - Doppler docking station.
  - The available data for river current speeds at the terminal location is limited and unreliable. The installation of a turning basin by dredging the river bottom will impact the current data. As soon as practical after the dredging is complete and preferably before the final orientation of the pier face is completed, a river current study is recommended in the vicinity of the pier.
  - A quick-release mooring system is recommended to allow for vessel departures on short notice without the aid of additional personnel ashore.
  - Facility light shielding is recommended to preventing interfering with other Columbia River vessel traffic.
- LNG Marine Carrier Familiarization Training for Pilots and Tug Operators: Prior to the arrival of the first vessel, joint simulator training is recommended for Pilots and Tug Operators identified as having responsibility for LNG traffic.
- Dynamic Under Keel Clearance System: Installation of a real time system for data collection on under keel clearance is strongly recommended and will increase the ability to safely navigate the Columbia River Bar in varying conditions. The lack of accurate data, will limit the conditions under which a vessel may safely transit the bar. An immersion study of deep draft LNG vessels transiting the bar during summer and winter conditions is recommended within the first 12 months.

Safety Measures

- Vessel and Facility Inspections: LNG tankers and facilities are subject to (at a minimum) annual Coast Guard inspections to ensure compliance with federal and international safety, security and pollution regulations. In addition, LNG vessels and facilities are typically required to undergo a transfer monitor.
- Shore-Side Fire-Fighting: Firefighting capability is extremely limited along the entire transit route. Shore side firefighting resources and training would need to be augmented in order to provide basic protection services to the facility as well as the communities along the transit route.
- In-Transit Fire-Fighting: It is recommended that all crew members assigned to the escort and assist tugs be trained in the use and limitations of the installed Class I firefighting

systems. Significant resource and jurisdictional issues exist in any marine fire incident on an underway vessel in the Columbia River. Current planning and preparedness efforts focus on a shore based response to a vessel moored at a facility.

- Public Notification System and Procedures: Adequate means to notify the public along the transit route, including ongoing public education campaigns, emergency notification systems (such as reverse 911 and siren systems), and adequate drills and training are recommended. Education programs must be tailored to meet the various needs of all river users, including commercial and recreational boaters, local businesses, local residents, and tourists.
- Gas Detection Capability: With the exception of the HAZMAT team in Astoria, gas detection capability is not resident and may not be available to initial responders along the transit route and at the facility. Emergency response personnel (both Police and Fire) require appropriate gas detection equipment, maintenance, and training.
- Communication Systems and Protocols: Inter-agency communications pose a significant obstacle to joint operations. Deployment of a Regional Communication Plan and associated equipment is recommended to ensure that the facility, associated command centers, emergency responders, Coast Guard, Tug Operators, Escort Vessels, and Pilots can communicate in an effective manner. The system should provide for monitoring and communicating on both secure and unsecure (e.g., Ch. 16, 13, 22), as well as sending and receiving both speech and data.

Security Measures

- Security Boardings, Waterway Monitoring, Shoreline Patrols, and Vessel Escorts: Extensive security measures will be recommended to provide adequate protection for LNG vessel while transiting the Columbia River and moored at the facility. The details of these measures are Sensitive Security Information, and are outlined in a separate supplementary analysis.
- Facility Security Measures: LNG facilities are subject to the security regulations outlined in 33 CFR 105, and are required to submit s Facility Security Plan (FSP) for Coast Guard approval, and undergo (at a minimum) an annual Coast Guard security inspection. The facility should also develop a plan to provide for appropriate security measures from the start of construction through implementation of the Coast Guard approved FSP.

The Coast Guard's LOR is a recommendation on the current status of the waterway to FERC, the lead agency responsible for siting the proposed LNG facility. Neither the Coast Guard nor FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the Emergency Response Plan or the Cost Sharing Plan (see section 4.1.13.9). However, if the project is approved and if the appropriate resources are not in place, then neither agency would allow the project to go into operation. As the Coast Guard recommended that additional measures beyond those proposed by Oregon LNG in the WSA would be needed to responsibly manage the maritime safety and security risks associated with LNG marine traffic, **we recommend that:**

- **Oregon LNG should receive written authorization from the Director of OEP prior to commencement of service at the terminal. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility**

and the waterway have been put into place by Oregon LNG or other appropriate parties.

4.1.13.9 Emergency Response and Evacuation

As required by 49 CFR 193.2509, Oregon LNG would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…"

Section 3A(e) of the NGA, added by Section 311 of the EPAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The FERC must approve the ERP prior to any final approval to begin construction. Oregon LNG has provided a draft of its ERP. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Therefore, **we recommend that:**

- **Oregon LNG should develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

  b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

  c. procedures for notifying residents and recreational users within areas of potential hazard;

  d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

  e. locations of permanent sirens and other warning devices; and

  f. an "emergency coordinator" on each LNG marine carrier to activate sirens and other warning devices.

  The ERP should be filed with the Secretary for review and written approval by the Director of OEP prior to initial site preparation. Oregon LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its ERP at 3-month intervals.

A number of organizations and individuals have expressed concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG marine carriers while in transit and unloading/loading at the berth. Section 3A(e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine carriers that serve the facility. Therefore, **we recommend that:**

- **The ERP should include a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Oregon LNG should file the Cost-Sharing Plan for review and written approval by the Director of OEP prior to initial site preparation. Oregon LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost-Sharing Plan at 3-month intervals.**

The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine carrier, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

4.1.13.10 Facility Security and LNG Vessel Safety

Security requirements for the facilities at the terminal are governed by 49 CFR 193, Subpart J – Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Additional requirements for maintaining security of the terminal are found in 33 CFR 105.

As recommended in the LOR Analysis, Oregon LNG would provide security for the terminal according to a Facility Security Plan that must be prepared under 33 CFR 105. This plan and any modifications to this plan would need to be approved by the Coast Guard COTP. The requirements of this plan may include:

- a Facility Security Assessment to identify site vulnerabilities, possible security threats, consequences of an attack, and facility protective measures;
- procedures for responding to security incidents;
- a designated FSO responsible for implementing and periodically updating the Facility Security Plan and Assessment;
- scalable security measures to provide increasing levels of security at increasing MARSEC levels;
- security exercises at least once each calendar year and drills at least every 3 months; and
- mandatory reporting of all breaches of security and security incidents.

Security at the facility would be provided by both active and passive systems. The entire site would be surrounded by a protective enclosure (i.e., a fence) with sufficient strength to deter unauthorized access. The enclosure would be illuminated with not less than 2.2 lux between sunset and sunrise. Intrusion detection systems and day/night camera coverage would identify unauthorized access. A separate security staff would conduct periodic patrols of the plant, and screen visitors and contractors. The security staff may also assist in maintaining security of the marine terminal during cargo loading or unloading. Oregon LNG would be required to submit any revisions to their Facility Security Plan to the COTP Portland for approval 60 days before commencement of operations.

4.1.13.11 Conclusions on Facility Reliability and Safety

As part of the review required for a FERC authorization, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. Based on our technical review of the preliminary engineering designs, we conclude that sufficient layers of safeguards would be included in the facility designs to mitigate the potential for an incident that could damage the facility, injure operating staff, or impact the safety of the off-site public.

The principal hazards associated with the substances involved in the liquefaction, storage and vaporization of LNG result from cryogenic and flashing liquid releases; flammable and toxic vapor dispersion; vapor cloud ignition; pool fires; BLEVEs; and overpressures. As part of our review, we also assess the potential for public safety impacts using the information which Oregon LNG must produce to comply with the federal siting standards in 49 CFR 193. As a result of our review, we conclude that the siting of the project facilities with the proposed recommendations would not have a significant impact on public safety.

4.1.13.12 ODE Safety Advisory Report

The NGA, as modified by the EPAct, requires that FERC consult with the state in which an LNG terminal is proposed to be located regarding state and local safety matters. The governor of Oregon designated the ODE as the state agency that FERC should consult with on safety and siting matters for the Oregon LNG project. On November 10, 2008, the ODE submitted its Safety Advisory Report to FERC (ODE, 2008c). In the report, ODE addressed state and local considerations. The EPAct also stipulates that before FERC may issue an order authorizing an LNG terminal, it must "review and respond specifically" to the safety matters raised by the state agency designated as the lead for the state and local safety matters. Appendix C1 provides FERC's response to the ODE Safety Advisory Report for the Oregon LNG project. We also note that Oregon LNG has entered into an MOU with the ODE regarding the development of an emergency planning and preparedness program for the terminal.

4.1.13.13 Pipeline Facilities

The transportation of natural gas by pipeline involves some incremental risk to the public due to the potential for accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane is inactive biologically and essentially nontoxic. It is not listed in the International Agency for Research on Cancer, National Toxicology Program, or by the Occupational Safety and Health Administration as a carcinogen or potential carcinogen.

Methane has an auto-ignition temperature of 1,000 ºF and is flammable at concentrations between 5.0 and 15.0 percent in the air. An unconfined mixture of methane in air is not explosive; however it may ignite and burn if there is an ignition source. A flammable concentration within an enclosed space in the presence of an ignition source can explode. Methane is buoyant at atmospheric temperatures and disperses rapidly in air.

Safety Standards

The DOT is mandated to prescribe minimum safety standards to protect against risks posed by pipeline facilities under Title 49, U.S.C. Chapter 601. The PHMSA OPS administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. PHMSA's safety mission is to ensure that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level.

Title 49, U.S.C. Chapter 601 provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards. A state may also act as DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement actions. In Oregon, the Public Utility Commission (PUC) has inspection and enforcement authority for regulations of DOT, under a delegation from DOT. The OPUC has implemented pipeline safety regulations that include, and sometimes exceed, the DOT regulations at 49 CFR 192. In Washington, by signed agreement with the OPS, the state inspects interstate gas and hazardous liquid pipeline operators. This work is performed by the Washington Utilities and Transportation Commission.

The DOT pipeline standards are published in Parts 190-199 of Title 49 of the CFR. Part 192 specifically addresses natural gas pipeline safety issues.

Under a *Memorandum of Understanding on Natural Gas Transportation Facilities* (Memorandum) dated January 15, 1993 between the DOT and FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of FERC's regulations requires that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection. Alternatively, an applicant must certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with Section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert the DOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and aboveground facilities associated with the Oregon LNG Project must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR 192. The regulations are intended to ensure adequate protection for the public and

to prevent natural gas facility accidents and failures. The DOT specifies material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

Commenters expressed concern about how the pipeline would be maintained over time and the long-term safety of operations. As stated previously, any natural gas facility has some degree of risk and, although any structure will eventually degrade, the DOT rules require regular inspection and maintenance, including repairs as necessary, to ensure the pipeline has adequate strength to transport the natural gas safely.

The DOT defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined below:

Class 1 – Location with 10 or fewer buildings intended for human occupancy.

Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy.

Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.

Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. For instance, pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock. All pipelines installed in navigable rivers, streams, and harbors must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures; hydrostatic test pressures; MAOP; inspection and testing of welds; and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Preliminary class locations for the Oregon LNG Project have been determined based on the relationship of the pipeline centerline to other nearby structures and manmade features. The Oregon LNG Project would consist of 78.2 miles of Class 1, 1.3 miles of Class 2, and 7.3 miles of Class 3 pipe.

If a subsequent increase in population density adjacent to the right-of-way results in a change in class location for the pipeline, Oregon LNG would reduce the maximum allowable operating pressure or replace the segment with pipe of sufficient grade and wall thickness, if required to comply with the DOT requirements for the new class location.

The U.S. DOT Pipeline Safety Regulations require operators to develop and follow a written integrity management program that contains all the elements described in 49 CFR 192.911 and addresses the risks on each transmission pipeline segment. The rule establishes an integrity management program which applies to all high consequence areas (HCAs).

We received several comments about the potential effects of a pipeline rupture and natural gas ignition. The DOT has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for DOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of two ways. In the first method, an HCA includes:

- current Class 3 and 4 locations;
- any area in Class 1 or 2 where the potential impact radius[16] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle[17]; or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.

An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days per week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

In the second method, an HCA includes any area within a potential impact circle that contains:

- 20 or more buildings intended for human occupancy; or
- an identified site.

Once a pipeline operator has determined the HCAs along its pipeline, it must apply the elements of its integrity management plan to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan in 49 CFR 192.911. The HCAs have been determined based on the relationship of the pipeline centerline to other nearby structures and identified sites. Of the 86.8 miles of proposed pipeline route, Oregon LNG has identified 6.8 miles that would be classified as an HCA. The pipeline integrity management rule for HCAs requires inspection of the pipeline HCAs every 7 years. Oregon LNG has provided a framework for its integrity management plan and has committed to provide the completed plan to us prior to the start of construction.

The DOT prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. We received comments that a pipeline emergency response plan should be in place prior to installation of the pipeline. Each pipeline operator is required to establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of system and safe restoration of service;

[16] The potential impact radius is calculated as the product of 0.69 and the square root of: the maximum allowable operating pressure of the pipeline in psig multiplied by the square of the pipeline diameter in inches.
[17] The potential impact circle is a circle of radius equal to the potential impact radius.

- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

The DOT requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Oregon LNG would provide the appropriate training to local emergency service personnel before the pipeline is placed in service.

Oregon LNG would establish and maintain liaison with emergency responders and public officials through one-on-one meetings, One-Call Center participation, and a Pipeline Education and Awareness Program. At a minimum, the Pipeline Education and Awareness Program would be designed to raise public awareness of company facilities by providing information on hazard awareness and prevention, pipeline location information, leak recognition and response, and damage prevention. Oregon LNG would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle operational pipeline emergencies.

We received a number of comments related to fires associated with the pipeline. Oregon LNG's emergency response plan would include procedures to address forest fire as a result of a pipeline breach. During pipeline construction and operation, there is a risk of forest fires resulting from normal construction and maintenance activities. Pipeline construction and maintenance activities would be subject to the wildfire prevention and suppression requirements of ORS 477 (*Fire Protection of Forests and Vegetation)*. These requirements and Oregon LNG's fire prevention BMPs are detailed in section 4.1.6.2.

We also received comments from residents who were concerned about the construction and operational impacts, as well as pipeline rupture impacts on vulnerable populations such as children, the elderly, or the infirm. Oregon LNG has routed the pipeline, and is continuing to evaluate route modifications, to minimize risks to local residents and vulnerable locations. Only two residences would be within 50 feet of the pipeline construction right-of-way. There would be no schools, hospitals, or nursing homes in the vicinity of the pipeline. The DOT pipeline safety regulations described above are designed to ensure minimum requirements for safety of all populations.

Pipeline Accident Data

The DOT requires all operators of natural gas transmission pipelines to notify the DOT of any significant incident and to submit a report within 30 days. Significant incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization; or
- involve property damage of more than $50,000 in 1984 dollars.[18]

[18] $50,000 in 1984 dollars is about $115,000 as of March 2014 (U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index, 2014).

During the 20-year period from 1994 through 2013, a total of 1,237 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.1.13-8 provides a distribution of the causal factors, as well as the number of each incident by cause.

The dominant causes of pipeline incidents are corrosion and pipeline material, weld or equipment failure constituting 48.2 percent of all significant incidents. The pipelines included in the data set in table 4.1.13-8 vary widely in terms of age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents and material failure, since corrosion and pipeline stress/strain are time-dependent processes.

Table 4.1.13-8

Natural Gas Transmission Pipeline Significant Incidents by Cause (1994-2013) [a]

Cause	Number of Incidents	Percentage
Corrosion	292	23.6
Excavation [b]	211	17.0
Pipeline material, weld or equipment failure	304	24.6
Natural force damage	142	11.5
Outside force [c]	74	6.0
Incorrect operation	33	2.7
All Other Causes [d]	181	14.6
Total	**1,237**	**—**

[a] All data gathered from PHMSA Significant incident files, March 25, 2014. http://primis.phmsa.dot.gov/comm/reports/safety/
[b] Includes third-party damage
[c] Fire, explosion, vehicle damage, previous damage, intentional damage
[d] Miscellaneous causes or unknown causes

The use of both an external protective coating and a cathodic protection system[19], required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

Outside force, excavation, and natural forces are the cause in 34.5 percent of significant pipeline incidents. These result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 4.1.13-9 provides a breakdown of outside force incidents by cause.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller-diameter pipelines, which have a greater rate of outside forces

[19] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at a faster rate to reduce corrosion.

incidents. Small-diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

Since 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (for example, oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

Table 4.1.13-9

Outside Forces Incidents by Cause (1994-2013) [a]

Cause	Number of Incidents	Percent of all Incidents
Third-party excavation damage	176	14.2
Operator excavation damage	25	2.0
Unspecified equipment damage/previous damage	10	0.8
Heavy rain/floods	72	5.8
Earth movement	35	2.8
Lightning/temperature/high winds	21	1.7
Natural Force (other)	14	1.1
Vehicle (not engaged with excavation)	45	3.6
Fire/explosion	8	0.6
Previous mechanical damage	5	0.4
Fishing or maritime activity	7	0.6
Intentional damage	1	0.1
Electrical arcing from other equipment/facility	1	0.1
Unspecified/other outside force	7	0.6
TOTAL	**427**	**—**

[a] Excavation, Outside Force, and Natural Force from table 4.1.13-8.

The PHMSA data on significant incidents for gas transmission and gas distribution pipeline systems indicate that there have been 10 rupture or leak incidents in Oregon and 22 incidents in Washington between 2003 and October 1, 2014. These incidents were caused by failures of materials, welds, or equipment; excavation damage; corrosion; natural forces; other outside forces; or incorrect operation (PHMSA, 2014). In Oregon, 1 of the 10 incidents occurred on a natural gas transmission pipeline, in Portland in 2006, and was attributed to incorrect operation of the pipeline. The other nine incidents occurred on gas distribution pipelines. In Washington, 9 of 22 significant incidents took place on transmission pipelines, and 13 on gas distribution pipelines. The predominant cause of the leaks or ruptures in transmission pipelines was failure of materials, welds, or equipment (six of nine incidents). Corrosion, incorrect operation, and natural force damage (flooding) each caused one incident. On natural gas distribution pipelines, most incidents were caused by excavation damage and damages from other outside forces.

Impact on Public Safety

The service incidents data summarized in table 4.1.13-9 include pipeline failures of all magnitudes with widely varying consequences. Table 4.1.13-10 presents the average annual injuries and fatalities that occurred on natural gas transmission lines for the 5-year period between 2009 and 2013. The majority of fatalities from pipelines are due to local distribution pipelines not regulated by FERC. These are natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller

diameter pipes and/or plastic pipes which are more susceptible to damage. Local distribution systems do not have large rights-of-way and pipeline markers common to FERC-regulated natural gas transmission pipelines.

Table 4.1.13-10

Injuries and Fatalities - Natural Gas Transmission Pipelines

Year	Injuries	Fatalities
2009	11	0
2010 [a]	61	10
2011	1	0
2012	7	0
2013	2	0

[a] All of the fatalities in 2010 were due to the Pacific Gas and Electric pipeline rupture and fire in San Bruno, California on September 9, 2010.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.1.13-11 in order to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornados, or floods.

Table 4.1.13-11

Nationwide Accidental Deaths [a]

Type of Accident	Annual Number of Deaths
All accidents	117,809
Motor vehicles	43,343
Poisoning	23,618
Falls	19,656
Injury at work	5,113
Drowning	3,582
Fire, smoke inhalation, burns	3,197
Floods [b]	89
Tractor turnover [c]	62
Lightning [b]	54
Natural gas distribution lines [d]	14
Natural gas transmission pipelines [d]	2

[a] All data, unless otherwise noted, reflects 2005 statistics from U.S. Census Bureau, Statistical Abstract of the United States: 2010 (129th Edition) Washington, DC, 2009, http://census.gov/statab.

[b] NOAA National Weather Service, Office of Climate, Water and Weather Services, 30 year average (1983-2012) http://www.weather.gov/om/hazstats.shtml

[c] Bureau of Labor Statistics, 2007 Census of Occupational Injuries

[d] PHMSA significant incident files, March 25, 2014. http://primis.phmsa.dot.gov/comm/reports/safety/, 20 year average.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1994 to 2013, there were an average of 62 significant incidents, 10 injuries, and 2 fatalities per year. The number of significant incidents over the more than 303,000 miles of natural gas transmission lines indicates the risk is low for an incident at any given location. The operation of the Oregon LNG Project would represent a slight increase in risk to the nearby public.

4.2 WASHINGTON EXPANSION PROJECT

4.2.1 Geological Resources

4.2.1.1 Geologic Setting

The WEP would be located generally along the interface between the Puget Lowland and Cascade Range physiographic provinces and pass back and forth between them. The Cascade Range Province is divided into two sections, the North Cascades and the South Cascades. The WEP would traverse the western side of both the North and South Cascades. The North Cascades has a highly complex structure of Mesozoic crystalline and metamorphic rocks brought together by fault movement. The South Cascades consist mainly of younger Cenozoic volcanic rocks that lack the structural complexity of the North Cascades (WDNR, 2014). Both sections contain volcanoes, with Mount Baker and Glacier Peak in the North Cascades and Mount Rainier, Mount Adams, and Mount St. Helens in the South Cascades.

The Puget Lowlands Province is a wide, low-lying area region west of the Cascade Range. The northern portion of the Puget Lowlands is mainly made up of a flat glacial plain that is interrupted by the bays and inlets of Puget Sound. The southern portion consists of alluvial valleys. Tertiary sedimentary rocks containing coal resources are exposed along the eastern margin of the Puget Lowlands. Extensive deposits of glacial outwash sand and gravel are present throughout the province (WDNR, 2014).

The surface elevation in the project area ranges from about 15 to 1,500 feet. A large part of the WEP would be near the western base of the Cascade Range where the elevation is typically between 150 and 500 feet. The WEP would cross many geologic formations from Woodland to Sumas, Washington. The main geologic units that would be crossed by the Woodland Loop include Tertiary volcanic and sedimentary rocks and Quaternary volcanic, glacial, and alluvial deposits. The Chehalis Loop would cross mostly Middle to Upper Eocene sedimentary rocks with some andesite at the northern end, and Quaternary landslide, glacial, and alluvial deposits. From the Sumner South Loop through the Mt. Vernon North A Loop, the WEP would cross mostly Pleistocene glacial deposits. The Mt. Vernon North B and Sumas Loops would cross a mix of Quaternary alluvial fan, glacial, and alluvial deposits.

Although the WEP would cross areas of shallow bedrock, Northwest does not anticipate that blasting would be used to construct the WEP as a precaution to protect the existing pipeline in the Northwest right-of-way. Traditional excavation methods would likely be used for sedimentary rock. For harder igneous and metamorphic rocks, Northwest would use alternative excavation methods such as rock saw, hydraulic rock hammers, expansive grouts, or powerful excavators equipped with rock teeth. Blasting would be used only if these alternative excavation methods fail to adequately excavate the trench. Blasting could also be used if shallow bedrock is encountered in segments where the WEP would be routed away from the existing Northwest pipeline; however such conditions are not expected in these areas. If blasting is required, Northwest would follow the procedures in its Blasting Plan to mitigate hazards and impacts, including:

- A site-specific blasting plan would be prepared for each location by the pipeline contractor. If in-water blasting is determined to be necessary, a detailed blasting plan for in-water blasting would be prepared and appropriate resource agency notifications would be made.
- The peak particle velocity would be limited to 4 inches per second measured adjacent to an underground pipeline, unless otherwise approved by Northwest. The peak particle

velocity limit for any aboveground structure (including water wells), would be as recommended in the latest edition of the International Society of Explosives Engineers' *Blaster's Handbook*.

- Seismic monitoring would be conducted during blasting at the adjacent pipeline; at water wells, potable springs, and at any above ground structure within 150 feet of the blasting.
- Water flow performance and water quality testing would be conducted before blasting at water wells or potable springs within 150 feet. If a well is damaged, the owner would either be compensated for damages or a new well would be provided.
- Aboveground structures within 150 feet of blasting would be inspected before and after blasting. The owner would be compensated if damage occurs.
- The size of charges would be limited based on guidelines provided by the Office of Surface Mining Reclamation and Enforcement, and blasting mats would be used.
- Nearby residents and other building occupants would be notified at least 72 hours in advance of the blasting.
- Additional restrictions described in right-of-way grant and permit stipulations may apply for blasting in or near environmentally sensitive areas.
- Specific storage requirements and procedures for protecting personnel as described in Northwest's Blasting Plan would be followed.

4.2.1.2 Mineral Resources

Databases from the USGS, WDNR, and individual counties were used to identify historic and current mining operations as well as mineral processing plants, oil wells, gas wells, and geothermal resources that would be in the vicinity of the WEP. The mineral and natural resources that would be within 0.25 mile of the WEP are listed in table 4.2.1-1 along with the development status of each resource. Thirty-nine mineral resource features would be within 0.25 mile of the WEP and 21 of those are quarries of rock, stone, or gravel.

Table 4.2.1-1

Mineral Resources Within 0.25 Mile of the WEP

Milepost	Feature Type (Mine/Resource Name)	ID Number (Reference Source) [a]	Development Status [b]	Operator/Investigator	Distance/ Direction from Pipeline (feet) [c]
1261.5	Rock/stone (Kelso Quarry)	1614 (WDNR)	Producer	Highland Ridge, LLC	Crosses
1267.6	Unnamed Stone Quarry	10203761 (USGS)	Past Producer	Department of Highways	600/West
1274.7	Sand & Gravel (LT-1)	2526 (WDNR)	Unknown	Unknown	Crosses
1281.1	Fire Clay (Buswell)	10301713 (USGS)	Occurrence	Unknown	1,300/West
1281.7	Sand & Gravel (Mulford Pit)	10253258 (USGS)	Past Producer	Mulford	300/West
1293.2	Geothermal Gradient Heatflow Well	62 (WDNR)	Unknown	Unknown	1,300/East
1294.9	Oil/Gas Well	345 (WDNR)	Unknown	Continental Oil Co.	1,000/East
1301.8	Coal (Be-Knights)	3 (Lewis County)	Unknown	Unknown. Operated prior to 1918.	Crosses/ Southeast
1303.6-1306.4	Coal (TransAlta Mine)	1701 (WDNR)	Past Producer	TransAlta Centralia Mining, LLC	Crosses
1305.3	Coal (Freeburn)	44 (Lewis County)	Unknown	Unknown	Crosses [d]/ Northwest
1305.6	Coal (Black Prince)	10 (Lewis County)	Unknown	George and Wilber Parkins. Operated mine from 1929 – 1979.	Crosses [d]/ Northwest
1305.7	Coal (Victory)	40 (Lewis County)	Unknown	Abe Flewelling. Operated mine from 1910 – 1927.	Crosses [d]/ Northwest
1305.9	Coal (K and K)	50 (Lewis County)	Unknown	Unknown	Crosses [d]/ Southeast
1306.0	Coal (Belle Slope)	4 (Lewis County)	Unknown	Unknown. Started operating mine in 1944.	Crosses [d]/ Southeast
1310.3	Sand and Gravel (Mcconnell Pit)	10278194 (USGS)	Past Producer	Thurston County	1,300/Northwest
1338.3	Sand and Gravel (Frederickson)	1942 (WDNR)	Unknown	Rand Land II Partnership	700 [d]/Southeast
1338.8	Unnamed Sand and Gravel Pit	10155688 (USGS)	Past Producer	Unknown	300 [d]/Northwest
1339.2	Sand and Gravel (South Canyon)	1965 (WDNR)	Unknown	Looker Properties LLC	600/Northwest
1340.9	Geothermal Water Well	70 (WDNR)	Unknown	Unknown	900/East
1342.9	Geothermal Water Well	74 (WDNR)	Unknown	Unknown	700/East
1343.3	Sand and Gravel (Lundblad Pit)	10253025 (USGS)	Past Producer	Woodworth and Company; 9th Street Pit	1,200/Northwest
1343.3	Sand and Gravel (9th Street Pit)	1963 (WDNR)	Unknown	Pierce County Public Works	1,200/Northwest
1344.7	Sand and Gravel (Puyallup Pit)	10305394 (USGS)	Past Producer	Lige Dickson Co.	700/Northwest
1345.0	Geothermal Water Well	2827 (WDNR)	Unknown	Unknown	1,100/Southeast
1345.9	Geothermal Water Well	2829 (WDNR)	Unknown	Unknown	1,000/Southeast
1345.9	Unnamed Sand and Gravel Pit	10277634 (USGS)	Past Producer	Pyramid Sand and Gravel	1,300/Northwest
1350.0	Unnamed Sand and Gravel Pit	10232393 (USGS)	Past Producer	Sumner Pit and Plant	600/East
1350.5	Unnamed Sand and Gravel Pit	2003 (WDNR)	Unknown	Tim Corliss & Sons, Inc.	600/East
1351.7	Sand and Gravel (Valley View)	2002 (WDNR)	Unknown	City Transfer, Inc.	1,300/East
1363.9	Sand and Gravel (Black River S&G)	2074 (WDNR)	Unknown	Lakeside Industries, Inc.	800/Northwest
1375.8	County-Identified Mining Hazard	3 (King County)	Unknown	Unknown	200/East
1408.2	Sand and Gravel (Machias Pit)	10253761 (USGS)	Past Producer	EJ Templeton	600/East
1435.9	Crushed/Broken Stone	10277138 (USGS)	Past Producer	Department of Highways	800West

Table 4.2.1-1

Mineral Resources Within 0.25 Mile of the WEP

Milepost	Feature Type (Mine/Resource Name)	ID Number (Reference Source) [a]	Development Status [b]	Operator/Investigator	Distance/ Direction from Pipeline (feet) [c]
1437.0	Unnamed Sand and Gravel Pit	10155719 (USGS)	Producer	Earl R. Curry	300/Southwest
1437.7	Unnamed Sand and Gravel Pit	10131528 (USGS)	Unknown	Unknown	700/West
1443.0	Nickel (Clear Lake)	10277049 (USGS)	Occurrence	Unknown	400/East
1478.7	Diatomite Deposit	10156985 (USGS)	Occurrence	Vogel Farm	100/Northwest
1481.2	Oil/Gas Well	640 (WDNR)	Unknown	Lyndon Oil & Gas Development Co. and Pacific Gas & Oil Development Co.	800/Northwest
1482.1	Sand and Gravel (Killam)	2486 (WDNR)	Producer	Herbert and Grace Killam	Crosses

[a] Identification (ID) numbers shown are provided by USGS, WDNR, or the counties. In cases where the same mineral resource appeared in both the USGS and WDNR databases, the milepost information shown in the table comes from the database entry that has the closest coordinates to the pipeline.

[b] Definition of status terms used by USGS:
Occurrence = Ore mineralization found in outcrop, shallow pits, or isolated drill hole. Grade, tonnage, and extent of mineralization are unknown. No production and little or no activity since discovery other than routine claim maintenance.
Past Producer = A former producer that was closed at the time of data entry with no known plans to reopen.
Producer = a mine that was in production at the time the data was entered, includes intermittent and seasonal producers.

[c] Distances provided in table are generally the distances between the pipeline centerline to the edge of disturbed areas within the associated quarries, rounded down to the nearest 100-foot increment.

[d] Lewis County has identified numerous coal mines that are or were present near mileposts 1305.3 to 1306.4. These are old abandoned underground mines and whether any mine tunnels exist beneath the WEP alignment is unknown.

Sources: (King County, 2006), (Lewis County, 2012), (Pierce County, 2011a and 2011b), (Snohomish County, 2011), (Thurston County, 2012) (USGS, 2005c,d), (WDNR, 2004; 2010b; 2011a,b; 2012), (Whatcom County, 1998)

The Kelso Quarry at MP 1261.5 is a basalt mine that is presently not in use but has an active permit. According to WDNR records, mining has not occurred since 1994. The valuable mineral deposits are north and east of the existing Northwest Pipeline right-of-way and it is anticipated that any future mining would proceed in that direction.

A sand and gravel pit, referred to as LT-1, would be crossed at MP 1274.7 near the Toutle River crossing. The material in the area is primarily sand and silty sand that was dredged out of the Toutle River after the eruption of Mount St. Helens. Cowlitz County has since constructed and is operating a gun range on the site. Because of this, it is not anticipated that significant mining activities for dredged sand would occur near the WEP.

The Be-Knights mine at MP 1301.8 is a historic coal mine that is no longer active. The TransAlta Coal Mine would be crossed between MP 1303.6 and 1306.4. Active surface mining operations ceased in 2006 and the mine is now undergoing reclamation. The area encompassed by the surface mine includes numerous old underground mines that were dug mostly between the 1860s and the 1950s, including five abandoned underground coal mines shown in table 4.2.1-1 (Freeburn, Black Prince, Victory, K and K, and Belle Slope). As discussed further in section 4.2.1.4, there has been no record of subsidence within the TransAlta mine area impacting Northwest's existing pipelines. In 2005, a landslide covering a 375 by 150-foot area occurred within the existing right-of-way at MP 1304.9. Strain gauge readings since 2005 have not exceeded thresholds that would require further action. Landslide hazards and mitigation are further discussed in section 4.2.1.3.

Killam Quarry is an active sand and gravel quarry at MP 1482.1 that is being excavated with traditional excavation equipment such as excavators, front-end loaders, and dozers. As part of the quarry permit conditions, a 125-foot setback must be maintained between any mining or disturbance associated with the quarry and the closest pipeline. The quarry owners have permanently staked the edges of the pipeline right-of-way. There are currently three pipelines within the right-of-way across the Killam Quarry, the abandoned 26-inch-diameter pipeline, a 30-inch-diameter pipeline, and a 36-inch-diameter pipeline. The WEP would be placed in the trench of the 26-inch-diameter pipeline after its removal and no additional right-of-way would be acquired. A 40-foot-wide temporary construction right-of-way would be used during construction. The existing right-of-way in combination with temporary construction right-of-way would be within the 125-foot setback allotted in the mining permit. Therefore, construction activity would not impact the mining operations.

Because the WEP would be constructed primarily within an existing established pipeline right-of-way, we conclude that the project would not have significant impacts on current or future mineral resource development. Further, none of the identified mine activity would represent a risk to the WEP.

4.2.1.3 Seismic Related Hazards and Mitigation

Seismic hazards with potential to affect the pipeline include earthquakes, surface faults, and soil liquefaction. According to the most recent tsunami hazard mapping available from WDNR (WDNR, 2010a), the WEP would not be situated within any mapped tsunami inundation areas. Therefore, tsunamis are not considered a significant hazard to the proposed project.

Earthquakes

The seismic setting of the Pacific Northwest, including the CSZ, is described in section 4.1.1.1. The WEP would be about 100 miles east of the CSZ at MP 1275.0 (the westernmost location of the WEP). Based on historical records, western Washington experiences relatively frequent earthquakes that range in magnitude from 3.0 to 6.0 (USGS, 2010). Several higher magnitude earthquakes (between 6.0 and 7.1) have occurred in the southern Puget Sound area (see figure 4.2.1-1).

Northwest obtained PGA values for every 10-mile segment of the WEP pipeline alignment from USGS seismic hazard maps. The PGA values (as a percentage of g) are shown in table 4.2.1-2. PGAs for soft rock/stiff soil ground conditions are shown for earthquakes with 10 percent probability of exceedance in 50 years, 5 percent probability of exceedance in 50 years, and 2 percent probability of exceedance in 50 years. The highest PGAs occur near the center of the WEP pipeline, in the vicinity of MP 1340.0 on the Sumner South Loop. The lowest PGAs would occur at the beginning of the pipeline (MP 1250.0 on the Woodland Loop) and at the end of the pipeline (MP 1480.0 on the Sumas Loop). The PGA values gradually decrease from the center of the WEP toward each end.

Table 4.2.1-2

Peak Ground Accelerations Along the WEP

Loop	Structure	Milepost	Probability of Exceedance in 50 Years		
			PGA for 10%	PGA for 5%	PGA for 2%
Woodland	Pipeline	1250.0	0.19	0.28	0.41
Woodland	Pipeline	1260.0	0.20	0.29	0.42
Woodland	Pipeline	1270.0	0.21	0.30	0.44
Woodland	Pipeline	1280.0	0.22	0.31	0.46
Woodland	Pipeline/compressor station	1290.0	0.24	0.33	0.47
Chehalis	Pipeline	1300.0	0.26	0.36	0.50
Chehalis	Pipeline	1310.0	0.27	0.37	0.52
Sumner South	Pipeline	1340.0	0.28	0.38	0.53
Sumner South	Pipeline/compressor station	1350.0	0.28	0.38	0.52
Sumner North A	Pipeline	1360.0	0.28	0.37	0.51
Sumner North B	Pipeline	1370.0	0.28	0.37	0.53
Sumner North B	Pipeline	1380.0	0.27	0.37	0.53
Snohomish	Pipeline/compressor station	1400.0	0.26	0.36	0.53
Snohomish	Pipeline	1410.0	0.25	0.33	0.46
Mt. Vernon South/ Mt. Vernon North A	Pipeline/compressor station	1440.0	0.22	0.30	0.44
Mt. Vernon North B	Pipeline	1460.0	0.20	0.27	0.39
Sumas	Pipeline/compressor station	1480.0	0.19	0.27	0.39

Data Source: USGS, 2008.

Modern steel pipelines with high quality electric arc welded joints have a history of performing well during seismic events and ground displacements up to 60 cm because of the restrained, welded joints and the flexibility of the pipeline to move with the earth during ground shaking (Ballantyne, 2008). The pipeline would be designed in accordance with all applicable federal and state safety codes, which would govern pipeline thickness, welding standards for joints, and pipeline strength. We conclude that this would allow the pipeline to withstand nearly all ground shaking that could be anticipated to occur, with the possible exception of ground movement associated with a fault rupture.

Surface Faults

According to the USGS Quaternary fault and fold database (USGS, 2006) and WDNR mapping (WDNR, 2011), the WEP would be in proximity to a number of Quaternary faults and fault zones. The WEP would cross two fault zones and be within 15 miles of several other fault features as described below, based on information from USGS (2006) and WDNR (2011) (see figure 4.2.1-1).

- **Seattle Fault Zone** (crossed between MPs 1371.7 and 1379.4): This is a 2.5- to 4.3-mile-wide, east-trending fault zone that extends from Hood Canal to the Cascade Range foothills. It crosses the Puget Lowland region and extends beneath the cities of Seattle, Bellevue, and Bremerton. The fault zone consists of three or more south-dipping thrust faults and multiple north-dipping thrust faults, although there is likely a south-dipping master fault. The Seattle Fault Zone is about 43 miles long and has ruptured within the last 15,000 years.

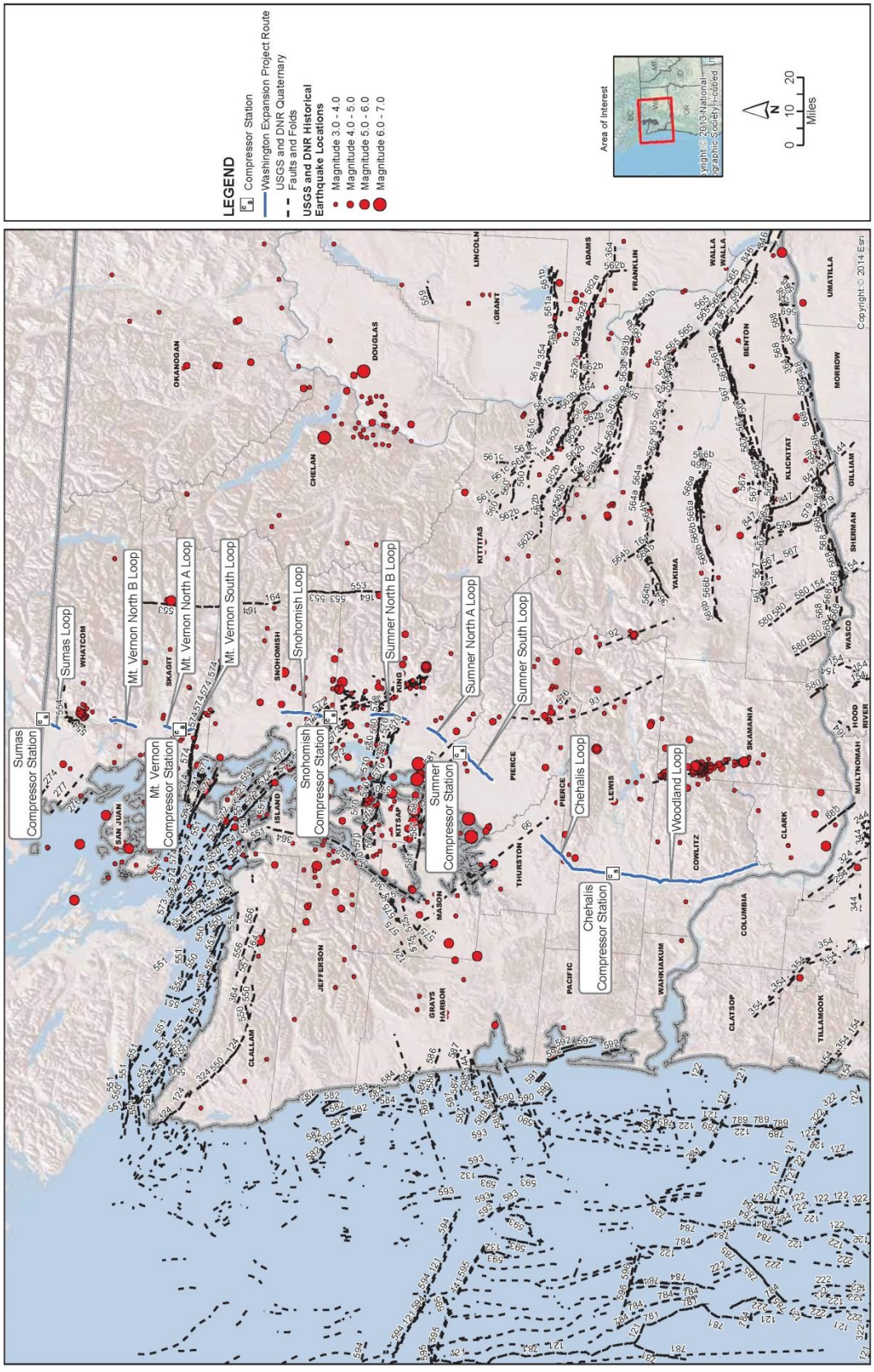


Figure 4.2.1-1: Quaternary Faults and Historical Earthquakes, Washington Expansion Project Area

- **Southern Whidbey Island Fault Zone** (crossed between MPs 1394.6 and 1399.9): This is a 3.1- to 4.3-mile-wide, northwest-trending thrust fault zone that extends across Possession Sound, southern Whidbey Island, Admiralty Inlet, and into the eastern Strait of Juan de Fuca. The fault zone is about 40 miles long and has ruptured within the last 15,000 years. The WDNR mapping indicates that the WEP pipeline would cross the fault zone, and the Snohomish Compressor Station is within 0.5 to 1.0 mile of the fault zone. However, the USGS mapping indicates that the pipeline would be about 11 miles to the east.
- **Devils Mountain Fault** (0.7 mile south of MP 1435.7): This is a north-dipping oblique-slip fault that extends west from the Cascade Range foothills to offshore Vancouver Island. Both ends of the Devils Mountain Fault merge or intersect with other fault zones. It is about 76 miles long and has ruptured within the last 130,000 years. The Mt. Vernon Compressor Station is within about 5 miles of the Devils Mountain Fault.
- **Tacoma Fault** (1.5 miles northwest of MP 1351.8 and the Sumner Compressor Station based on USGS information): This north-dipping thrust fault extends from the Tacoma region to Hood Canal and is thought to be a backthrust to the south-dipping Seattle Fault. The fault is about 14 miles long and has ruptured within the last 15,000 years. The USGS mapping indicates that the WEP would be about 23 miles southeast of the fault.
- **Olympia Structure** (3 miles northeast of MP 1315.6): This suspected fault is not in the USGS database, so limited information is available. According to the WDNR database, this is an inferred fault trace of unknown age.
- **Macaulay Creek Thrust (also called Boulder Creek Thrust)** (5 miles south of MP 1478.6): This is a south-dipping thrust fault that occurs in the Northern Cascade Mountains. This fault is thought to be interconnected with the Smith Creek and Boulder Creek faults. The fault is 2.5 miles long and has ruptured within the last 1,600,000 years. Some researchers have suggested that this fault may have been active as recently as 1990; however, no direct evidence of faulting has been found in Pleistocene or Holocene deposits.
- **Strawberry Point Fault** (12 miles west of MP 1435.7): This is a west-northwest-trending, subvertical fault that extends across northern Whidbey Island. Research suggests that the fault bifurcates into a 1.2-mile-wide fault zone on the eastern side of Whidbey Island that contains four fault splays. The fault is about 16 miles long and has ruptured within the last 130,000 years.
- **Utsalady Point Fault** (12 miles west of MP 1435.7): This is a northwest-trending, subvertical fault that extends across northern Whidbey Island. The fault is about 18 miles long and has ruptured within the last 15,000 years.

As indicated above, the fault features that would be directly crossed by the WEP consist of fault zones instead of a well-defined individual faults. Fault zones are generally not conducive to mitigation measures because the precise rupture location is difficult to predict. Therefore, Northwest does not expect to implement mitigation for fault rupture.

Soil Liquefaction

Soil liquefaction and lateral spreading are defined in section 4.1.1.1. Liquefaction can cause pipelines to undergo movement, including buoyancy, which can result in increased stress in the pipeline

and possible damage. Lateral spreading can be hazardous to pipelines, especially if the ground movement occurs perpendicular to the axis of the pipeline.

Based on WDNR mapping, about 41 locations along the WEP pipeline would have a moderate to high, or high relative liquefaction hazard, for a total of about 20.5 miles (see table 4.2.1-3).

Table 4.2.1-3

Locations with Moderate to High Liquefaction Hazard Along the WEP

Loop	Begin Milepost	End Milepost	Crossing Length (miles)	Relative Liquefaction Hazard
Woodland	1244.3	1244.3	< 0.1	Moderate to High
Woodland	1253.4	1253.6	0.2	Moderate to High
Woodland	1260.3	1260.6	0.3	Moderate to High
Woodland	1269.3	1269.4	0.1	Moderate to High
Woodland	1274.2	1274.5	0.3	Moderate to High
Woodland	1274.6	1275.0	0.4	Moderate to High
Woodland	1275.0	1275.5	0.5	Moderate to High
Woodland	1275.5	1275.7	0.2	Moderate to High
Woodland	1281.4	1282.5	1.1	Moderate to High
Woodland	1282.6	1283.2	0.6	Moderate to High
Chehalis	1294.1	1294.8	0.7	Moderate to High
Chehalis	1298.9	1299.0	0.1	Moderate to High
Chehalis	1301.7	1301.9	0.2	Moderate to High
Chehalis	1304.6	1304.7	0.1	Moderate to High
Chehalis	1305.1	1305.3	0.2	Moderate to High
Chehalis	1306.1	1306.5	0.4	Moderate to High
Chehalis	1308.7	1309.1	0.4	Moderate to High
Chehalis	1309.3	1310.2	0.9	Moderate to High
Sumner South	1347.0	1347.4	0.4	High
Sumner South	1347.4	1347.9	0.5	Moderate to High
Sumner South	1347.9	1347.9	< 0.1	High
Sumner South	1348.0	1348.2	0.2	High
Sumner South	1348.2	1349.5	1.3	Moderate to High
Sumner South	1349.5	1349.5	0.1	High
Sumner South	1349.5	1349.8	0.3	Moderate to High
Sumner South	1349.8	1349.9	0.1	High
Sumner South	1349.9	1350.1	0.2	Moderate to High
Sumner North A	1356.9	1357.2	0.3	Moderate to High
Sumner North B	1371.1	1371.2	0.1	Moderate to High
Sumner North B	1372.8	1373.5	0.7	Moderate to High
Snohomish	1397.0	1397.6	0.6	Moderate to High
Snohomish	1397.8	1397.9	0.1	Moderate to High
Snohomish	1401.0	1402.9	1.9	Moderate to High
Snohomish	1407.8	1408.3	0.5	Moderate to High

Table 4.2.1-3

Locations with Moderate to High Liquefaction Hazard Along the WEP

Loop	Begin Milepost	End Milepost	Crossing Length (miles)	Relative Liquefaction Hazard
Mt. Vernon North A	1440.4	1441.7	1.3	Moderate to High
Mt. Vernon North A	1445.0	1445.0	0.1	Moderate to High
Mt. Vernon North B	1454.4	1454.5	0.1	Moderate to High
Mt. Vernon North B	1454.6	1454.8	0.2	Moderate to High
Mt. Vernon North B	1459.2	1460.2	1.0	Moderate to High
Mt. Vernon North B	1460.4	1461.9	1.5	Moderate to High
Sumas	1482.2	1484.5	2.3	Moderate to High
Total			**20.5**	

Source: WDNR, 2010b

Some of the risk of liquefaction along the WEP would be mitigated by use of trenchless techniques to cross some of the major rivers along the route (Cowlitz, Newaukum, Puyallup, Snohomish, and South Fork Nooksack Rivers). Installation using trenchless techniques, such as HDD, would allow the pipeline to be installed at deeper depths where the risk of liquefaction and lateral spread may be reduced. The risk of the pipeline becoming buoyant can be mitigated by adding weight to the pipeline (e.g., installing concrete coating or weights) at locations where it travels through potentially liquefiable soil. The risk of pipeline damage from lateral spread can be minimized by aligning the pipeline to travel parallel to the ground slope instead of placing it across the slope. Northwest would perform detailed liquefaction analyses at critical locations along the route during final design and determine appropriate site-specific mitigation.

4.2.1.4 Other Geologic and Natural Hazards

Volcanism

The major Cascade volcanoes that would be closest to the WEP and their distances are: Mount Adams, 61 miles; Mount St. Helens, 31 miles; Mount Rainier, 31 miles; Glacier Peak, 44 miles; and Mount Baker, 17 miles.

USGS volcanic hazard maps (USGS, 1996) indicate that eruptions from the Cascade volcanoes could impact the WEP. Table 4.2.1-4 lists the areas where the WEP would cross volcanic hazard areas, including 13 locations where the WEP would cross a mapped lahar hazard. The lahar hazard areas include the valleys formed by the Kalama, Cowlitz, Toutle, Puyallup, White, Skagit, South Fork Nooksack, and Fraser Rivers. In addition, the WEP would cross a location that is mapped as being susceptible to a volcanic blast, lava flows, and damaging flows from Mount Baker. The existing Sumas Compressor Station is in a mapped Mt. Baker lahar hazard area.

Table 4.2.1-4

Volcanic Hazards in Proximity of the WEP

Loop	Begin Milepost	End Milepost	Volcanic Hazard	Volcano
Woodland	1253.3	1253.5	Lahar	Mt. St. Helens
Woodland	1269.0	1269.5	Lahar	Mt. Rainier
Woodland	1274.2	1274.9	Lahar [a]	Mt. St. Helens
Woodland	1275.6	1275.7	Lahar	Mt. St. Helens
Woodland	1278.8	1287.0	Lahar	Mt. Rainier
Sumner South	1347.2	1351.9	Lahar	Mt. Rainier
Sumner South	1347.7 [b]	1348.1	Lahar	Mt. Rainier
Sumner North A	1356.9	1357.4	Lahar	Mt. Rainier
Mt. Vernon North A	1440.7	1441.9	Lahar	Glacier Peak
Mt. Vernon North A	1440.8	1441.0	Lahar	Mt. Baker
Mt. Vernon North A	1444.7	1445.0	Lahar	Glacier Peak
Mt. Vernon North A	1444.9	1445.0	Lahar	Mt. Baker
Mt. Vernon North B	1458.8	1461.9	Blast/Lava/Flow	Mt. Baker
Sumas	1482.3	1484.5	Lahar	Mt. Baker

[a] Existing lahar deposits from previous eruptions have been mapped between MPs 1274.2 and 1275.0 (WDNR, 2010c).

[b] Some of the volcanic hazards overlap each other because different eruption scenarios modeled in the USGS study produce lahars at the same location.

Source: U.S. Geological Survey, 1996.

In addition to these hazards, volcanic ash and tephra could fall across the project area during an eruption. The ash is not considered a major hazard, mostly causing disruptions to social and economic activities, minor health hazards for people, and damaging certain types of equipment. Ash and tephra would cause little to no impact on buried pipelines or associated aboveground facilities. Because most of the WEP facilities within the lahar and lava flow hazard areas would be below ground, and given the infrequency of eruptions relative to the project lifetime, we do not consider volcanism to be a significant hazard for the WEP.

Landslide Susceptibility

The WEP would cross areas of steep slopes that could be susceptible to landslides. The general characteristics of landslide susceptibility and landslide risks are described in section 4.1.1.2. We received comments expressing concerns that vegetation clearing associated with construction of the WEP could increase landslide risk, particularly in areas outside of the existing right-of-way.

To assess landslide susceptibility along the proposed WEP pipeline route, Northwest prepared two types of landslide hazard maps. The first type is based on WDNR and available county data (Lewis, Thurston, and Skagit Counties do not have landslide information) and shows areas where new landslides potentially may occur in the future based largely on steep slope angles and the presence of soils known to be susceptible to instability. The second type contains the documented landslides that have been identified in the WEP vicinity based on WDNR, Cowlitz County, King County, and Whatcom County data as well as geotechnical studies conducted by Northwest over the years for its existing pipeline right-of-way.

The locations mapped as potential landslide hazards or steep slopes are summarized in table K2-1 of appendix K2. These include 11 locations along the Woodland Loop, 62 locations along the Sumner

South Loop, 4 locations along the Sumner North A Loop, 1 location along the Sumner North B Loop, and 29 along the Snohomish Loop. The WEP would cross 39 documented landslides that have been identified by WDNR or counties but no distinction is made regarding whether they are active or inactive. These are described in table K2-2 of appendix K2 and include 24 along the Woodland Loop, 8 along the Chehalis Loop, 4 along the Sumner North A Loop, and 3 along the Sumner North B Loop.

The 22 active landslide areas along the Woodland, Chehalis, Snohomish, and Mt. Vernon North A Loops, which Northwest identified based on previous experience operating its existing pipeline, are summarized in table K2-3 of appendix K2. This table includes a description of the measures that Northwest has implemented to mitigate the impacts of each landslide hazard. At a minimum, all of these areas are visually monitored on a regular basis and surface displacement surveys are conducted periodically in some locations. Other mitigation measures that Northwest has implemented, depending on the location, include: installation of drainage systems, regrading of slopes, installation of strain gauges to monitor ground movement, and excavations to relieve strain.

Following any event that is determined to carry a significant potential to have reactivated old landslides or triggered new landslides, Northwest initiates a route reconnaissance. Such events include unseasonably heavy precipitation (generally precipitation that results in extensive flooding or is reported to trigger more landslides than usual) and large seismic events. At a minimum, the event-driven route reconnaissance consists of a low-level (helicopter) aerial reconnaissance supplemented by on-ground reconnaissance of any identified potential hazards.

Ninety-four percent of the WEP pipeline would be installed within Northwest's existing pipeline right-of-way, and the geologic hazards at the locations where it would deviate would be similar to known conditions in the existing right-of-way. Northwest would incorporate into the WEP mitigation measures similar to those already in place for its existing pipeline system at the known landslide hazard areas along the proposed route. Plans for addressing specific landslides would be developed during the design phase of the WEP. During the construction phase, a geotechnical engineer or geologist would be available as required to observe construction in landslide areas and determine where additional monitoring and mitigation equipment may be necessary. Northwest would also follow the best management practices it has developed for construction in landslide areas. Examples include surface and groundwater control, or incorporating select backfill (such as rounded pea-gravel or sand), which can deform around the pipeline and induce less stress on the pipe compared with conventional backfill material during land movement.

Northwest has stated that it would address specific landslides and incorporate mitigation measures into the design of the WEP. Therefore, **we recommend that:**

- **<u>Prior to construction,</u> Northwest should file with the Secretary, for review and written approval by the Director of OEP, the following:**

  a. results of final geotechnical investigations necessary to support final pipeline routing/mitigation measures through geologically hazardous areas; and

  b. a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan.

Climate change is expected to produce more frequent extreme precipitation events. This could lead to an increased risk of landslide on steep slopes maintained in a nonforested condition. The risk of landslides would be highest the first couple of years after construction while vegetation is getting re-established. The measures for erosion control on steep slopes included in Northwest's Plan, Procedures,

and the installation of engineered subsurface drainage to reduce soil saturation would help mitigate the risk of increased extreme precipitation events.

Subsidence

The WEP would not cross areas where large amounts of groundwater or oil are being extracted and would be more than 0.5 mile from concentrations of oil or gas wells. Further, the WEP would not cross any areas known to contain karst topography.

As discussed above under section 4.2.1.2, a number of abandoned underground mines are in the vicinity of MP 1301.0 and MP 1307.0. Between 1304.4 and 1306.0, there is sporadic evidence at the ground surface that underground tunnels have collapsed, but it is unknown whether these collapses were intentional or unintentional. Many of these underground mines in this area were likely removed through surface mining at the TransAlta Mine. There could be other abandoned underground mines in the area that were not recorded in federal or state databases; however, the WEP would be installed adjacent to an existing Northwest pipeline that has not experienced any subsidence.

If evidence of underground mining features is unexpectedly encountered during the WEP construction, Northwest would consult with licensed engineers and geologists to determine whether the feature presents a hazard to the pipeline and how to mitigate it. Mitigation measures may include filling underground voids with concrete or engineered fill, bridging small voids, or rerouting the WEP around the voids. Northwest would monitor the permanent right-of-way regularly and any subsidence that could pose a risk to the pipeline would likely be quickly identified so that corrective actions could be implemented.

Flooding, Bank Erosion, and Scour

Flooding (like shallow groundwater) can cause buoyancy in pipelines. Flooding can also induce lateral migration of streams and cause scour that can undermine or expose a pipeline.

The WEP would cross FEMA-mapped 100-year floodplains at 40 different locations as shown in table 4.2.1-5. A total of about 11.2 miles of pipeline would be within 100-year floodplain zones, out of a total pipeline length of about 140 miles. The pig launcher/receiver and MLV at the interconnect with the Oregon LNG pipeline (MP 1244.3) would be at the edge of a 100-year floodplain. In addition, the Sumas Compressor Station (MP 1284.5), where a new pig launcher/receiver and MLV would be constructed, is within a 100-year floodplain. As required by Executive Order 11988, floodplains were considered during the siting process and avoided, to the extent possible. However, because of the linear nature of the WEP and because it would be co-located with existing Northwest facilities, total avoidance would not be possible. The pipeline would be installed below the ground surface, and the surface of the right-of-way restored and stabilized following construction which would minimize environmental impacts and modification of floodplains.

Table 4.2.1-5

Portions of the WEP Within the 100-year Floodplain

Loop	Begin Milepost	End Milepost	Crossing Length (miles)
Woodland	1244.3	1244.3	<0.1
Woodland	1253.4	1253.5	0.1
Woodland	1257.0	1257.3	0.2
Woodland	1257.6	1257.6	<0.1
Woodland	1260.4	1260.6	0.3
Woodland	1264.9	1265.0	<0.1
Woodland	1265.2	1265.3	0.1
Woodland	1274.4	1274.6	0.2
Woodland	1280.8	1281.0	0.2
Woodland	1281.5	1282.6	1.1
Woodland	1284.6	1284.6	<0.1
Woodland	1285.4	1285.4	<0.1
Chehalis	1294.1	1294.7	0.5
Chehalis	1299.0	1299.1	<0.1
Chehalis	1301.7	1301.9	0.2
Chehalis	1304.5	1304.6	0.1
Chehalis	1305.2	1305.3	0.1
Chehalis	1306.2	1306.6	0.4
Chehalis	1309.0	1309.1	0.1
Chehalis	1309.2	1309.4	0.2
Chehalis	1315.0	1315.1	0.1
Sumner South	1340.0	1340.0	0.1
Sumner South	1340.0	1340.0	0.1
Sumner South	1340.7	1340.1	0.1
Sumner South	1346.9	1347.1	0.1
Sumner South	1347.1	1347.3	0.2
Sumner South	1347.9	1348.2	0.2
Sumner South	1350.0	1350.0	<0.1
Sumner North B	1371.1	1371.2	0.1
Snohomish	1397.1	1398.0	0.9
Snohomish	1400.9	1402.9	2.0
Snohomish	1407.8	1408.3	0.5
Mt. Vernon South	1437.9	1438.0	0.1
Mt. Vernon South	1439.1	1439.2	0.2
Mt. Vernon North A	1440.4	1441.5	1.1
Mt. Vernon North A	1444.9	1445.0	0.1
Mt. Vernon North B	1459.3	1460.1	0.8
Sumas	1478.8	1478.9	0.1
Sumas	1483.1	1483.1	<0.1
Sumas	1483.9	1484.5	0.6
Total			**11.2**

Source: FEMA, 1981-2004.

The largest areas along the pipeline route that would be susceptible to flooding are at the crossings of the following major rivers: Cowlitz, Newaukum, Puyallup, Snohomish, and South Fork Nooksack. Northwest would install the pipeline using trenchless techniques at these rivers. These installation methods would result in the pipeline being located at sufficient depth that flooding would not be a hazard to the pipeline.

Northwest conducted a high-level stream channel assessment and scour analysis for waterbodies that would be crossed by the WEP (CH2M HILL, 2014). The waterbodies assessed included streams with perennial flow regimes and those supporting federally listed salmonids. A total of 173 waterbodies were evaluated to determine which pipeline crossings have a predisposition for vertical scouring or lateral migration. Seventy-nine waterbodies had moderate or higher potential for vertical scour and 26 of these had a severe potential for scour. Eighty-four waterbodies had a moderate potential for lateral channel migration, and 25 had a severe potential. Six of the eight major waterbodies that would be crossed by the WEP had moderate potential for lateral channel migration and none had moderate or higher potential for vertical scour.

The results of the stream channel assessment and scour analysis would be used to inform engineers which streams require special attention regarding depth of pipeline during final design. The depth and length that the pipeline would be buried for each severe scour or lateral-migration stream would be addressed during final design. Northwest would weight the pipeline to counteract buoyancy at waterbody crossings and in floodplains. In addition to regular monitoring of the pipeline, Northwest would inspect the pipeline after significant rain or flooding events for areas of scour or pipeline exposure.

Climate change is predicted to increase extreme precipitation events which could increase runoff and the velocity and energy in streamflows. This could increase the risk of scouring and erosion of streambeds. Northwest has committed to burying the pipeline under streams at a depth that would minimize the risk of exposing the pipe in the event of streambed scouring or channel migration.

4.2.1.5 Paleontological Resources

As shown in table 4.2.1-6, Northwest has identified a number of geologic units that would be crossed by the WEP that have potential to contain fossils. Seven of these geologic units may contain invertebrate and plant fossils and have high paleontological sensitivity.

Table 4.2.1-6

Location of Potentially Fossiliferous Geologic Units

Stratigraphic Unit	Age	Paleontological Sensitivity	Milepost Range [a]
Peat Deposits	Quaternary	Moderate to Unknown	Throughout
Troutdale Formation	Pliocene to Miocene	High	1261.4 to 1263.0
Cowlitz Formation	Eocene	High	1261.1 to 1276.4
Wilkes Formation	Miocene	Moderate	1272.6 to 1278.9
Toutle Formation	Oligocene to Eocene	High	1281.3 to 1281.4
Lincoln Creek Formation	Oligocene to Eocene	High	1298.5 to 1301.5
Skookumchuck Formation	Eocene	High	1301.5 to 1309.3
Puget Group, Tukwila Formation	Eocene	High	1374.9 to 1375.6
Puget Group, Renton Formation	Oligocene to Eocene	High	1375.6 to 1376.2
Huntingdon Formation	Oligocene-Eocene	Moderate	1479.3 to 1480.89

[a] From the first outcrop to the last. These geologic units occur intermittently and may overlap each other.

Only the excavation phase of the WEP would have the potential to adversely impact paleontological resources. Direct impacts on paleontological resources could occur as a result of construction equipment digging up and mechanically damaging fossils, or from unauthorized collection of fossils once they have been exposed by an excavation. Project operations and the construction of aboveground facilities (other than excavations for foundations) would have no potential to impact paleontological resources.

Prior to construction, Northwest would develop a PRMMP that would be implemented during construction. The PRMMP would summarize and identify final preconstruction determinations of paleontological sensitivity along the WEP route, and provide requirements and measures for:

- construction monitoring and coordination;
- worker education;
- emergency discovery;
- sampling and data recovery, if needed;
- museum storage coordination for any specimens and data recovered;
- a program for preconstruction and construction-phase coordination; and
- reporting, including monitoring reports, incident reports, and a final report.

Implementation of these mitigation measures would reduce the potential impact from project-related ground disturbance on paleontological resources by allowing for the recovery of fossils and associated specimen data, and corresponding geologic and paleoenvironmental data, that otherwise might be lost to excavations or to unauthorized fossil collecting.

We conclude that the WEP would not have significant impacts on geologic resources. In addition, with the implementation of Northwest's proposed mitigation measures and our recommendations, the geologic risk to project facilities would be minimized.

4.2.2 Soils

We used the USDA's NRCS SSURGO database and NRCS Soil Survey Reports to obtain information about soils in the WEP area. Section 4.1.2 contains a complete description of the soils review methods, which were the same for the WEP as for Oregon LNG.

4.2.2.1 Existing Environment

Information regarding soils along the WEP pipeline is based on Soil Surveys of Cowlitz (NRCS, 2012), Lewis (NRCS, 1987), Thurston (NRCS, 1990), Pierce (NRCS, 1979), King (NRCS, 1973), Snohomish (NRCS, 1983), Skagit (NRCS, 1989), and Whatcom (NRCS, 1992) Counties. The loops would cross numerous different soil types across these eight counties. The soil associations for each loop are described in table 4.2.2-1. Soil associations are groups of soil series that occupy associated areas on a particular landscape and represent a larger grouping than a specific soil series. Most of the affected soils have been previously disturbed during construction of the existing pipeline facilities and these have been successfully stabilized since construction.

Table 4.2.2-1

Soil Associations Along the WEP Pipeline

Facility/Soil Map Unit	Miles Crossed	Description
Woodland Loop		**Cowlitz County**
Caples-Clato-Newberg	0.9	This map unit has very deep and well or artificially drained. It is located on floodplains and has a slope of 0 to 3 percent. These soils are used for crops, pasture, wooded areas, residential development, and industrial development.
Kelso-Kalama-Minniece	1.0	This map unit has very deep, somewhat poorly and moderately well drained soils. It occurs on terraces and terrace escarpments with slopes of 0 to 60 percent. These soils are used for hay, pasture, residential development, and wooded areas.
Riverwash-Cowlitz-Delameter	1.0	This map unit has very deep, somewhat excessively drained soils or riverwash. It has slopes of 0 to 30 percent and is in floodplains and terraces. These soils are used for wooded areas, pastureland, and recreation.
Centralia-Buckpeak	2.1	This map unit has very deep, well drained soils on hill slopes, plateaus, and ridge tops. It has slopes of 0 to 90 percent. These soils are used for crops, pasture, and wooded areas.
Hazeldell-Olympic	27.4	This map unit has very deep, well drained soils on benches, terraces, hill slopes, and mountain slopes. It has slopes of 2 to 65 percent. These soils are used for crops, pasture, and wooded areas.
Seaquest-Sara	2.6	This map unit has very deep, moderately well drained and well drained soils. It has slopes of 0 to 40 percent. These soils are used for crops, pasture, and wooded areas.
		Lewis County
Ledow-Cloquato	1.3	This map unit has very deep, somewhat excessively drained and well drained soils on floodplains and terraces. It has slopes of 0 to 3 percent. These soils are used for timber production and crops.
Salkum-Prather-Lacamas	7.8	This map unit has very deep, moderately well drained and poorly drained soils on plains, high terraces, ridge tops, and bottomlands. Slopes range from 0 to 65 percent. These soils are used for timber production, hay, pasture, and crops.
Melbourne-Buckpeak-Centralia	1.1	This map unit has very deep, well drained soils on beaches, hillsides, and ridge tops. Slopes range from 0 to 90 percent. These soils are used for timber, crops, hay and pasture.
Chehalis Loop		**Lewis County**
Reed-Chehalis	4.7	This map unit has very deep, poorly drained and well drained soils on floodplains and terraces. Slopes range from 0 to 3 percent. These soils are used for timber production, crops, hay, and pasture.
Salkum-Prather-Lacamas	5.9	This map unit has very deep, moderately well drained and poorly drained soils on plains, high terraces, ridge tops, and bottomlands. Slopes range from 0 to 65 percent. These soils are used for timber production, hay, pasture, and crops.
Melbourne-Buckpeak-Centralia	5.4	This map unit has very deep, well drained soils on beaches, hillsides, and ridge tops. Slopes range from 0 to 90 percent. These soils are used for timber, crops, hay, and pasture.
		Thurston County
Chehalis-Newberg	0.7	This map unit has very deep, well drained soils on floodplains. Slopes range from 0 to 3 percent. These soils are used for hay, pasture, crops, and wooded areas.
Spanaway-Nisqually	0.8	This map unit has very deep, somewhat excessively drained soils on glacial outwash terraces. Slopes range from 0 to 15 percent. These soils are used for hay, pasture, and wooded areas.
Alderwood-Everett	0.6	This map unit has moderately deep and very deep, moderately well drained soils on glacial till plains. Slopes range from 0 to 50 percent. These soils are used for hay, pasture, and wooded areas.

Table 4.2.2-1

Soil Associations Along the WEP Pipeline

Facility/Soil Map Unit	Miles Crossed	Description
Baumgard-Wilkeson	4.5	This map unit has deep to very deep, well drained soils on uplands and mountains. It has slopes from 5 to 65 percent. These soils are used for wooded areas and recreational development.
Salkum-Prather	0.8	This map unit has deep to very deep, well drained and moderately well drained soils on upland terraces. Slopes range from 3 to 30 percent. These soils are used for wooded areas, hay, and pasture.
Melbourne-Centralia	0.9	This map unit has deep and very deep, well drained soils on uplands. Slopes range from 5 to 65 percent. These soils are used for wooded areas and recreational development.
Sumner South Loop		**Pierce County**
Kapowsin	3.0	This map unit has moderately well drained soils in glacial till on uplands. Slopes range from 0 to 70 percent. These soils are used for wooded areas, urban development, and crops.
Alderwood-Everett	6.6	This map unit has moderately well drained and somewhat excessively drained soils in glacial till and outwash on uplands. Slopes range from 0 to 30 percent. These soils are used for timber production and residential and industrial development.
Spanaway	1.0	This map unit has somewhat excessively drained soils on glacial outwash on uplands. Slopes range from 0 to 15 percent. These soils are used for urban development, wood areas, and native grazing lands.
Puyallup-Sultan	3.2	This map unit has well to moderately well drained soils on floodplains. Slopes range from 0 to 3 percent. These soils are used for farming and residential and industrial development.
Sumner North A Loop		**King County**
Alderwood	3.2	This map unit has moderately well drained soils in glacial till on uplands and terraces. Slopes range from 0 to 30 percent. These soils are used for pasture, timber, and residential and industrial development.
Oridia-Seattle-Woodinville	0.6	This map unit has somewhat poorly and very poorly drained soils in major stream valleys. Slopes range from 0 to 30 percent. These soils are used for crops, pasture, and some residential development.
Everett	3.2	This map unit has somewhat excessively drained soils in gravelly glacial outwash on terraces. Slopes range from 0 to 30 percent. These soils are used for timber production and residential and industrial development.
Sumner North B Loop		**King County**
Alderwood	3.5	This map unit has moderately well drained soils in glacial till on uplands and terraces. Slopes range from 0 to 30 percent. These soils are used for pasture, timber, and residential and industrial development.
Everett	5.3	This map unit has somewhat excessively drained soils in gravelly glacial outwash on terraces. Slopes range from 0 to 30 percent. These soils are used for timber production, and residential and industrial development.
Beausite-Alderwood	2.3	This map unit has well and moderately well drained soils in glacial till on uplands. Slopes range from 15 to 75 percent. These soils are used for timber production and pasture.

Table 4.2.2-1

Soil Associations Along the WEP Pipeline

Facility/Soil Map Unit	Miles Crossed	Description
Snohomish Loop		**Snohomish County**
Puget-Sultan-Pilchuck	5.2	This map unit has poorly drained, moderately well drained and somewhat excessively drained soils on floodplains. Slopes range from 0 to 3 percent. These soils are used for hay, crops, and pasture.
Alderwood-Everett	5.6	This map unit has moderately well drained and somewhat excessively drained soils in glacial till and outwash on uplands. Slopes range from 0 to 70 percent. These soils are used for timber production, hay, pasture, and urban development.
Tokul-Pastik	4.8	This map unit is moderately well drained soils on till plains and terraces. Slopes range from 0 to 50 percent. These soils are used for wooded areas, hay, pasture, and urban development.
Mt. Vernon South Loop		**Skagit County**
Tokul-Skipopa-Dystric Xerochrepts	3.9	This map unit has somewhat poorly to well drained soil on terraces, hills, and escarpments. Slopes range from 0 to 90 percent. These soils are used for wooded areas, pasture, hay, and urban development.
Bow-Coveland-Swinomish	0.6	This map unit has somewhat poorly to moderately well drained soils on terraces and hills. Slopes range from 0 to 30 percent. These soils are used for wooded areas, hay, pasture, and urban development.
Mt. Vernon North A Loop		**Skagit County**
Larush-Pilchuck	0.2	This map unit has well and excessively drained soils on floodplains and low terraces. Slopes range from 0 to 5 percent. These soils are used for pasture, wooded areas, and urban development.
Vanzandt-Montbourne-Squires	4.7	This map unit has moderately well and well drained soils on plains and mountain sides. Slopes range from 0 to 65 percent. These soils are used for wooded areas.
Mt. Vernon North B Loop		**Skagit County**
Barneston-Dystric Xerorthents-Indianola	2.9	This map unit has somewhat excessively and excessively drained soils on terraces and terrace escarpments. Slopes range from 0 to 80 percent. These soils are used for wooded areas and urban development.
		Whatcom County
Mt. Vernon-Puyallup	1.2	This map unit has moderately well and well drained soils on river terraces and floodplains. Slopes range from 0 to 2 percent. These soils are used for hay, pasture, and crops.
Briscot-Oridia	0.6	This map unit has poorly drained soils that have been artificially drained on floodplains. Slopes range from 0 to 2 percent. These soils are used for hay, pasture, and cropland.
Kickerville-Barneston-Everett	3.6	This map unit has well drained and somewhat excessively drained soils on outwash terraces and moraines. Slopes range from 0 to 60 percent. These soils are used for hay, pasture, wooded areas, and crops.
Sumas Loop		**Whatcom County**
Briscot-Oridia	1.8	This map unit has poorly drained soils that have been artificially drained on floodplains. Slopes range from 0 to 2 percent. These soils are used for hay, pasture, and crops.
Kickerville-Barneston-Everett	4.1	This map unit has well drained and somewhat excessively drained soils on outwash terraces and moraines. Slopes range from 0 to 60 percent. These soils are used for hay, pasture, wooded areas, and crops.

The project would also include modifications to existing compressor stations and construction of new aboveground facilities, including pig launcher/receivers and MLVs. The compressor station modifications would be within the existing previously graded and graveled footprint and the aboveground facilities would be within the area of pipeline right-of-way as described in table 4.2.2-1. After construction, the disturbed areas of the aboveground facilities would be regraveled, and temporary workspaces would be revegetated or restored to previous uses.

4.2.2.2 Soil Characteristics and Limitations

Several soil characteristics have the potential to affect, or be affected by, construction and operation of the pipeline. These include erosion potential, depth to shallow bedrock, stony and rocky soils, compaction potential, revegetation concerns, drainage patterns, hydric soils, and prime farmlands or farmlands of statewide importance. Limitations for soils crossed by the project are summarized in table 4.2.2-2 by miles crossed for the loops and acres disturbed for aboveground facilities. The acres disturbed for aboveground facilities include only areas where the facility footprint would extend outside previously graded or graveled areas. The proposed compressor station upgrades are inside previously graded or graveled areas and thus are not included in table 4.2.2-2.

Table 4.2.2-2

Characteristics and Limitations of Soils Affected by Construction

Pipeline or Aboveground Facilities [a]	Shallow Depth to Bedrock or Coarse Fragments [b]	High Compaction Potential [c]	High Erosion Hazard from Water [d]	Poor Revegetation Potential [e]	Important Farmland Soils [f]
Woodland Loop	8.5	13.7	33.0	39.1	36.9
Chehalis Loop	2.0	15.0	16.6	17.0	18.4
Sumner South Loop	9.1	7.0	4.1	6.2	13.0
Sumner North A Loop	6.6	3.8	2.9	4.9	5.5
Sumner North B Loop	8.7	6.6	6.9	6.8	9.2
Snohomish Loop	11.4	13.8	10.0	5.7	14.7
Mt. Vernon South Loop	3.8	1.1	1.5	1.5	4.4
Mt. Vernon North A Loop	3.4	1.3	3.5	2.6	3.8
Mt. Vernon North B Loop	3.4	5.4	4.2	7.8	5.7
Sumas Loop	0.6	5.3	3.1	4.2	5.5
Total Pipeline	**57.3**	**72.9**	**85.8**	**95.9**	**117.2**
Aboveground Facilities	**4.0**	**3.5**	**3.6**	**7.8**	**9.2**

[a] Values for loops are shown in miles rounded to the nearest tenth. Values for aboveground facilities are in acres rounded to the nearest tenth and include only acreage outside existing graveled or graded areas.

[b] Soils identified as containing bedrock or coarse fragments to a depth of 5 feet or less from the surface.

[c] Includes soils in somewhat poor-to-very poorly drainage classes with surface textures of sandy clay loam or finer; includes all areas covered with water or seasonally ponded.

[d] Soils with Land Capability Class of 3 through 8 and a subclass of "e" indicating main limitation would be at risk of erosion unless close-grown cover would be maintained; includes all areas covered with water or seasonally ponded.

[e] Soils with Land Capability Class of 4 or higher and difficult to revegetate under normal management practices. Includes surface textures of fine sand or coarser and a drainage class of well, somewhat excessively, or excessively drained.

[f] Includes Prime, Unique, and Farmland of Statewide Importance, as designated by the NRCS and the State of Washington.

Stony/Rocky and Shallow to Bedrock Soils

About 57.3 miles (43 percent) of the WEP pipeline would occur in soils classified as having shallow depth to bedrock. This soil characteristic would be highly variable across the loops. The loops in the south and far north (i.e., Woodland, Chehalis, and Sumas) generally would have fewer soils with shallow depths to bedrock and the loops in the central areas would have more soils with shallow depths to bedrock. About 4.0 acres (30 percent of the total area) occupied by the aboveground facilities outside the existing graveled or graded areas would be in shallow depth- to bedrock soils.

Areas with shallow depth to bedrock pose a risk of introducing rock into the topsoil in agricultural and residential areas. Minimization efforts would include segregating topsoil and storing topsoil separate from subsoil during construction. Excess rock in the top 12 inches of the topsoil would be removed before topsoil is replaced. When topsoil is replaced, density, size and distribution of rocks would be similar to adjacent areas. In areas where excess rock is used to backfill the trench, depth of topsoil would match the preconstruction soil profile. Excess rock may be removed from other areas if requested by landowners.

Areas of shallow bedrock require special excavation techniques as described in section 4.2.1. Northwest would not use blasting in shallow bedrock conditions in order to protect its existing pipelines.

Soil Compaction and Rutting

Soil compaction and rutting caused by heavy equipment during pipeline construction may increase runoff, reduce agricultural crop yields and adversely affect growth of lawns and ornamental plants in residential areas. About 72.9 miles (49 percent) of the WEP route would occur in soils with high compaction potential. The Woodland, Mt. Vernon South, and Mt. Vernon North A Loops would have fewer soils (less than 30 percent) with high compaction potential. The Snohomish and Sumas Loops would have greater than 89 percent soils with high compaction potential. The area occupied by aboveground facilities would include about 3.5 acres (24 percent) of soils with high compaction potential.

Northwest would minimize soil compaction and rutting by following its Plan, Procedures, and ECRP (see appendix J1). When soils are disturbed by construction activities in residential and agricultural areas, compaction potential in soils would be tested using penetrometers or other devices to measure soil compaction and compared to similar, undisturbed soils under similar moisture conditions. Severely compacted agricultural areas would be plowed to reduce compaction and subsoil would be decompacted in areas with topsoil segregation. If requested by the landowner, temporary crops would be planted and plowed under to reduce soil bulk density and improve soil structure.

Water Erosion

During pipeline construction, existing vegetation would be cleared, increasing the risk of erosion from water that could result in a loss of fertile topsoil and reduced agricultural productivity.

About 85.8 miles (61 percent) of the proposed WEP route would cross soils with high potential for water erosion. The majority of the loops would range from 50 percent to 73 percent highly water erodible soils, but the Sumner South and Mt. Vernon South Loops both would have less than 33 percent highly erodible soils. About 3.6 acres (24 percent) of proposed aboveground facilities would be constructed in soils with high water erosion potential.

Northwest would minimize soil erosion potential by following its Plan, Procedures, and ECRP. Temporary erosion control measures would include specified construction ingress and egress points, and use of sediment barriers, temporary slope breakers, runoff controls, mulch, and erosion control fabric. Permanent erosion control measures would include trench breakers, slope breakers, and revegetation. Reseeding of disturbed areas would follow guidance from the NRCS and other state and local agencies.

Revegetation Potential

The clearing and grading of soils with poor revegetation potential could result in a lack of adequate vegetation following construction and restoration of the right-of-way, which could lead to increased erosion, a reduction in wildlife habitat, and negative visual impacts.

About 95.1 miles (68 percent) of the proposed WEP route would cross soils classified with poor revegetation potential. About 7.8 acres (54 percent) of the proposed aboveground facilities would occur in soils classified with poor revegetation potential. Distribution of soils with poor revegetation potential varies widely across the loops. The Mt. Vernon North B Loop would cross almost entirely (93 percent) soils with poor revegetation potential, whereas about one-third of the soils crossed by the Mt. Vernon South (33 percent) and Snohomish Loops (37 percent) have would have poor revegetation potential.

Revegetation measures would follow Northwest's Plan, Procedures, and ECRP. Revegetation would also be guided by terms and conditions of applicable Washington State permits and regulatory review, and landowner requests. In areas with poor revegetation potential, Northwest would take additional efforts to ensure successful site restoration, such as additional seedbed preparation, rock collection and removal, soil grading, soil scarification, or additional soil amendments or preparation. Erosion control would remain in place until vegetation has been successfully established.

Important Farmland and Drain Tiles

The potential impacts on Important Farmland soils during the WEP construction would include mixing of topsoil and subsoil, soil compaction, and rutting. These impacts would result primarily from the trench excavation and backfilling, and vehicular traffic along the right-of-way. Permanent impacts would include removal of Important Farmland availability for certain types of crops.

About 117.2 miles (83 percent) of the WEP route would cross Important Farmland soils. Important Farmland soils would be distributed relatively evenly across the loops. About 9.2 acres (64 percent) of the construction footprint for aboveground facilities would occur in soils classified as Important Farmland. Less than 0.5 acres of Important Farmland would be permanently impacted by aboveground facilities.

The majority of the impacts on Important Farmland soils would occur during construction and would be temporary. Impact mitigation for the proposed WEP would follow Northwest's Plan, Procedures, and ECRP. Mitigation measures could include restoration of subsoil and topsoil horizons, soil compaction minimization and mitigation, fertilization, revegetation, and erosion control. All farmland areas would be restored regardless of current use.

Drain tiles and below ground irrigation systems could be damaged during pipeline construction. Prior to construction, Northwest would consult with landowners to identify locations of drain tiles and irrigation systems. Northwest has committed to repair or remediate damaged drain tiles or irrigation systems associated with construction to preconstruction functionality.

4.2.2.3 Soil Contamination

Section 4.2.9.11 discusses sites in the vicinity of the project with potential for soil contamination. Because the WEP route follows an existing pipeline corridor within right-of-way controlled by Northwest, the pipeline would be unlikely to encounter new areas of soil contamination. Trenching operations would be monitored to identify potentially contaminated soils by visual inspection for stained soils, groundwater sheen, or suspect odors. In the unlikely event that contaminated soils or groundwater are encountered during construction, Northwest would follow protocol in its Unanticipated Discovery of Contamination Plan (see appendix J2). This plan includes procedures to test for contaminants if suspect soils are encountered as well as management and disposal of contaminated soils at a licensed disposal facility.

4.2.2.4 Alternative Measures to Our Plan

Northwest anticipates that wood chips may be generated during clearing operations and that they would be scattered across the right-of-way with the logs and slash. In some areas where wood chips would be scattered on the right-of-way, Northwest would implement alternative measures to those described in section IV.F.4.e of our Plan (see table 4.2.2-3), which requires a wood chip density of 1 ton per acre or less and application of the equivalent of 11 pounds per acre of available nitrogen. These alternative measures would be implemented as needed to stabilize slopes. We have reviewed the alternative measures and conclude they are acceptable.

Table 4.2.2-3

Alternative Measures to Our Plan

Section	Measure	Proposed Alternative Measure
IV.F.4.e	If wood chips are used as mulch, do not use more than 1 ton per acre.	The use of woody debris for the WEP may exceed this density in some areas, as needed. To stabilize the soil on slopes, mulch would be uniformly applied at a rate of 2 tons per acre, or as necessary, to cover at least 75 percent of the ground surface.
IV.F.4.e	If wood chips are used as mulch, add the equivalent of 11 pounds per acre available nitrogen (at least 50 percent of which is slow release).	Northwest proposes to implement alternative measures in some areas. The alternative measures would be developed in consultation with the appropriate local, state, and/or federal agencies, with the goal of maintaining the proper carbon-nitrogen balance.

With implementation of its ECRP, Plan, Procedures and other project-specific plans Northwest would adequately avoid, minimize, or mitigate impacts on soil resources. Based on our analysis, we conclude that potential impacts on soils would be avoided or effectively minimized or mitigated.

4.2.3 Water Resources

4.2.3.1 Groundwater

Regional Setting

Mapped regional aquifer systems that would directly underlie the WEP include unconsolidated deposit aquifers and pre-Miocene aquifers (USGS, 2005b). Minor unmapped groundwater units and unconsolidated aquifers also occur locally. The aquifers receive recharge primarily from local surface infiltration. Average annual precipitation along the WEP pipeline route ranges from 48 inches at the south end near Longview, Washington to 38 inches at the north end near Everson, Washington.

As described in section 4.1.3.1, the EPA designates sole source aquifers under the Safe Drinking Water Act as aquifers that supply at least 50 percent of the drinking water consumed in the area overlying the aquifer, and for which there are no other reasonably available alternative drinking water source. The WEP would cross two EPA-designated sole source aquifers including the Cross Valley aquifer within the Snohomish Loop and Central Pierce County aquifer within the Sumner South Loop. The Cedar Valley sole-source aquifer would be between the Sumner North A and Sumner North B Loops but would not be crossed. The interconnect with the Oregon LNG pipeline would be less than 1 mile from the Troutdale sole source aquifer, which is south of the Lewis River.

Impacts on groundwater are regulated under RCW 90.44 and administered by WA Ecology. Counties and cities along the WEP have developed groundwater management programs that are consistent with state government objectives and policies and identify groundwater management areas. Impacts on water quality from wells are regulated by the Washington Department of Health under the state Wellhead Protection Program. The Growth Management Act specifies 13 overall planning goals. One of these goals, environmental planning, requires designation and protection of aquifer recharge areas and CARAs to protect drinking water by preventing pollution and maintaining supply.

Aquifers Crossed

The majority of the aquifers in the project vicinity are comprised of the regional Puget Sound unconsolidated aquifers. The Puget Sound aquifer system is primarily composed of glacial and interglacial Pleistocene deposits that are overlain by thick intervals of Holocene alluvial deposits.

The Puget Sound aquifer system includes aquifers composed of coarse-grained glacial outwash deposits, proglacial deposits, and alluvial deposits, interbedded with low permeability confining or semi-confining units (Vaccaro et al., 1998). Recharge is from direct infiltration of precipitation and groundwater discharges to local and regional surface water drainage systems. Water quality in the Puget Sound aquifer system is generally good and acceptable for most uses with high yields. Concentrations of total dissolved solids range from 100 to 150 mg/L. In some localized areas, groundwater quality has been degraded by high concentrations of nitrate, which appear to be associated with agricultural activity. Near Puget Sound and areas along the coast with groundwater pumping, there are high chloride concentrations from seawater intrusion (Vaccaro et al., 1998). The Puget Sound aquifer system provides water for industrial, agricultural, and public water supply (Vaccaro et al., 1998). Public water supply wells yield up to 10,000 gallons per minute in the Puget Sound area (Whitehead, 1994).

Pre-Miocene aquifers in the project vicinity are composed of fine-grained sedimentary rocks primarily of marine origin and associated volcanic rocks (Whitehead, 1994). Groundwater recharge is primarily from precipitation and locally from discharge of saline water from deeper groundwater-bearing zones. Groundwater discharge varies seasonally, but contributes to stream base flow year-round. Water quality in pre-Miocene aquifers is relatively poor, with concentrations of dissolved solids greater than 500 parts per million. Yields are also typically low (less than 100 gallons per minute) and use is limited to domestic, agricultural, and industrial uses.

Water Supply Wells and Groundwater Use

The WEP route passes through multiple CARAs and wellhead protection areas as designated by counties. Some of these aquifers are also identified as sole-source aquifers by the EPA. The sole-source aquifers designation requires the EPA to review certain proposed projects within the designated area. EPA review would be coordinated with state and local regulatory agencies with groundwater regulatory authority. Under Washington's Critical Areas Ordinance, counties along the pipeline have developed groundwater management rules that vary by county. Northwest would comply with the Critical Areas

Ordinances for each county regarding protection of aquifers and sensitive groundwater areas. Depending on county requirements, Northwest may complete additional site assessments or hydrogeological studies prior to construction to demonstrate how the WEP would be consistent with a particular county's Critical Area Ordinance. In general, the measures outlined in Northwest's Plan, Procedures, ECRP, and Spill Plan for Oil and Hazardous Materials would meet the intent of county ordinances regarding groundwater protection; however, each county may impose additional measures for areas where the WEP would cross designated CARAs or well protection area.

Cowlitz County

A description of Cowlitz County's CARAs is provided in section 4.1.3.1. Table 4.2.3-1 lists the CARAs that would be crossed by the Woodland Loop in Cowlitz County and their level of sensitivity.

Table 4.2.3-1

CARAs Crossed by the Woodland Loop in Cowlitz County

Beginning Milepost	Ending Milepost	Aquifer Sensitivity
1244.3	1253.4	Moderate
1253.4	1253.5	Severe
1253.5	1260.5	Moderate
1260.5	1268.5	Moderate
1268.5	1268.6	Slight
1268.6	1269.3	Moderate
1269.3	1269.4	Severe
1269.4	1274.2	Moderate
1274.2	1274.4	Severe
1274.5	1275.8	Severe
1275.8	1279.0	Moderate
1279.0	1279.2	Slight
1279.2	1279.3	Moderate

Cowlitz County allows construction of natural gas pipelines in all aquifer recharge categories, but activities in higher sensitivity areas (i.e., severe) require additional monitoring and hydrogeologic assessments. Northwest plans to complete a hydrogeological assessment in consultation with Cowlitz County for CARAs prior to construction. In addition, Northwest would implement measures outlined in its ECRP to restore disturbed areas to preconstruction drainage patterns. Northwest would work with Cowlitz County to ensure critical area ordinance compliance.

Lewis County

Lewis County critical area ordinances apply to portions of the Woodland and Chehalis Loops (Lewis County Code 17.35.850 and 17.35A.850 for agricultural areas). Lewis County has three categories of aquifer sensitivity. The WEP would cross CARAs with a Severe Aquifer Sensitivity (Category I), which is defined as areas that provide rapid recharge with little protection, having highly permeable soils. Table 4.2.3-2 lists CARAs that would be crossed by the Woodland and Chehalis Loops in Lewis County.

Table 4.2.3-2

CARAs Crossed by the Woodland and Chehalis Loops in Lewis County

Loop	Beginning Milepost	Ending Milepost	Aquifer Sensitivity
Woodland	1281.4	1281.4	Severe
	1281.5	1282.5	Severe
	1282.5	1282.5	Severe
	1282.6	1282.7	Severe
	1282.9	1282.9	Severe
	1281.4	1281.4	Severe
Chehalis	1294.1	1294.3	Severe

Lewis County allows natural gas pipelines in all aquifer recharge categories. Activities are subject to monitoring and mitigation requirements in the critical area ordinance. According to Lewis County code, Northwest would be required to submit a design and management plan, hydrogeologic information, an assessment of potential risks of groundwater contamination, spill prevention measures and an emergency spill management plan.

Thurston County

Thurston County critical area ordinances (Thurston County Code 24.10) apply to portions of the Chehalis Loop. Thurston County critical area ordinances use the following standards:

- Extreme Aquifer Sensitivity (Category I) – areas that provide very rapid recharge with little protection, contain coarse soil textures and soil materials, and are derived from glacial outwash materials. Aquifers in subsurface geologic formations that are extremely vulnerable to contamination.
- High Aquifer Sensitivity (Category II) – areas that provide slightly lower recharge, also provide little protection, and contain materials from glacial deposit. Aquifers in subsurface geologic formations that are highly vulnerable to contamination.
- Moderate Aquifer Sensitivity (Category III) – areas with aquifers present but that have a surface soil material that encourages run-off and slows water entry into the ground. Aquifers in subsurface geologic formations that are moderately vulnerable to contamination.

Table 4.2.3-3 includes CARAs that would be crossed by the Chehalis Loop in Thurston County.

Table 4.2.3-3

CARAs Crossed by the Chehalis Loop in Thurston County

Beginning Milepost	Ending Milepost	Aquifer Sensitivity
1308.4	1308.5	Moderate
1308.8	1308.9	Moderate
1308.9	1309.1	Moderate
1309.1	1309.2	High
1309.0	1309.2	Moderate
1309.2	1309.3	Moderate
1309.3	1309.4	Extreme
1309.4	1309.5	High
1309.5	1309.6	Extreme
1309.6	1309.8	High
1309.8	1309.8	Extreme
1309.8	1310.0	Extreme
1310.0	1310.0	Extreme
1310.0	1310.1	Extreme
1310.4	1310.5	Extreme
1315.0	1315.1	High
1315.1	1315.2	Extreme
1315.2	1315.4	Extreme
1315.4	1315.6	Extreme

Thurston County allows natural gas pipelines in all aquifer recharge categories (Thurston County Code 24.10.180) but projects are required to provide a Drainage and Erosion Control plan, which Northwest has incorporated into the ECRP (see appendix J1), and a Hydrogeological Report, which would be done during local permitting. Northwest would work with county staff to ensure that the project complies with the critical area ordinances.

Pierce County

Pierce County critical area ordinances (Pierce County Code 18E.50) apply to the entire Sumner South Loop. Pierce County uses the DRASTIC model, developed by the National Well Water Association and the EPA, to calculate a DRASTIC index value as a way to rate aquifer susceptibility to municipal and industrial pollutants. In this model, the index values range from 65 to 223. Values higher than 180 indicate a high pollution susceptibility and values over 200, a very high susceptibility. The Sumner South Loop would pass through the Clover/Chambers Creek Basin aquifer recharge area between MPs 1338.0 and 1341.9, which is identified as a sensitive aquifer recharge area by Pierce County. Table 4.2.3-4 shows the portions of the Sumner South Loop that would cross areas of the DRASTIC model zones rated above 180, which include the two highest sensitivity aquifer classes in the model. Under Pierce County code, natural gas pipeline projects are exempted from hydrogeological assessment requirements. Northwest would obtain a Critical Area Ordinance permit from Pierce County for crossing sensitive groundwater areas prior to construction.

Table 4.2.3-4

CARAs Crossed by the Sumner South Loop in Pierce County

DRASTIC Zone	Beginning Milepost	Ending Milepost
200+	1338.0	1338.9
	1339.7	1341.4
181-199	1338.9	1339.1
	1341.4	1342.2
	1342.3	1342.6
	1342.8	1343.0
	1346.8	1350.1

King County

The Sumner North A and B Loops would cross Category I and II CARAs in King County at the locations shown in table 4.2.3-5 (King County Code 21A.24.313). These CARAs are defined below.

- Category I – these are mapped areas that King County has determined are highly susceptible to groundwater contamination and are located within a sole-source aquifer or wellhead protection areas.
- Category II – these are mapped areas that King County has determined:
  - have a medium susceptibility to groundwater contamination and are in sole-source aquifers or wellhead protection areas; or
  - are highly susceptible to groundwater contamination and are not in sole-source aquifers or wellhead protection areas.

Table 4.2.3-5

CARAs Crossed by the Sumner North A and B Loops in King County

Loop	Beginning Milepost	Ending Milepost	CARA Category
Sumner North A	1356.9	1357.3	II
	1357.3	1357.3	II
	1359.0	1360.2	II
	1360.7	1360.9	II
	1361.1	1361.2	II
	1361.5	1362.0	II
	1362.3	1362.9	I
Sumner North B	1370.9	1371.0	II
	1371.7	1371.9	II
	1372.0	1372.0	II
	1372.4	1372.7	II
	1374.2	1374.3	II
	1377.2	1377.2	II
	1377.3	1377.4	II
	1377.5	1377.7	II
	1377.7	1379.3	I

New development proposals and alterations to transmission pipelines carrying petroleum or petroleum products are not allowed on a site in a Category I CARA (KCC 21A.24.316). The King County director may approve otherwise restricted alterations to critical areas under KCC 21A.24.070.A.1. The WEP pipeline would cross two groundwater management areas in King County. The Sumner North A Loop would cross the South King County groundwater management area between MPs 1356.9 and

1363.9 and the Sumner North B Loop would cross the Issaquah Creek Valley groundwater management area between MPs 1370.9 and 1382.9. Both aquifers are located beneath largely urban areas.

Snohomish County

Snohomish County critical area ordinances apply to portions of the Snohomish Loop (Snohomish County Code 32.62C). The County classifies CARAs as:

- EPA-designated sole-source aquifers;
- areas determined by the Department of Health delineation methodologies (Chapter 246-290 WAC) to be within the 10-year travel zone of Group A wellhead protection areas; and
- areas of high, medium, and low sensitivity to groundwater contamination, based on depth to groundwater.

The Cross Valley sole-source aquifer would be crossed by the Snohomish Loop between MPs 1393.8 and 1395.3. No 10-year travel zones of Group A wellhead protection areas would be crossed by the WEP. Sensitivity to groundwater contamination based on depth to groundwater could not be determined based on currently available data.

Skagit County

Skagit County critical area ordinances apply to portions of the Mt. Vernon North A, North B, and South Loops (Skagit County Code 14.24.310). Skagit County divides aquifer recharge areas into two categories. Category I are areas that need protection due to a preexisting land use or because they are identified as areas in need of aquifer protection where a proposed land use may pose a potential risk (which increases aquifer vulnerability). These include designated sole-source aquifers, seawater intrusion areas, wellhead protection areas, and areas within 0.5 mile of a surface water source limited stream. Category II areas are those that have not been identified as Category I areas.

The Mt. Vernon North B Loop would be within a Category I area for about 2.9 miles from the southernmost point of the loop to the county line. Pipelines are not listed as a prohibited activity within Category I areas. Northwest would complete the standard site assessment requirements and submit a site plan, a description of hydrogeological site characteristics, and an identification of potential down-gradient receptors to the county for review.

Whatcom County

Whatcom County critical area ordinances apply to the Mt. Vernon North B and Sumas Loops (Whatcom County Code 16.16.500). Whatcom County uses criteria established by WA Ecology to place aquifer recharge areas into low, moderate, and high susceptibility categories.

The Mt. Vernon North B Loop would cross one aquifer recharge area classified as high susceptibility between MPs 1456.4 and 1461.8. The Sumas Loop crosses a series of aquifer recharge areas classified as high and moderate susceptibility between MP 1478.6 and the Sumas Compressor Station at MP 1484.4. Pipelines are an allowed activity within aquifer recharge areas. Whatcom County has the authority to require a critical area assessment report for projects located within an aquifer recharge area.

Groundwater Use and Water Supply Wells

The pipeline would be constructed near existing public water supply wells. Public water wells in Washington are divided into two categories. Group A wells have 15 or more connections or service 25 or more people and are regulated by the EPA and Washington Department of Health. Group B wells have fewer than 15 connections or service less than 25 people and are regulated only at the state level, by the Washington Department of Health. The Department of Health's Source Water Assessment Program GIS mapping tool and database (Washington Department of Health, 2012b) were used to identify wells within 400 feet of the construction right-of-way, as shown in table 4.2.3-6 and table 4.2.3-7. No wells were identified within the construction right-of-way.

Northwest used WA Ecology's Well Log GIS database (WA Ecology, 2012a) to identify 214 registered private wells with water rights within 200 feet of the WEP construction work area (see appendix K3). Not all wells in the GIS database provide specific coordinates for the well, but wells would not be inside the existing pipeline right-of-way because well construction is not an allowed activity. Northwest would work with landowners to verify the location of the wells that are near the construction right-of-way or ATWS. No springs or seeps within 200 feet of the WEP were identified by the WA Ecology Well Log GIS database search.

Table 4.2.3-6

Group A Public Water Supply Wells within 400 Feet of the Construction Right-of-Way

Nearest Milepost	System Name	Loop	System Type	Well Depth	Well within 50 Feet of Workspace
1247.4	Columbia Crest Estates	Woodland	Community	225 feet	No
1257.4	Carrols Water Association	Woodland	Community	4 wells 200 to 323 feet	Yes
1253.5	Mahaffey RV Park	Woodland	Transient Noncommunity	72 feet	No
1282.2	Cowlitz Shores Camper Club	Woodland	Transient Noncommunity	3 wells 40 to 51 feet	Yes
1315.6	Rainier Water Department	Chehalis	Community	2 wells 150 and 247 feet	Not Provided
1340.6	Firgrove Mutual Inc.	Sumner South	Community	32 wells 624 to 24 feet	No
1343.8	Fruitland Mutual Water Company	Sumner South	Community	7 wells 636 to 258 feet	Not Provided
1350.5	City of Sumner	Sumner South	Community	7 wells 408 to 285 feet	Not Provided
1363.9	Covington Water District	Sumner North A	Community	7 wells 260 to 75 feet	Not Provided
1370.9	Green Acres Water Association	Sumner North B	Community	160 feet	Not Provided
1372.6	Issaquah Valley Water Association	Sumner North B	Community	84 feet	No
1379.4	Sammamish Plateau Water & Sewer	Sumner North B	Community	21 wells 954 to 100 feet	Not Provided
1371.8	Four Creeks Ranch Water System	Sumner North B	Community	133 feet	Not Provided
1371.9	Twenty-Three 800 Tiger Mountain	Sumner North B	Community	2 wells 150 and 154 feet	Not Provided
1381.9	NE Sammamish Sewer and Water District	Sumner North B	Community	7 wells 606 to 154 feet	Not Provided

Table 4.2.3-7

Group B Public Water Supply Wells within 400 Feet of the Construction Right-of-Way

Nearest Milepost	System Name	Loop	Well Depth (feet)	Well within 50 Feet of Workspace
1262.5	Taft Acres	Woodland	108	Not Provided
1282.2	Smith Herriford Rd	Woodland	45	Yes
1283.8	Sunnyridge Mobile Home Park	Woodland	2 wells; 61 and 74 feet	No
1289.5	NWP Chehalis Compressor Station	Woodland	0	No
1291.4	Evans	Chehalis	103	No
1293.0	Forest Lane Estates West	Chehalis	53	No
1293.0	Forest Lane Estates East	Chehalis	52	No
1293.0	Haberstrohs Mountain View Estates	Chehalis	55	No
1340.3	Kiehn Water System	Sumner South	85	No
1347.5	Van Lierop Supply	Sumner South	113	Yes
1351.0	Bryon Stowe Water System	Sumner South	47	No
1359.9	Horan-Crane	Sumner North A	120	No
1359.9	Butler, E	Sumner North A	101	No
1360.1	Guise	Sumner North A	119	No
1371.7	Shields, D	Sumner North B	170	No
1372.4	Oxford Tiger Mtn Community	Sumner North B	236	No
1372.5	William Wilder Water System	Sumner North B	200	No
1373.8	Stranak	Sumner North B	397	No
1374.0	Relf Water System	Sumner North B	132	Yes
1374.0	Young, E.T.	Sumner North B	99	Yes
1374.0	Park Place Water System	Sumner North B	91	Yes
1374.2	St. Michael S Mount	Sumner North B	278	Yes
1402.4	Fobes Grocery	Snohomish	Unknown	No
1408.7	Myers Water System	Snohomish	43	No
1408.9	Breckenridge Well	Snohomish	98	No
1409.2	River Estates Water System	Snohomish	50	No

Contaminated Groundwater

Northwest searched WA Ecology's facility/site database and identified 203 potential contaminant sources within 0.25 mile of the WEP. The relatively shallow depth of the pipeline trench reduces the likelihood of encountering contaminated groundwater. However, Northwest would implement measures

outlined in its Unanticipated Discovery of Contamination Plan (see appendix J2) if signs of contamination (for example, odorous soils and/or groundwater or petroleum sheen on groundwater) are encountered.

Groundwater Impacts and Mitigation

Northwest would minimize impacts on groundwater through adherence to its Plan and Procedures. Northwest has developed Spill Plans for Oil and Hazardous Materials that outline spill prevention practices and emergency response procedures that would be followed in the case of incidents during construction. Proper storage, containment, and handling procedures minimize the chance of inadvertent spills of fuels, lubricants, and other materials during construction. Prior to construction, the Spill Plan would identify hazardous materials to be used during construction and all personnel working on the project would have environmental training to include an understanding of the Spill Plan. The Spill Plan follows FERC guidance of a 100-foot setback for vehicle refueling from any waterbody.

A Groundwater Supply Monitoring and Mitigation Plan has been developed to verify the location of groundwater supply wells and implement measures to mitigate potential groundwater impacts. These measures include:

- If blasting would be needed, the peak particle velocity limit for any aboveground structure (including water wells), would be as recommended in the latest edition of the International Society of Explosives Engineers' *Blaster's Handbook* to protect from damage.
- If contamination occurs, Northwest would replace the source with a permanent water supply.

Northwest would construct the WEP mainly during dry summer and early fall months when groundwater levels are typically at their lowest levels. Groundwater could still be encountered during construction near waterbodies and could require trench dewatering. Dewatering activities would discharge water into upland areas using an approved dewatering structure as described in the ECRP. Because the construction would be completed in a short time frame, potential impacts on groundwater from dewatering would be temporary. Water table elevations would be expected to quickly equilibrate to background conditions after construction. In locations where dewatering is not feasible, the pipeline would be pushed, pulled, or floated into place.

Excavated topsoils and subsoils would be segregated, where appropriate, and returned as closely as possible to their original soil horizon to avoid long term changes in water table elevation and subsurface hydrology. Because soil compaction would be localized, passage of heavy machinery is not expected to substantially impact groundwater resources or quality. Minimization measures and best management practices for soil compaction are detailed in the ECRP.

Because Northwest would not use groundwater for construction or operation and would implement its Spill Plan for Oil and Hazardous Materials and its Groundwater Supply Monitoring and Mitigation Plan, we conclude that the WEP would not result in significant impacts on groundwater.

4.2.3.2 Surface Waters

Surface Water Regulations and Standards

Federal and State Regulations

Federal and Washington State surface water regulations and standards are discussed in section 4.1.3.2. State water quality classifications and use designations for each waterbody that would be crossed by the WEP are provided in table 4.2.3-8.

Table 4.2.3-8

Surface Waterbody Classifications

	Aquatic Life Uses						Recreation Uses			Water Supply Uses				Miscellaneous Uses				
Use Designations for Fresh Waters by Water Resource Inventory Area (WRIA)	**Char Spawning/Rearing**	**Core Summer Habitat**	**Spawning/Rearing**	**Rearing/Migration Only**	**Redband Trout**	**Warm Water Species**	**Ex Primary Contact**	**Primary Contact**	**Secondary Contact**	**Domestic Water**	**Industrial water**	**Agricultural Water**	**Stock Water**	**Wildlife Habitat**	**Harvesting**	**Commerce/Navigation**	**Boating**	**Aesthetics**
WRIA 1 – Nooksack																		
Breckenridge Creek and tributaries		X						X		X	X	X	X	X	X	X	X	X
Nooksack River, South Fork, from mouth to Skookum Creek (RM 14.3)		X						X		X	X	X	X	X	X	X	X	X
WRIA 3 Lower Skagit-Samish																		
Nookachamps Creek, East Fork, and unnamed creek at latitude 48.4103 longitude -122.1657: All waters (including tributaries) above the junction	X							X		X	X	X	X	X	X	X	X	X
Samish River and tributaries above latitude 48.5472 longitude -122.3378 (Sect 18 T36 R4E)		X						X		X	X	X	X	X	X	X	X	X
Skagit River mainstem from mouth to Skiyou Slough-lower end (RM 25.6)		X						X		X	X	X	X	X	X	X	X	X
WRIA 7 Snohomish																		
Pilchuck River from mouth to Boulder Creek		X					X			X	X	X	X	X	X	X	X	X
Snohomish River from below Pilchuck Creek (latitude 47.9045 longitude -122.0917) to confluence with Skykomish and Snoqualmie River (RM 20.5)			X						X	X	X	X	X	X	X	X	X	X
WRIA 8 Cedar-Sammamish																		
Issaquah Creek from Lake Sammamish to headwaters (including tributaries) except where designated Char		X						X		X	X	X	X	X	X	X	X	X
WRIA 9 Duwamish-Green																		
None defined																		
WRIA 10 Puyallup-White																		
Puyallup River from RM 1.0 to junction with White River		X						X		X	X	X	X	X	X	X	X	X
WRIA 12 Chambers-Clover																		
None defined																		

Table 4.2.3-8

Surface Waterbody Classifications

Use Designations for Fresh Waters by Water Resource Inventory Area (WRIA)	Aquatic Life Uses						Recreation Uses			Water Supply Uses				Miscellaneous Uses				
	Char Spawning/Rearing	Core Summer Habitat	Spawning/Rearing	Rearing/Migration Only	Redband Trout	Warm Water Species	Ex Primary Contact	Primary Contact	Secondary Contact	Domestic Water	Industrial water	Agricultural Water	Stock Water	Wildlife Habitat	Harvesting	Commerce/Navigation	Boating	Aesthetics
WRIA 13 Deschutes																		
Deschutes River, and tributaries, upstream of the tributary to Offutt Lake (all waters in or above the national forest boundary)		X					X			X	X	X	X	X	X	X	X	X
WRIA 23 Upper Chehalis																		
Hanaford Creek and all tributaries from east boundary of Sec. 25-T15N-R2W (RM 4.1) to the unnamed tributary at latitude 46.7295 longitude -122.6812 except where designated Char		X						X		X	X	X	X	X	X	X	X	X
Newaukum River and tributaries (except where designated Char)		X						X		X	X	X	X	X	X	X	X	X
Skookumchuck River and tributaries from junction with Hanaford Creek to headwaters (except where designated Char)		X					X			X	X	X	X	X	X	X	X	X
WRIA 26 Cowlitz																		
Coweeman River and tributaries from mouth to latitude 46.1405 longitude -122.8532 (Section 31 T8N R1W)			X					X		X	X	X	X	X	X	X	X	X
Cowlitz River from latitude 46.2622 longitude -122.9001 (Section 14 T9N R2W) base of Riffe Lake Dam (RM 52.0)		X						X		X	X	X	X	X	X	X	X	X
Toutle River and tributaries from mouth to Green River on North Fork		X						X		X	X	X	X	X	X	X	X	X
WRIA 27 Lewis																		
Kalama River east of I-5 to Kalama River Falls (RM 10.4) (including tributaries)		X						X		X	X	X	X	X	X	X	X	X

Table 4.2.3-9 includes all surface waters categorized as 303(d) that would be crossed by the WEP. WA Ecology may impose additional restrictions on activity near 303(d) waters. Northwest has prepared a Water Quality Monitoring Plan (see appendix J3) to address monitoring requirements to ensure regulatory compliance.

Table 4.2.3-9

Water Quality Impaired and Water-Quality-Limited Streams Crossed by the WEP

Name	Milepost	Loop	WRIA [a]	Status [b]	WA Ecology-Designated Uses [c]	Reason
Ostrander Rock Creek South Fork	1264.9	Woodland	26	5	None	Temperature
Salzer Creek	1299.0 1300.1	Chehalis	23	4a	AL, R, W, M	Temperature, Dissolved oxygen, Bacteria, pH
Covington Creek	1359.6	Sumner North A	9	5	None	Fecal coliform
North Fork Issaquah Creek	1377.3	Sumner North B	8	4a	AL, R, W, M	Bacteria
East Fork Nookachamps Creek	1440.4	Mt. Vernon North A	3	4a	AL, R, W, M	Temperature, Bacteria, pH
Turner Creek	1441.4	Mt. Vernon North A	3	4a	AL, R, W, M	Temperature
Landing Strip Creek	1461.3	Mt. Vernon North B	1	5	None	Dissolved oxygen
South Fork Nooksack River	1461.6	Mt. Vernon North B	1	5	AL, R, W, M	Temperature

Upstream tributaries of affected river sections classified as Category 4 and 5 303(d) streams are not included in this table.

[a] WRIA = Water Resources Inventory Area, 1: Nooksack , 3: Lower Skagit-Samish, 8: Cedar-Sammamish, 9: Duwamish-Green, 23: Upper Chehalis, 26: Cowlitz

[b] Category 5 = 303(d) listed, require a TMDL, Category 4a = 305(b) waterbody with an approved TMDL that is being implemented.

[c] Aquatic Life Use (AL), Recreation Uses (R), Water Supply (W), Miscellaneous Use (M).

The WDNR manages state-owned aquatic lands under RCW 79.105.030 with the following goals:

- encourage direct public use and access;
- foster water-dependent uses;
- ensure environmental protection;
- promote continuing production of renewable resources;
- allow suitable state aquatic lands to be used for mineral and material production; and
- generate income from use of aquatic lands, consistent with the previous goals.

The WEP route would cross 10 waterbodies that are state-owned aquatic lands. The waterbodies are the Kalama, Coweeman, Toutle, Cowlitz, Newaukum, Deschutes, Puyallup, Snohomish, Pilchuck, and South Fork Nooksack Rivers. Northwest would file a Joint Aquatic Resources Permit Application with the WDNR for each crossing.

County and City Regulations

Each county that would be crossed by the WEP has established critical area ordinances that apply to surface waters. Critical area ordinances vary by county, but all use the WDNR's stream typing system to determine the buffer distance from the waterbody. Some cities the WEP route passes through have also identified specific waterbodies, which are considered critical areas. Buffer distances range from 25 feet to 250 feet, depending on the stream type and surrounding land use. These buffer distances will determine final mitigation amounts and Northwest would negotiate with each county individually. Section 4.3.1.3 describes mitigation for impacts on surface waters.

Each county on the WEP route have identified specific waterbodies as designated shoreline areas. These designations are authorized under the Washington Shoreline Management Act (RCW 90.58). Rules developed under the Act apply to marine shorelines, rivers with a flow greater than 20 cubic feet per second, lakes larger than 20 acres, and upland areas within 200 feet of these waterbodies. These designations may overlap with the critical area ordinance waters described above. Each county has created zone categories for shorelines and identified allowed uses for designated shorelines. Permitting for projects occurring in designated shoreline areas is administered by individual counties. WA Ecology reviews permits in some instances. Specific regulations for each county are discussed below under waterbody crossings for each loop.

Existing Environment

The WEP pipeline would cross 15 watersheds, defined by the 4-digit HUC. These watersheds are Lewis, Lower Columbia-Clatskanie, Lower Cowlitz, Upper Chehalis, Deschutes, Puget Sound, Puyallup, Duwamish, Lake Washington, Snohomish, Skykomish, Lower Skagit, Strait of Georgia, Nooksack, and Fraser. The WEP would cross a total of 271 waterbodies, including 161 perennial, 73 intermittent, and 37 ephemeral waterbodies (see table 4.2.3-10). Appendix K1 contains a list of all waterbodies that would be crossed by the WEP pipeline, including stream type, WA Ecology designated use ratings, stream width, water quality ratings, crossing method and other relevant characteristics.

Table 4.2.3-10

Surface Waterbodies Crossed by Each Loop

Loop	Perennial	Intermittent	Ephemeral	Total	WRIA
Woodland	79	30	20	129	Lewis, Cowlitz
Chehalis	25	14	7	46	Upper Chehalis, Deschutes
Sumner South	6	5	2	13	Chambers-Clover, Puyallup-White
Sumner North A	6	1	0	7	Duwamish-Green River
Sumner North B	14	3	2	19	Cedar-Sammamish
Snohomish	11	2	2	15	Snohomish
Mt. Vernon South	1	0	0	1	Lower Skagit-Samish
Mt. Vernon North A	3	5	0	8	Lower Skagit-Samish
Mt. Vernon North B	10	12	4	26	Lower Skagit-Samish, Nooksack
Sumas Loop	6	1	0	7	Nooksack
Total	**161**	**73**	**37**	**271**	

The Pierce County-owned River Grove Levee on the Puyallup River would be crossed by HDD along the Sumner South Loop at MP 1348.0. This is the only dike or levee that would be crossed by the WEP.

Surface Water Impacts and Mitigation

We received comments expressing concerns regarding pollution, sediment, and construction impacts on water resources. Activities associated with the proposed pipeline that could affect surface water resources include waterbody crossings, water appropriation and discharge associated with hydrostatic testing and HDD, vegetation clearing, stormwater runoff, and accidental spills of fuel or hazardous materials, and mitigation for impacts on state-owned aquatic lands.

Similar to Oregon LNG (see section 4.1.3.1), the WEP would need to obtain federal and state permits before beginning waterbody crossings. The construction method planned for each crossing is

listed in appendix K1. General descriptions of each crossing type are included in section 2.2.3.2. In selecting the method proposed to cross a particular waterbody, Northwest considered a number of factors, including the size of the waterbody, presence of sensitive aquatic resources, topography, surrounding surface features, subsurface conditions, and agency input. Each method has its own advantages and drawbacks. For example, HDD can generally avoid in-water impacts but carries the risk of an inadvertent release of drilling fluid, and the level of risk depends on subsurface conditions. Additionally, HDD is not feasible under certain geologic or topographic conditions and requires relative large workspaces. Aerial spans also avoid in-water impacts but have long-term visual impacts and are less desirable for operation and maintenance.

General Waterbody Crossing Impacts

Construction of the project would result in short-term impacts from in-water construction activities or construction disturbance on slopes adjacent to waterbodies. In-water construction would include clearing and grading of streambanks, in-water trenching, trench dewatering, and backfilling. These activities could modify aquatic habitat, increase sedimentation, increase turbidity, decrease dissolved oxygen concentrations, release chemical and nutrient pollutants from sediments, and introduce chemical pollutants.

To minimize adverse impacts at waterbody crossings, Northwest would follow its Plan and Procedures. Northwest plans to cross waterbodies during periods of low water flow levels whenever possible and comply with in-water work windows established by the WDFW. Northwest stated that exemptions to in-water work windows may be needed at certain crossings. However, Northwest has not yet stated which streams it may need to cross outside of the recommended in-water work windows, nor has it provided justification and agency approval for construction outside of these timeframes consistent with section V.B.1 of our Procedures. Therefore, **we recommend that:**

- **Prior to construction, Northwest should file with the Secretary documentation of WDFW approval for any modification to the WDFW in-water work windows at waterbody crossings.**

Streambank disturbance would be minimized through the use of equipment bridges, mats, and pads. Equipment bridges could consist of equipment pads over culverts or clean rock fill over culverts. Portable bridges may be installed in areas with excessively soft soils in the streambed or during high water flows. Bridges would be maintained throughout construction to prevent soil entering the waterbody and flow restriction while the bridge is in use. Trench spoil from the stream would be placed at least 10 feet from the water's edge. Staging areas and additional spoil storage areas would be at least 50 feet from the waterbody boundaries where topographic conditions allow. FERC's Procedures require prior written approval for ATWS that must be placed within 50 feet of waterbodies and wetlands. Section 4.2.4.4 provides a list of these ATWS for the WEP along with Northwest's justification for why they are needed and our assessment.

Details on sediment control measures and BMPs for waterbody crossings are included in Northwest's ECRP (see appendix J1). These include use of sediment barriers such as silt fences, slope breakers, interceptor dikes and swales, mulch and erosion control fabric. Equipment would be parked overnight and/or fueled at least 100 feet from a waterbody with some unavoidable exceptions such as continuously operating pumps. In those circumstances, absorbent materials and containment booms would be kept on hand in the event of spills, and fuel would be stored with secondary containment capable of holding at least 150 percent of the storage volume with at least 1 foot of freeboard.

Trench dewatering may be required during waterbody crossings. During dewatering, water would be pumped from the trench into stable, vegetated areas through an approved dewatering structure at a regulated rate to prevent runoff. Regular inspection and maintenance would be performed on the dewatering structures to prevent the flow of silt-laden water directly into adjacent waterbodies.

In-water construction disturbance would temporarily degrade water quality by suspending existing sediments at waterbody crossings. These impacts would be localized and temporary. Minimization efforts would include crossing waterbodies during low flow periods when possible, sediment handling minimization, and minimizing the in-water disturbance for trench excavation and backfilling.

Water flow between the excavated trench adjacent to the waterbody and the trench within the waterbody would be minimized through the use of trench breakers (e.g., sack breakers, foam, etc.). Where needed, erosion control devices would be installed to prevent sediment from the disturbed construction area from entering the stream. Northwest would remove all surplus materials and equipment once in-water construction is complete and collect all litter and debris for disposal at an approved facility. No litter or debris would be discarded into waterbodies, trenches, or along the project right-of-way.

Although HDD and direct pipe methods generally avoid in-water impacts, they carry the potential for inadvertent releases of drilling fluids, which could create turbidity in the waterbody being crossed. Northwest would implement the measures in its contingency plan for inadvertent releases should a release occur.

In addition to these temporary, construction-related impacts, pipeline installation across waterbodies could result in long-term changes to the steam channel and function due to channel migration, avulsion, widening, and/or streambed scour. For the most part, the pipeline would be installed within Northwest's existing right-of-way that has been monitored for stream migration and scour over the past few decades. Northwest would use existing data on other waterbody crossings within its right-of-way to inform the pipeline burial depth for the WEP to minimize the chance of pipeline exposure due to scour. In response to FWS scoping comments, Northwest conducted an assessment on stream channel response to estimate the relative risk of geomorphic response due to proposed waterbody crossings. Northwest compared the channel gradient, channel confinement, and valley width of 173 waterbodies (all perennial waterbodies and waterbodies that support federally listed fish) that would be crossed by the WEP. Of these, 79 waterbodies were found to have moderate or higher potential for vertical scour, 26 waterbodies were ranked as having severe potential for vertical scour, and two waterbodies were classified as mass-wasting dominate channels. Fifty-five crossings have no or negligible potential for lateral channel migration (lateral scouring) at the reach scale, 10 have a slight potential, 84 have a moderate potential, and 25 have a severe potential for lateral channel migration.

All waterbody crossings would have at least 5 feet of cover from the top of pipe to bottom of streambed, but the pipeline may be buried deeper at waterbodies that have high scour potential. During final pipeline design, each waterbody crossing would be evaluated and the burial depth would be designed to accommodate reasonably expected depth of channel scour and degradation. In the lateral direction, the pipeline would be buried at a depth sufficient to protect it from the effects of lateral erosion by the channel banks. In some cases where historical observation and empirical evidence suggest that the scour potential may be different than that estimated by the scour assessment, Northwest would assume a severe scour potential and conduct additional surveys and engineering to accurately define the pipe burial depth

below the predicted scour elevation. Site-specific waterbody crossing figures for major waterbodies are included in appendix K4[1]).

Following construction, Northwest would conduct bi-yearly inspections of waterbody crossings for 3 years. During these inspections, Northwest would look for trench subsidence and erosion indicators such as gullies, undercutting banks, bare ground, bank slumping, or other evidence stream channel instability. If vertical scour or channel migration of waterbodies is observed, then Northwest may implement streambank and streambed restoration methods described in its ECRP (appendix J1) and in coordination with WDFW and Ecology. During operation, Northwest's pipeline personnel would conduct periodic aerial and ground inspections to identify conditions such as scour that could present a safety hazard or require preventative maintenance or repairs. Appropriate responses to conditions observed during inspection would be taken as necessary.

Access road construction would not impact surface waterbodies because no new roads would be constructed. Northwest would use existing roads, most of which are currently used to operate and maintain the existing pipeline and facilities and no modifications or improvements to these existing roads would be necessary. Northwest plans to locate contractor and pipe storage yards in previously graded areas, away from any waterbodies. Therefore, we do not expect water quality impacts from storage yards.

Sensitive and Major Waterbody Crossings

The WEP would cross seven major waterbodies (i.e., greater than 100 feet wide) including the Kalama, Toutle, Cowlitz, Newaukum, Puyallup, Snohomish, and South Fork Nooksack Rivers. Northwest has prepared site-specific drawings for these and four intermediate waterbody crossings that are environmentally sensitive. These site-specific drawings are provided in appendix K4[1] and these waterbodies are described in more detail below.

Kalama River

The Woodland Loop would cross the Kalama River at MP 1253.4 by modifying the existing aerial span that holds the existing 26-inch pipeline and replacing it with the proposed 36-inch pipeline. The Kalama River is critical habitat and contains federally listed species. Northwest would need ATWS on both banks of the river crossing. The ATWS on the south side would be about 0.1 acre and used for equipment staging. The ATWS on the north side would be about 0.7 acre and used for equipment staging and construction of span modifications.

Coweeman River

The Woodland Loop would cross the Coweeman River at MP 1260.5 using dry, open-cut flume installation. If flow is low enough during construction, a dam-and-pump option could be used. Northwest conducted geotechnical borings near the Coweeman River and determined that subsurface conditions were unfavorable for HDD. The river channel width is about 80 feet at the proposed crossing location and generally flat pasture on both sides. Construction is anticipated to occur between July 16 and September 30 and expected to take 3 to 4 days. The new 36-inch-diameter pipeline would be installed into the trench created from removal of the existing 30-inch-diameter pipe.

[1] The full report containing Northwest's waterbody crossing plans with detailed narrative was filed as appendix 2P to Washington Expansion Project Resource Report 2 and is available on FERC's eLibrary at http://www.ferc.gov/docs-filing/elibrary.asp under Docket No. CP13-507-000, Accession No. 20140602-5292.

Toutle River

The Woodland Loop would cross the Toutle River at MP 1274.4 using a wet, open-cut trench installation. This area of the river has a wide floodplain with large piles of dredged spoils. The river has been relocating within the floodplain since Mount St. Helens erupted in 1980. Northwest evaluated several alternative crossing methods and locations for the Toutle River, including HDD (see section 3.4.2.2). HDD was determined to be infeasible due to subsurface conditions as indicated by geotechnical borings.

The river channel width at the proposed crossing location is about 400 feet, but the expected wetted width during construction would be 200 to 250 feet. The 15-foot-tall southern bank of the river has 1,500 feet of riprap in an attempt to control erosion, but portions of the riprap have failed and eroded. South of the river bank there is a 400-foot-wide, sparsely vegetated flat floodplain area that ends in a steep, wooded slope. The north bank of the river is a gently sloping sand bar with moderate shrub cover, which is about 400 feet wide.

Northwest anticipates construction would to take 7 days of continuous in-water work with 4 to 5 total weeks of preparation before and after in-water construction. Construction would occur within the designated in-water work window (July 16 to August 15), unless approval is requested and granted by state and federal agencies for construction outside of this time window. The construction right-of-way at the crossing would be 75 feet wide and a total of 49 acres of temporary workspaces would be on either side of the river. Northwest would require large temporary workspaces due to the depth the pipeline must be installed under the river to prevent scour.

Based on expected low flow velocity at the time of construction, Northwest expects to fabricate the pipe outside of the river and install it into an excavated trench. Trench excavation would occur without diversion of the streamflow through the excavation area using excavators or draglines. After pipe installation, the trench would be backfilled using excavated material.

Cowlitz River

The Woodland Loop would cross the Cowlitz River at MP 1282.5 by HDD. The proposed crossing location consists of a gravel bar covered by grass and brush and an oxbow of the river. The north bank of the crossing consists of a relatively low riprap armored dike with grasses and brush on the upland side. The ATWS on the south side of the river would be about 1.2 acres and have an irregular shape to minimize impacts on landowners. The ATWS on the north side of the river would be about 4.3 acres and laid out in such a way to reduce impacts on the forest land on that side. The north side ATWS would be used for laying out the prefabricated pullback section of the HDD and equipment. The proposed HDD would be about 2,000 feet in length.

The primary risk associated with directional drilling is the potential for inadvertent releases of drilling mud. In small quantities, drilling mud that enters a waterbody would not adversely affect overall water quality as bentonite (the primary ingredient in drilling mud) is a nontoxic substance. In larger quantities, however, the release of drilling mud could adversely affect water quality by increasing turbidity and sedimentation in the stream and thereby reducing dissolved oxygen. Impacts on aquatic life are discussed in section 4.2.5. Containment and disposal of the used bentonite would be performed in accordance with permit requirements. The same risks would be present for each of the HDDs below.

Newaukum River

The Chehalis Loop would cross the Newaukum River at MP 1294.1 using the HDD method. The Newaukum River supports coldwater fisheries and is listed as EFH. Topography on the south side of the proposed river crossing consists of a bluff about 30 feet high that is immediately adjacent to the river, while the north side is generally flat, rising slightly from the elevation of the river. ATWS equaling about 1.2 acres would be used on the south side of the river to accommodate HDD entry, equipment, and access to the water for hydrostatic test and HDD water. On the north side of the river an ATWS would be in a field set back from the river to avoid cutting trees in the riparian area. In addition to supporting the HDD installation, the 25.1 acre ATWS would be used for equipment staging, pipe stockpiling and vehicle parking. The proposed HDD would be about 1,500 feet long.

Skookumchuck River

The Chehalis Loop would cross the Skookumchuck River at MP 1309.4 using dry, open-cut flume installation. If flow is low enough during construction, a dam-and-pump option could be used. Northwest determined that HDD would not be feasible for the Skookumchuck River because of unfavorable subsurface geology and a steep hillside on the south side of the river that would not allow for the necessary HDD workspace. The river channel width is about 90 feet at the proposed crossing location. Woody riparian vegetation is present in a narrow fringe on both sides of the riverbank, but the area outside this fringe is tilled agricultural fields within the 2,000-foot-wide floodplain. Construction is anticipated to occur between August 1 and August 31 and take 3 to 4 days.

Deschutes River

The Chehalis Loop would cross the Deschutes River at MP 1315.1 using dry, open-cut flume installation. If flow is low enough during construction, a dam-and-pump option could be used. The river channel width is about 80 feet at the proposed crossing and the river valley has steep, slopes on both sides, which precludes the use of HDD. Construction is anticipated to occur between July 16 and August 31 and take 3 to 4 days.

Puyallup River

The Sumner South Loop would cross the Puyallup River at MP 1348.0 using HDD. The Puyallup River supports federally listed species, contains critical habitat, and EFH. The west side of the river in the area where the crossing would occur is agricultural with a strip of trees and brush along the bank of the river. On the east side is a maintained grass field and residential buildings. Northwest would use a 6.5 acre ATWS on the west side for HDD entry and equipment along with layout for the pullback section. The east side of the river would have a 0.7 acre ATWS to access the river for HDD and hydrostatic test water, as well as a 0.5 acre ATWS for HDD equipment. The HDD would be about 1,750 feet long.

Snohomish River

The Snohomish Loop would cross the Snohomish River at MP 1397.6 using HDD. The Snohomish River supports federally listed fish species, contains critical habitat, and EFH. The existing river crossing is adjacent to residences and a mobile home park. To the north of the existing crossing the land is less developed. The west side of the river is vegetated by brush and trees on an island-type feature between the river and a side channel. West of the side channel is an agricultural field. The east side of the river at the proposed crossing location is a county park with a mixture of a grass field and brush and trees. The proposed location for the HDD was selected to minimize vegetation clearing and disturbance to residences. About 12.3 acres of ATWS would be on the west side of the river for layout of the pullback section. The east side of the river would have two ATWS totaling about 6.7 acres. They would

be used to access the river for HDD and hydrostatic test water as well as for HDD equipment and entry point. The HDD would be about 2,475 feet long.

Pilchuck River

The Snohomish Loop would cross the Pilchuck River at MP 1407.8 using dry, open-cut flume installation. The Pilchuck River supports federally listed fish species, contains critical habitat, and EFH. The river channel width is about 80 feet at the proposed crossing location. Geological mapping near the Pilchuck River indicate there would be an unacceptably high risk of HDD failure or inadvertent release of drilling fluid. The north side of the river contains residential development and the south side of the river is a steep wooded slope. Construction is anticipated to occur between August 1 and August 31 and take 3 to 4 days.

South Fork Nooksack River

The farthest north major waterbody crossing would be the Mt. Vernon North B Loop's crossing of the South Fork Nooksack River at MP 1461.6 using HDD. The South Fork Nooksack River supports federally listed fish species, contains critical habitat, and EFH. The proposed crossing would be south of the existing crossing. The alignment is close enough for construction crews to use the existing cleared right-of-way to access the river and minimize additional clearing. The south bank of the river in the area of the proposed crossing is gravel and cobble, while farther from the water are trees and open areas. Trees are on the north side of the river with open field farther up the gradual slope. About 1.9 acres of ATWS would be on the south side of the river for the pullback section, pipe staging, HDD equipment and exit point, and access to the river for hydrostatic test and HDD water. On the north side of the river, a 5.2 acre ATWS would be used for HDD equipment and entry point. The HDD would be about 1,950 feet long.

Contaminated Surface Water or Sediments

In rural areas, potential sources for contamination of sediments in waterbodies are agricultural fields containing fertilizers and pesticides, and leachate from feed lots and sanitary fields. In urban areas, contaminated stormwater runoff, wastewater discharges, erosion or leachate from industrial sites such as mineral processing or mining, petroleum refining, treatment plants, or landfills may contribute to the sediment contamination in waterbodies. If contaminated sediments are present during in-water work at waterbody crossings, disturbing the sediments could result in contaminants being released to the water and affecting water quality.

A review of the EPA National Priority List (EPA, 2012a) and WA Ecology's Cleanup Site Search (WA Ecology, 2012a) indicated that no known sites of contaminated sediment are present in the subsurface of the proposed alignment. The WEP is not expected to traverse contaminated sediments based on a review of the WA Ecology Environmental Information Management database.

Because the WEP would not directly cross any known contaminated sediments, no resulting adverse impacts are expected to occur; however, the chance for encountering undocumented contaminated sediments remains. Northwest would follow its Unanticipated Discovery of Contamination Plan (see appendix J2) if the situation were to occur. In general, the same measures that would be used to minimize turbidity (for example, minimizing in-water work duration and using dry open-cut crossing methods) would also minimize the impacts of disturbing contaminated sediments. In addition, trenchless methods would avoid disturbing sediments at a number of waterbody crossings.

Water for Hydrostatic Testing

The principal need for water appropriation and discharge for the project would be to supply water for hydrostatic testing. Hydrostatic testing would be performed to ensure structural integrity on the entire length of each loop before placing the pipeline into service. Possible impacts from water appropriation for hydrostatic testing include rate of uptake, condition of source stream, fish entrainment, and impacts on surface water quality. Hydrostatic testing would follow Northwest's Plan and Procedures as well as other conditions specified by other applicable local, state, and federal permits or authorizations.

Water for hydrostatic testing would be acquired from nearby rivers and municipal sources (see table 4.2.3-11). Hydrostatic test water for compressor stations would be obtained from nearby municipalities. Hydrostatic test water would be reused, when possible, for testing of the next segment. Discharge would be through an approved dewatering structure or directly into surface waters, depending on the location. Test water would only contact the new pipeline and no additives are proposed. Chlorinated water from municipal sources would only be discharged into upland areas, not directly into surface waters, to minimize the potential for contamination. Testing for chlorine would be completed where required by applicable permits.

Table 4.2.3-11

Hydrostatic Test Water Source and Discharge Locations

Loop	Water Source	Volume (million gallons)	Discharge Location (Milepost)
Woodland: TS1	Municipal Source	1.3	TS2 or Upland (1247.5)
Woodland: TS2	TS1 Discharge or Municipal Source	1.0	Upland (1247.5)
Woodland: TS3	TS4 Discharge or Kalama River	0.5	TS4 Discharge or Kalama River (1253.4)
Woodland: TS4	TS3 Discharge and Kalama River or Kalama River Only	1.1	TS3 Discharge or Kalama River (1253.4)
Woodland: TS5	TS6 Discharge or Coweeman River	0.8	TS6 Discharge or Coweeman River (1260.5)
Woodland: TS6	TS5 Discharge and Coweeman River or Coweeman River Only	3.7	TS5 Discharge or Coweeman River (1260.5)
Woodland: TS7	Toutle River	2.1	Toutle River (1274.4)
Woodland: TS8	Cowlitz River	1.9	Cowlitz River (1282.5)
Chehalis: TS1	Newaukum River	2.8	Newaukum River (1294.1)
Chehalis: TS2	Skookumchuck River or Deschutes River	4.0	Skookumchuck River (1309.4) or Deschutes River (1315.1)
Sumner South Loop: TS1	Puyallup River	3.7	Puyallup River (1348.0)
Sumner North A Loop: TS1	Green River	0.5	Green River (1356.9)
Sumner North A Loop: TS2	Municipal source	1.3	Upland (1363.9)
Sumner North B Loop: TS1	TS2 Discharge or Municipal source	0.6	TS2 Discharge or Issaquah Creek (1371.1)
Sumner North B Loop: TS2	TS3 Discharge or Municipal source	0.9	TS3 Discharge or Upland (1373.5)
Sumner North B Loop: TS3	Municipal source	1.4	Upland (1381.9)
Snohomish Loop: TS1	Snohomish River	0.9	Snohomish River (1397.7)
Snohomish Loop: TS3	Pilchuck River	1.2	Pilchuck River (1407.8)
Mt. Vernon South Loop: TS1	Municipal source	1.3	Upland (1435.7)
Mt. Vernon North A Loop: TS1	East Fork Nookachamps	0.7	East Fork Nookachamps (1440.4)
Mt. Vernon North A Loop: TS2	TS3 Discharge or Skagit River	0.2	TS3 Discharge or Skagit River (1443.5)
Mt. Vernon North A Loop: TS3	TS2 Discharge and Skagit River or Skagit River Only	0.4	TS2 Discharge and Skagit River or Skagit River Only (1445.0)
Mt. Vernon North B Loop: TS1	Nooksack River	2.2	Nooksack River (1461.6)
Sumas Loop: TS1	Municipal source	1.6	Upland (1484.5)
Total		**36.1**	

Northwest would obtain water for dust control primarily from municipal sources as identified for hydrostatic testing. Appropriate permits would be obtained prior to water withdrawal. Northwest would follow permit conditions and its Procedures concerning water withdrawals and discharge. Downstream uses, including aquatic life, would be maintained. Intakes would be screened as directed by permitting agencies and discharge would be regulated to prevent erosion, streambed scour, suspension of sediments, or excessive streamflow. Northwest would be required to notify appropriate state agencies of specific sources at least 48 hours prior to use. About 1 million gallons of water would be needed for dust control along each loop; however, the exact amount of water required would depend on site conditions.

Spills or Leaks

During pipeline construction, Northwest would mitigate accidental spills and leaks of fuels and hazardous materials by implementing the procedures designated in one of three loop-specific Spill Plans for Oil and Hazardous Materials. These Spill Plans contain measures to prevent leaks and spills. Should a leak or spill occur, the plans contain cleanup procedures to minimize the potential for contaminants to reach surface waters and emergency response procedures that would be followed.

Impact and Mitigation Summary

Impacts on surface waters would include temporary impacts from in-water construction activities, waterbody contamination from disturbance to adjacent areas (i.e., agricultural fields, industrial areas, etc.), and water appropriation and discharge for hydrostatic testing. In-water construction impacts and waterbody contamination would be minimized by using Northwest's Plan, Procedures, and ECRP (e.g., measures such as sediment controls and restrictions on equipment parking and fueling), crossing waterbodies during periods of low water, and complying with in-water work windows established by the WDFW. Northwest would minimize water appropriation impacts by using its Plan and Procedures, complying with permit conditions, reusing water where possible, and discharging water through approved dewatering structures.

In areas with scour potential and unstable banks, Northwest would increase the depth of cover beyond the 5 foot minimum to meet or exceed DOT requirements. Based on scour and erosion hazards outlined in the Site-specific Waterbody and Wetland Crossing Plans for major waterbodies, pipe depth would be adjusted to address vertical scour and horizontal migration of the stream.

Operation of the WEP generally would not affect surface waters, although maintenance activities requiring ground disturbance in or near waterbodies could result in temporary increases in turbidity. Such impacts would be minimized using the same types of erosion and sediment control measures used during construction. As part of continued operations and maintenance of the right-of-way, Northwest would monitor the 26-inch-diameter pipeline where it is abandoned in place. Northwest would take corrective actions if the pipeline becomes exposed.

4.2.4 Wetlands

Section 4.1.4 includes a discussion of the regulatory environment as it applies to wetlands at a federal and state level, the Cowardin system of wetland classification, and an explanation of wetland delineation protocols that would also apply to the WEP. In addition to federal and state regulations, county and city level regulations apply to wetlands in the project area. These regulations include critical area designations for some wetlands in the project corridor. All counties use the USACE methods for wetland delineation, though each county has a separate setback requirement. Setback requirements for

each county range from 50 feet to 300 feet based on the type of impact and the characteristics of the wetland.

Northwest delineated wetlands within the project area between September and November 2012 using the methodology outlined in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE, 2010). Northwest used a 200-foot survey corridor for field review. Off-site information and field observations from the edge of the survey corridor were used to identify potential wetlands outside the survey corridor. This provided additional data where setback buffers may include a distance of over 200 feet. Multiple wetland delineations previously conducted by Northwest within and adjacent to the survey corridor for other projects provided additional wetland data outside the 200-foot survey corridor.

For 11 wetlands, or about 2 percent of the overall total, site access was restricted and no on-site data were collected inside the survey corridor. These wetlands were delineated using off-site data and field observations. An on-site delineation would be completed for these areas before project construction.

WA Ecology's wetland ratings system ranks wetlands according to their functions and values into four categories based on rarity, sensitivity to disturbance, and the functions they provide (WA Ecology, 2004). All of the counties crossed by the project use WA Ecology's rating system as part of their system to determine buffers for wetland areas under the Critical Areas Ordinance. Higher value wetlands (i.e., Category I) receive larger buffers than lower value wetlands (i.e., Category IV). WA Ecology's wetland rating system scores wetlands on three functions: habitat, improvement to water quality, and hydrologic functions. Using these scores or other criteria noted below, wetlands are ranked into the following categories:

- Category I. Rare or unique wetlands that are sensitive to disturbance, and meet one or more of the following criteria:
  - Natural Heritage Wetlands;
  - bogs;
  - mature or old growth forested wetlands;
  - high quality regional wetlands with irreplaceable ecological functions; or
  - wetlands that perform many functions very well.

  When scored using WA Ecology's ranking system these wetlands have a cumulatively score of 70 or more (out of 100) when considering their contribution to habitat, improvement to water quality, and hydrologic functions.
- Category II. These wetlands provide most functions relatively well, or provide one group of functions very well and the other two functions moderately well. These wetlands possess significant habitat value and functions and score between 51 and 69 points in the three scored areas of habitat, improvement to water quality, and hydrologic functions.
- Category III. Wetlands with a moderate level of functions. In most cases, these wetlands have been disturbed in some way and are less diverse than higher quality wetlands. These wetlands score from 30 to 50 points in the three scored areas of habitat, improvement to water quality, and hydrologic functions.
- Category IV. Wetlands with a low level of functions that are often heavily disturbed. In some cases, these disturbed wetlands could be improved by providing additional functions. These wetlands score less than 30 points in the three scored areas of habitat, improvement to water quality, and hydrologic functions.

Northwest ranked wetlands in the project area using WA Ecology's wetland ranking system (see appendix K1) (see table 4.2.4-1) and would provide wetland mitigation based on these rankings. Compensatory wetland mitigation for the WEP would be separate from Oregon LNG's mitigation and would focus on using approved wetland mitigation banks in the watershed of the impacted wetland. Northwest's approach for compensatory mitigation is described in section 4.2.4.3.

4.2.4.1 Existing Environment

Wetlands in the project area can be generally grouped into four categories. Each of these categories corresponds to a Cowardin group with the exception of farmed wetlands (see section 4.1.4.1 for a full description of the Cowardin classifications). Farmed wetlands are a subset of PEM habitats in the Cowardin system but are treated as a separate group here because of their distinct nature with regard to wetland regulation.

Palustrine Emergent Wetlands

Most of the PEM wetlands in the project area have been disturbed by pipeline right-of-way maintenance or agricultural activities. They are often dominated by invasive or opportunistic vegetation such as reed canary grass. Native emergent wetlands are typically dominated by cattail and slough sedge but are uncommon in the WEP area. Wetland areas currently or recent tilled would be considered farmed wetlands when calculating mitigation requirements. These areas typically lack wetland vegetation due to agricultural activities, and may have altered hydrology due to drainage activities, but still qualify as jurisdictional under the USACE and WA Ecology guidance. Based on state and federal rules, farmed wetlands may receive different treatment for compensatory mitigation.

Palustrine Scrub/Shrub Wetlands

PSS wetlands range from highly disturbed (Category III or IV) to less disturbed (Category I or II). Highly disturbed PSS wetlands typically occur in the existing pipeline easement and are often subject to regular disturbance as part of maintenance activities. These wetlands are dominated by opportunistic species such as Douglas' spirea or invasive species such as Himalayan blackberry. Less disturbed PSS wetlands typically occur in areas that are too wet to receive regular maintenance and contain a wider range of species, including pacific willow, red-osier dogwood, and salmonberry.

Palustrine Forested Wetlands

Typical PFO are dominated by western red cedar, red alder, or black cottonwood in the overstory and skunk-cabbage and salmonberry. Because right-of-way maintenance requires the removal of trees, most of the PFO wetlands are outside the existing maintenance area for the pipeline.

Pipeline Loop Descriptions

A general description of the wetlands and typical plant species along each of the loops is included in table 4.2.4-1.

Table 4.2.4-1

Typical Wetland Plant Species Along the WEP Pipeline

Wetland Classification	Typical Dominant Wetland Plant Species
Woodland Loop	
PEM	Reed canary grass (Category III or IV), native sedges, rushes or grasses (Category II)
PSS	Western snowberry, willow
PFO	Red alder, western red cedar
Chehalis Loop	
PEM	Reed canary grass (Category III or IV), native sedges, rushes or grasses (Category II or I)
PSS	Hardhack, willow
PFO	Red alder, western red cedar
Sumner South Loop	
PEM	Reed canary grass (Category III or IV), native sedges, rushes or grasses (Category II)
PSS	Hardhack, willow
PFO	Red alder, black cottonwood
Sumner North A Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II)
Sumner North B Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II or I)
PSS	Hardhack, willow, salmonberry
PFO	Red alder, western red cedar
Snohomish Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II or I)
PSS	Hardhack, willow, dogwood
PFO	Red alder, western red cedar
Mt. Vernon South Loop	
PEM	Reed canary grass
PSS	Hardhack, blackberry
PFO	Red alder, western red cedar, western hemlock
Mt. Vernon North A Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II or I)
Mt. Vernon North B Loop	
PEM	Reed canary grass
PSS	Hardhack, blackberry
PFO	Red alder, western red cedar, paper birch
Mt. Vernon South Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II or I)
PSS	Hardhack, blackberry
PFO	Red alder, western red cedar, western hemlock
Sumas Loop	
PEM	Reed canary grass, Himalayan blackberry (Category III or IV), native sedges, rushes or grasses (Category II or I)
PSS	Hardhack, blackberry
PFO	Red alder, western red cedar, paper birch

PEM = palustrine emergent wetland; PFO = palustrine forested wetland; PSS = palustrine scrub-shrub wetland

About 75 percent of all wetlands along the proposed route contain Category III (37 percent) or Category IV (38 percent) features, most of which are heavily disturbed. About 22 percent of all the wetlands along the proposed route are Category I (2 percent) and Category II (20 percent) wetlands. Three percent were not rated. The Category I and II wetlands identified along the route are generally adjacent to the existing right-of-way, near a river crossing, or in areas too wet or too steep to undergo

regular pipeline corridor maintenance. Three Category I wetlands would be crossed by the project. One of these is along the Chehalis Loop at MP 1297.4. The other two are bogs, and include Queens Bog at MP 1379.1 along the Sumner North B Loop and an unnamed bog at MP 1381.3 along the Sumner North B Loop.

Queen's Bog is the only wetland with documented natural heritage features that would be crossed by the project. Bogs, including Queen's Bog, are typically characterized by spongy peat deposits, acidic waters, and a floor covered by sphagnum moss. Queen's Bog is about 1,700 feet wide at its widest point (measured generally east to west) and about 650 feet from north to south. The existing Northwest pipeline right-of-way crosses the western edge of the bog for about 250 feet.

The unnamed bog is about 950 feet from north to south and the existing right-of-way crosses near its east edge for about 800 feet. The unnamed bog is part of a larger wetland complex.

4.2.4.2 Wetland Impacts and Mitigation

Scoping comments focused on minimizing wetland impacts during construction. Construction of the pipeline would temporarily impact about 176.6 acres of wetlands and permanently impact about 30.7 acres of wetlands (see table 4.2.4-2). Because the pipeline would be installed along a maintained pipeline corridor, the majority of the wetlands impacted by the project would be PEM wetlands, which have been previously disturbed by pipeline installation and are maintained in an emergent state due to ongoing maintenance activities (i.e., mowing). The project would clear vegetation in areas where the pipeline deviates from the existing right-of-way and impacts on PFO or PSS wetlands would be unavoidable. Northwest would use HDD techniques to avoid impacts on wetlands near certain river crossings.

Table 4.2.4-2

Construction Wetlands Impacts Along the WEP Pipeline

Pipeline Loop	WA Ecology [a] Category	Temporary Impacts (acres)	Permanent Impacts (acres)		
		PEM	PFO	PSS	Total Permanent
Woodland	II	10.7	0.4	1.3	1.8
	III	8.8	0.1	<0.1	0.2
	IV	26.3	0.6	0.8	1.5
	Total	**45.8**	**1.2**	**2.2**	**3.4**
Chehalis	I	—	0.2	—	0.2
	II	3.6	2.3	2.4	4.7
	III	32.1	2.4	1.6	4.0
	IV	23.0	0.3	0.1	0.4
	No Rating [b]	—	—	0.9	0.9
	Total	**58.6**	**5.2** [c]	**5.0**	**10.2**
Sumner South	II	0.1	0.2	—	0.2
	III	2.1	0.8	0.8	1.6
	IV	5.2	0.2	1.1	1.3
	No Rating [b]	0.4	—	—	0.0
	Total	**7.7**	**1.2**	**1.9**	**3.1**

Table 4.2.4-2

Construction Wetlands Impacts Along the WEP Pipeline

Pipeline Loop	WA Ecology [a] Category	Temporary Impacts (acres)	Permanent Impacts (acres)		
		PEM	PFO	PSS	Total Permanent
Sumner North A	II	0.7	—	—	0.0
	III	2.9	—	—	0.0
	IV	0.5	—	—	0.0
	No Rating [b]	—	<0.1	—	<0.1
	Total	**4.1**	**<0.1**	—	**<0.1**
Sumner North B	I	1.3	0.2	1.0	1.2
	II	0.7	<0.1	1.2	1.2
	III	0.6	0.1	0.5	0.6
	IV	3.0	—	0.0	0.0
	No Rating [b]	0.7	—	—	
	Total	**6.3**	**0.3**	**2.7**	**3.0**
Snohomish	I	0.3	—		0.0
	II	8.0	0.8	0.4	1.1
	III	4.4	<0.1	4.7	4.7
	IV	3.8	<0.1	0.2	0.2
	No Rating [b]	0.0	<0.1	—	<0.1
	Total	**16.6**	**0.9**	**5.2**	**6.1**
Mt. Vernon South	II	—	0.6	1.6	2.3
	III	3.9	1.3	—	1.3
	IV	3.0	<0.1	—	0.0
	Total [b]	**6.9**	**2.0**	**1.6**	**3.6**
Mt. Vernon North A	III	1.5	—	0.1	0.1
	IV	4.5	—		0.0
	Total [b]	**6.0**	**—**	**0.1**	**0.1**
Mt. Vernon North B	I	1.3	—	—	0.0
	II	6.7	—	—	0.0
	III	5.0	—	0.4	0.4
	IV	1.5	0.1	—	0.1
	No Rating [b]	0.0	0.2	0.3	0.4
	Total	**14.5**	**0.2** [c]	**0.7**	**0.9**
Sumas	II	0.5	<0.1	0.2	0.2
	III	1.9	<0.1	<0.1	<0.1
	IV	3.0	—	<0.1	<0.1
	No Rating [b]	4.7	—	—	—
	Total	**10.1**	**0.1**	**0.2**	**0.2**
All Loops	I	2.9	0.4	1.0	1.5
	II	30.9	4.4	7.0	11.4
	III	63.1	4.7	8.2	12.9
	IV	73.9	1.3	2.2	3.5
	No Rating [b]	5.8	0.2	1.2	1.4
	Total [c]	**176.6**	**11.0**	**19.6**	**30.7** [c]

[a] Wetland category according to the WA Ecology rating system (WA Ecology, 2004).
[b] Some wetland areas did not receive a WA Ecology Category because insufficient data was available.
[c] Addition accuracy lost due to rounding.

The WEP construction would create short-term impacts on wetland hydrology, water quality, and vegetation communities in disturbed wetlands. Northwest routed areas of the project that would be outside the existing right-of-way so that impacts on PFO and PSS wetlands would be minimized to the extent possible; however, these wetlands would not be entirely avoided due to construction requirements and land use constraints. In areas where a new permanent right-of-way is required in PFO and PSS wetlands, permanent impacts would occur due to a conversion from PFO or PSS habitats to PEM habitats.

FERC's Procedures require that the width of the construction right-of-way be reduced to 75 feet in wetlands and ATWS be at least 50 feet from wetlands and waterbodies unless otherwise approved. Section 4.2.4.4 provides further discussion on these requirements.

Northwest's wetland impact minimization procedures would depend on whether the wetland is saturated at the surface at the time of construction. Many wetlands in the project area are not saturated at the surface during summer months. In these wetlands, when construction occurs during nonsaturated periods, the top 1 foot of topsoil would be segregated and returned to its original position whenever practicable. Northwest would also minimize the duration of topsoil segregation to the extent practicable and retain plants and seedbank in the topsoil to promote revegetation. Once construction is complete, right-of-way area contours would be restored to preconstruction conditions to restore the original wetland hydrologic conditions. Pipeline stringing and fabrication may occur in nonsaturated wetland areas, but concrete coating applications would follow Northwest's Procedures and occur at least 100 feet from the wetland.

In wetlands that are saturated during the construction period, Northwest would use mats to minimize rutting and soil mixing. Low ground weight equipment also may be used to minimize soil compaction. Northwest would not segregate topsoil because saturated soils spread out when stacked and mix together. Pipeline stringing and fabrication may occur within the wetland, but concrete coating applications would follow Northwest's Procedures and occur at least 100 feet from the wetland.

Some impacts on high quality wetlands (Categories I and II) and wetlands adjacent to flowing surface waters would be minimized but would not be avoided due to site-specific alignment restrictions. In most cases, these wetlands are in the existing right-of-way and have recovered from the previous disturbance sufficiently to fall into Category I or II. Avoidance of these impacts would require creation of a new pipeline right-of-way and additional clearance of high quality wooded or shrub upland habitat.

Northwest would cross Queen's Bog (MP 1379.1) and the unnamed bog at MP 1381.3 using the push/pull technique described in section 2.1.4.2. Site-specific crossing plans for these wetlands are provided in appendix K4. These crossings would each require several weeks to complete but the actual work within the bogs would be completed within 10 days (Queen's Bog) to 2 weeks (unnamed bog). The width of the construction right-of-way would be reduced to 75 feet within the bogs. Northwest considered the use of trenchless construction methods such as HDD at these locations but determined that they would not be feasible because of the topography. Minor route variations to avoid these features were also considered but Northwest determined that the additional impacts on landowners and increased tree and other vegetation clearing would result in greater overall impacts. We agree with Northwest's assessment.

No wetlands would be impacted by construction activities associated with the compressor stations, access roads, or contractor and pipe storage yards. The majority of the access roads are currently used to operate and maintain the existing pipeline and no improvements to the roads are currently planned, so no wetland impacts are anticipated. Contractor and pipe storage yards would be outside of wetland areas.

Northwest would restore PEM and farmed wetlands in-place and in-kind. Wetlands areas would be graded to preconstruction contours wherever practical and trench plugs would be installed to minimize percolation through the pipeline trench. Northwest would use NRCS-recommended seed mixes in wetlands and adjacent upland areas during site reclamation unless the USACE, WA Ecology, or local regulations recommend a different seed mix. Individual landowners may also specify seed mixes for their properties, if requests meet regulatory guidelines. Northwest would return farmed wetland areas to their preconstruction agricultural condition and seeded only where required for erosion control. Impacted PSS and PFO wetland areas outside the required maintenance area would be seeded with an herbaceous seed mix at approved USACE and WA Ecology application rates to restore wetland vegetation and encourage natural recruitment of woody vegetation. No plantings of woody vegetation are anticipated. Northwest would monitor restoration areas every 6 months for 1 year and annually thereafter for a total of 3 years. If initial actions are not sufficient, Northwest would undertake additional restoration efforts. Restoration efforts would include landowner and regulatory coordination and comply with permit conditions. Detailed descriptions of restoration procedures are included in Northwest's ECRP (see appendix J1).

4.2.4.3 Compensatory Wetland Mitigation

Northwest would mitigate unavoidable permanent impacts on PSS, PFO, and Category I and II wetlands through off-site wetland mitigation banking sites. Specific sites would be identified during the final permitting stage in coordination with the USACE and WA Ecology. Credits available through active wetland mitigation banks are expected to be sufficient to cover compensatory wetland mitigation required for the project. If approved mitigation banking site credits are not sufficient, Northwest would use USACE and WA Ecology approved in-lieu fee programs to supplement banking credits.

At this time Northwest has not identified specific compensatory wetland mitigation banking sites; therefore, **we recommend that:**

- **Prior to construction, Northwest should file with the Secretary its agency-approved Wetland Mitigation Plan developed in consultation with the USACE and WA Ecology.**

4.2.4.4 Alternative Measures to Our Procedures

Our Procedures specify that the construction right-of-way width in wetlands be limited to 75 feet. Northwest requested approval for certain areas where a wider construction right-of-way would be necessary in Category I and II wetlands based on site-specific conditions. Northwest depicted these locations on aerial photo-based Environmental Construction Alignment Sheets and provided a site-specific explanation of the conditions that would require a wider right-of-way. We have reviewed the Environmental Construction Alignment Sheets and Northwest's explanations to determine whether to approve or deny each area requested (see table 4.2.4-3).

Table 4.2.4-3

Areas Where Northwest Requested a Construction Right-of-Way Width Greater than 75 Feet in Category I and II Wetlands

Loop/ Milepost	Wetland/ Stream	Cowardin	Justification	Approval Status
Woodland				
1268.5	W3_LO1_029	PSS/PFO/ PEM	95 feet of construction right-of-way needed in an area of rugged hilly terrain and side slopes.	Approved
1269.4	W1_LO1_031 W1_LO1_030	PFO PEM	Extra construction right-of-way needed in an area of rugged hilly terrain and side slopes.	Approved
1282.7	W3_LO1_043	PEM/PFO/ PSS	Extra construction width needed due to point of inflection (PI) and connection with Cowlitz River HDD section.	Approved
1288.2 1288.6	W2_LO1_035 W2_LO1_038	PEM PSS	Extra construction width needed due to the length of the wetland complex and the need to confine unconsolidated and saturated soils to the work area. Also, additional material would be excavated due to the increased depth and trench width requirements resulting from high water table, concrete coating, and road/tributary crossings.	Approved
Chehalis				
1293.8	Wetland- 1293.8	PFO/PEM	The right-of-way would be reduced to 85 feet through this long wetland complex. The extra construction width is needed to confine unconsolidated and saturated soils to the work area. Also, additional material would be excavated due to the increased depth and trench width requirements resulting from high water table, concrete coating, and road/tributary crossings.	Approved
1295.4	Wetland-1295.4	PEM/PFO	Extra construction width need due to PIs required rejoining the 26-inch alignment.	Approved
1296.1	Wetland-1296.1	PEM/PFO	Extra construction width needed to negotiate Logan Hill Road crossing.	Approved
1296.5 1296.6 1296.9	Wetland-1296.5 Wetland-1296.6 Wetland-1296.9	PEM/PFO PFO PFO	Extra construction width needed due to rugged, hilly terrain and side slopes and to accommodate timber clearing and relay in a long segment with limited access.	Approved
1297.6	Wetland-1297.6	PFO	Extra construction width needed in an area of rugged, hilly terrain and side slopes and to accommodate timber clearing and relay in a long segment with limited access.	Approved
1299.0	Wetland-1299.0	PEM	Extra construction width needed to accommodate additional excavated material due to increased depth and trench width requirements resulting from high water table, concrete coating, and crossings of Salzer Creek and Proffitt Road.	Approved
1311.6	W2_LO2_007	PSS	Extra construction width needed to provide additional clearance from overhead power line adjacent to right-of-way.	Approved
1315.0	JW-WA-3-2	PSSC	Extra construction width needed for Deschutes River crossing for pipe storage and excavated material.	Approved
Sumner South				
1349.1	WP_LO3_007	PEM	Extra construction width needed to negotiate sharp PI and additional excavation required to cross the existing 26-inch pipeline.	Approved

Table 4.2.4-3

Areas Where Northwest Requested a Construction Right-of-Way Width Greater than 75 Feet in Category I and II Wetlands

Loop/ Milepost	Wetland/ Stream	Cowardin	Justification	Approval Status
Sumner North B				
1371.1	W1_LO5_004	PEM	Extra construction width needed to accommodate PIs and additional excavated material due to increased depth and trench width requirements for crossing Issaquah Creek. Also, the existing pipeline corridor at this location is narrower than the standard 75 feet, and additional space is needed to work over the existing 30-inch pipeline.	Approved
1377.3	W3_LO5_001	PSS	Extra construction width needed to negotiate steep slope and accommodate tree removal. Also, there would be excess excavated material due to increased depth and trench width requirements for crossing North Fork Issaquah Creek.	Approved
Snohomish				
1400.9	W2_LO6_005	PEM	Extra construction width needed to accommodate a reverse lay segment through long wetland. Also, additional material would be excavated due to the increased depth and trench width requirements resulting from high water table, concrete coating, and road/tributary crossings.	Approved
Mt. Vernon South				
1437.8	MV-20	PFO	Extra construction width needed to negotiate crossing of Walker Valley Road and PI.	Approved
Mt. Vernon North B				
1454.3	W1_LO9_006	PEM	Extra construction width needed through small portion of wetland in an area of rugged, hilly terrain and side slopes and to accommodate timber clearing and relay in a long segment with limited access.	Approved
1458.5	W4_LO9_004	PEM	Extra construction width needed to accommodate a reverse lay segment.	Approved
1459.9	W2_LO9_005	PEM	Extra construction width needed to accommodate a reverse lay segment and storage of unconsolidated and saturated soils within the work area. Also, additional material would be excavated due to the increased depth and trench width requirements resulting from high water table, concrete coating, and crossing of Doren Road.	Approved
1461.5	WP_LO9_003	PSS	Extra construction width needed for South Fork Nooksack River HDD.	Approved
Sumas				
1479.0	S-21	PSS/PFO/ PEM	Extra construction width needed at a location where the alignment rejoins the existing 26-inch trench downstream of an offset. Extra workspace would be required for spoil storage, negotiating PIs, removing existing pipeline, and crossing Kinney Creek.	Approved
1481.0	S-9	PSS/PEM	Extra construction width needed for crossing unnamed tributary to lake.	Approved

PEM = palustrine emergent wetland; PFO = palustrine forested wetland; PSS = palustrine scrub-shrub wetland ; PSSC = palustrine scrub-shrub seasonally flooded wetland

Based on our review, the requests for a wider construction right-of-way appear to be reasonable and adequately justified. However, Northwest has provided justification for a construction right-of-way width greater than 75 feet in only WA Ecology-defined Category I and II wetlands. It is not clear if right-of-way of greater than 75 feet is necessary for other wetlands. Our Procedures require prior written approval to increase the construction right-of-way width beyond 75 feet for all federally defined wetlands. Therefore, **we recommend that:**

- **Prior to the close of the draft EIS comment period, Northwest should file with the Secretary site-specific justification for Category III and Category IV wetlands identified in table 4.2.4-2 of the EIS, where it proposes to use a construction right-of-way width greater than 75 feet.**

Without prior written approval, our Procedures require that ATWS be at least 50 feet away from wetland boundaries and waterbodies, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. Table 4.2.4-4 lists the ATWS for which Northwest has requested approval to place less than 50 feet from wetlands and waterbodies and the reason each would be needed. We reviewed these ATWS and conclude that all but one (for stockpiling pipe at about MP 1458.9) is reasonable and adequately justified.

Table 4.2.4-4

ATWS Less than 50 Feet from Wetlands and Waterbodies

Loop/ Milepost	Wetland/ Waterbody	Cowardin	Justification	Approval Status
Woodland				
1253.4	S3_LO1_011	R	ATWS needed for hydrostatic testing equipment and to negotiate double PIs. A paved road separates the ATWS from the waterbody.	Approved
1268.5	W3_LO1_029	PSS	ATWS needed in an area of rugged hilly terrain and side slopes.	Approved
1274.4	Toutle River	R	ATWS needed for wet, open-cut crossing.	Approved
1275.7	S3_LO1_041	R	ATWS needed for a PI and a crossover.	Approved
1282.7	W3_LO1_043	PEM	ATWS needed for HDD pullback.	Approved
1282.8	W3_LO1_043	PFO	ATWS needed for HDD pullback.	Approved
1282.8	W3_LO1_043	PSS	ATWS needed for HDD pullback.	Approved
1282.8	S4_LO1_102	R	ATWS needed for HDD pullback.	Approved
Chehalis				
1294.1	Newaukum River	R	ATWS needed for access to hydrostatic test water. The majority of the ATWS is within an agricultural area with no woody riparian vegetation.	Approved
1295.4	1295.4	PEM/PFO	ATWS needed where PIs required rejoining the 26-inch alignment.	Approved
1295.4	1295.4	R	ATWS needed for PI and 26-inch abandonment cap	Approved
1309.4	Skookumchuck River	R	ATWS need for waterbody crossing near an operational line. The majority of the ATWS would be within an agricultural area and riparian vegetation would be avoided during construction.	Approved
1315.1	Deschutes River	R	ATWS need for waterbody crossing near an operational line. Riparian vegetation would be avoided during construction.	Approved

Table 4.2.4-4

ATWS Less than 50 Feet from Wetlands and Waterbodies

Loop/ Milepost	Wetland/ Waterbody	Cowardin	Justification	Approval Status
Sumner South				
1347.9	S3_LO3_002	R	ATWS needed to access hydrostatic test water from Puyallup River.	Approved
1349.1	WP_LO3_007	PEM	ATWS needed to negotiate sharp PI and excavation required to cross the existing 26-inch pipeline.	Approved
Sumner North A				
1356.9	WP_LO4_001	PFO	ATWS needed for water access used for hydrostatic testing.	Approved
Sumner North B				
1371.1	W1_LO5_004	PEM	ATWS needed to accommodate PI.	Approved
1371.2	S1_LO5_004	R	ATWS needed for wetland staging and PI.	Approved
1376.1	S4_LO5_101	R	ATWS needed for setup for the I-90 crossing. Steep topography limits other workspace locations.	Approved
1377.3	W3_LO5_001	PSS	ATWS needed in cleared area for North Fork Issaquah Creek crossing.	Approved
1381.3	SN-45	R	ATWS needed for equipment staging for a bog crossing. Wetlands and residential development limit other workspace locations.	Approved
1381.3	SN-44	PEM	ATWS needed at bog crossing to offset from existing pipelines.	Approved
1397.5	S4_LO6_101	R	ATWS needed for HDD pullback and access to hydrostatic test and HDD water.	Approved
1397.6	Snohomish River	R	ATWS needed for HDD pullback and access to hydrostatic test and HDD water.	Approved
1398.2	S1_LO6_002	R	ATWS needed pipe and equipment staging.	Approved
1399.4	S1_LO6_004	R	ATWS needed to accommodate steep topography.	Approved
1399.7	S1_LO6_005	R	ATWS needed to accommodate steep topography.	Approved
Snohomish				
1409.3	MV-71	PEM/PSS/ PFO	ATWS need for crossing of Meridian Street	Approved
1407.8	Pilchuck River	R	ATWS need for waterbody crossing near an operational line. Topography and residential development limits other workspace locations.	Approved
Mt. Vernon South				
1437.8	S4_LO7_101	R	ATWS needed for road crossing. Wetlands and residential development limits other workspace locations.	Approved
1437.8	MV-20	PFO/PSS	ATWS needed to negotiate a road crossing and PI. ATWS on opposite side of Walker Valley Road from wetland.	Approved

Table 4.2.4-4

ATWS Less than 50 Feet from Wetlands and Waterbodies

Loop/ Milepost	Wetland/ Waterbody	Cowardin	Justification	Approval Status
Mt. Vernon North A				
1444.9	Skagit River	R	ATWS needed for tie-in with existing aerial span and installation of aboveground facilities.	Approved
Mt. Vernon North B				
1454.8	S2_LO9_010	R	ATWS needed for timber storage, parking, and staging. No riparian vegetation is present.	Approved
1455.2	S2_LO9_007	R	ATWS needed for crossover and timber storage.	Approved
1455.3	WP_LO9_004	PFO	ATWS needed for staging of the existing 26-inch pipeline and timber for removal from the right-of-way in a long segment with limited access. Additionally, there is a railway encroachment in this area.	Approved
1458.9	WP_LO9_001	PEM	ATWS in wetland needed for stockpile of pipe.	Not approved. Wetland could be avoided by using nearby agricultural area.
1459.9	W2_LO9_005	PEM	ATWS need for crossing of Maleng Road. ATWS on opposite site of road from wetland.	Approved
1461.5	WP_LO9_003	PSS	ATWS needed for HDD crossing of South Fork Nooksack River HDD.	Approved
Sumas				
1484.2	WP_L010_001	PEM	ATWS needed for pipe and construction equipment storage.	Approved

PEM = palustrine emergent wetland; PFO = palustrine forested wetland; PSS = palustrine scrub-shrub wetland; R = riverine

4.2.5 Aquatic Resources

4.2.5.1 Existing Aquatic Resources

The WEP would traverse three major drainage basins: the Lower Columbia River, the Chehalis River (entering Grays Harbor on the Washington coast), and Puget Sound. These three broadly defined basins are important because they generally correspond to populations of federally listed fish (discussed in section 4.2.8.1) along the WEP pipeline route. The pipeline would cross 271 waterbodies, ranging from minor ephemeral and intermittent streams to major rivers, such as the Cowlitz and Snohomish Rivers, across 11 different WRIAs (see table 4.2.5-1).

Table 4.2.5-1

Fish-bearing Waterbodies by Water Resource Inventory Area Crossed by the WEP

Water Resource Inventory Area	Loops	Major Watersheds Crossed	Fish-bearing Waterbodies Crossed (number)
WRIA 1 Nooksack	Sumas, Mt. Vernon North B	Nooksack and Sumas Rivers	6
WRIA 3 Lower Skagit – Samish	Mt. Vernon North B, Mt. Vernon South	Skagit River	1
WRIA 7 Snohomish	Snohomish	Snohomish River	8
WRIA 8 Cedar-Sammamish	Sumner North B	Lake Sammamish	12
WRIA 9 Duwamish-Green	Sumner North A	Green River	7
WRIA 10 Puyallup-White	Sumner South	Puyallup River	3
WRIA 12 Chambers-Clover	Sumner South	Steilacoom Lake/Puget Sound	0
WRIA 13 Deschutes	Chehalis	Deschutes River	1
WRIA 23 Upper Chehalis	Chehalis	Chehalis River	15
WRIA 26 Cowlitz	Woodland	Cowlitz River	31
WRIA 27 Lewis	Woodland	Columbia River	6

Primary fisheries resources in the project area include coldwater anadromous and resident fish, including salmonids. Eight anadromous species contribute to the regional commercial, recreational, and tribal fisheries; these include Chinook, coho, chum, pink, and sockeye salmon, bull trout, Dolly Varden, steelhead, and coastal cutthroat trout. The WDFW considers all eight of these anadromous fish as state priority species. Federally listed species are discussed in detail in section 4.2.8. The generalized life history of Pacific salmon and steelhead is described in sections 4.1.5 and 4.1.8. Fish use at proposed waterbody crossings is listed in tables K5-1 and K5-2 in appendix K5. The approximate life history timing of salmonids in each of the WRIAs that would be crossed by the WEP is also summarized in table K5-3 in appendix K5.

Other special status species that may occur in the project area include eulachon, pacific lamprey, river lamprey, Olympic mudminnow, leopard dace, mountain sucker, and kokanee salmon. These species are also discussed in section 4.2.8. In addition to these priority species, various streams at or downstream of the pipeline crossings provide year round habitat for several resident fish species. These include mountain whitefish, northern pikeminnow, sculpins, largescale suckers, western brook lamprey, speckled dace, and longnose dace.

Several warmwater fisheries are present in western Washington. Warmwater species are typically nonnative and occur in lakes. Largemouth bass, smallmouth bass, pumpkinseed, yellow perch, black crappie, and brown bullhead have been introduced to Lake Washington (about 10 miles west of Sumner North B Loop) and Lake Sammamish (about 3 miles west of Sumner North B Loop) in King County. With the exception of pumpkinseed, these warmwater fish have also been introduced to Lake Stevens (about 1 mile west of Snohomish Loop) in Snohomish County. Big Lake (less than 0.5 mile west of Mt. Vernon South Loop) in Skagit County supports largemouth bass and crappie. However, there are no records of those species' occurrence in tributaries to those lakes or other waterbodies that would be crossed by the WEP. Although it is possible that a few individuals could occur in the streams flowing into or exiting from these lakes, it is doubtful that the WEP would encounter warmwater species because they typically do not spawn or rear in streams.

4.2.5.2 Aquatic Resources Impacts and Mitigation

We received comments from state and federal agencies, Native American tribes, and individual citizens expressing concerns about impacts on aquatic resources from pipeline construction, specifically at waterbody crossings. Specific topics related to pipeline crossing methods and impacts on water quality are discussed in section 4.2.3.2. Potential effects on habitat due to riparian clearing and impacts on sensitive fish species, especially listed salmon, are discussed in this section and in section 4.2.8.

Aquatic species within each of the affected WRIAs (see table 4.2.5-1) would experience similar impacts, depending on the type of crossing, and the duration of in-water work. Northwest plans to cross waterbodies during the low-flow periods in the summer or early fall, and some of the ephemeral waterbodies that would be crossed at this time are expected to be dry, thereby avoiding direct effects on fish. Northwest would follow WDFW's recommended time frame for in-water work (see table K5-1 in appendix K5) unless they receive a variance from WDFW to work outside the in-water work window.

Construction Impacts and Mitigation

Because Northwest would implement its Plan and Procedures, we conclude that neither the modification of compressor stations nor development of storage and contractor yards and aboveground facilities would affect aquatic species. Northwest does not propose any new access roads, or improvements to existing roads.

Installation of the pipeline in and next to waterbodies could result indirect effects on aquatic resources. Potential impacts on fish and other aquatic resources at or near proposed stream crossings would depend largely on the type of construction method used to cross the stream. Standard upland construction methods would be used to cross nonflowing, intermittent or ephemeral streams. Northwest proposes to use trenchless methods to cross five streams that have high-quality fisheries. This method avoids direct contact with the stream, thereby avoiding or minimizing potential effects on fish. Four waterbodies with fisheries would be crossed by span or aerial span (see section 2.2). For other waterbodies that have flowing water at the time of construction, Northwest would use dry open-cut (flume or dam and pump), methods, except at the Toutle River, which would have a wet open-cut crossing. These methods are described in section 2.2.3.2. In general, open-cut crossings result in the greatest impact on fish species because they require work in the stream. Trenchless and aerial crossings avoid direct contact with the water. However, trenchless and aerial crossings also have associated environmental impacts and constructability constraints that need to be taken into consideration when selecting the most appropriate crossing method for a given waterbody, as discussed in section 4.2.3.2. Potential impacts associated with pipeline construction and measures to mitigate impacts are described below.

In 2014, FERC staff conducted a site review with Northwest and state agencies at proposed waterbody crossings. The WDFW recommended that Northwest consider trenchless crossings (HDD or span) for several waterbodies that are proposed as dry open-cut crossings, specifically the Coweeman (MP 1260.5), Skookumchuck (MP 1309.4), Deschutes (1315.1), and Pilchuck (1407.8) Rivers. Northwest conducted geotechnical borings near the Coweeman River and determined that subsurface conditions were unfavorable for HDD; therefore, the proposed dry open-cut method was retained as most feasible. Geotechnical borings at the Skookumchuck River indicated it was also unfavorable for HDD, and a steep hillside on the south side of the river would not allow for the necessary HDD workspace. Similarly, the steep slopes on either side of the Deschutes River crossing also preclude the use of HDD at that site. Geological mapping near the Pilchuck River indicate there would be an unacceptably high risk

of HDD failure or inadvertent release of drilling fluid. The Pilchuck River crossing is also constrained by residential areas that would further complicate the use of HDD.

Northwest also considered using aerial crossings at these waterbodies but determined that visual impacts of new aerial span on the rural, undeveloped settings of these rivers would be greater than the temporary impacts associated with the proposed dry open-cut crossings. Aerial span structures may also require in-water support structures that would permanently impact the waterbody. Furthermore, buried pipelines are generally preferred over aboveground pipelines for safety and security reasons. We have reviewed Northwest's proposed waterbody crossing methods and conclude that they are reasonable based on the information available about site conditions and the limitations of HDD and aerial crossings.

Direct Mortality

During dry, open-cut crossings, direct mortality can occur if fish are trapped between temporary upstream and downstream dams. To minimize the potential for such mortality, Northwest would remove any fish remaining in the isolated in-water work areas prior to dewatering and excavation. Fish salvage techniques, including seining and/or electrofishing, would be employed until no additional fish are evident for three electrofishing or seine passes. Northwest would obtain applicable fish handling permits from WDFW and NMFS (and FWS, as necessary) before fish salvage begins, and all collected fish would be relocated to an appropriate area within the same stream. The handling, moving, and reintroduction of fish in designated work areas would be conducted in accordance with the FWS *Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards* (FWS, 2012c) and WSDOT's *Fish Exclusion Protocols and Standards* (WSDOT, 2012). The methods described in these protocols prioritize the use of seines, baited minnow traps, and dip nets to capture fish over the use of electrofishing. In particular, the FWS protocol recommends the following:

- use only dip nets and seines composed of soft (nonabrasive) nylon material;
- conduct a minimum of three complete passes without capture using seines and/or nets prior to the use of electrofishing;
- confirm success of fish capture and removal before completely dewatering or commencing with other work within the isolated work area by conducting a minimum of two complete passes without capture using electrofishing equipment;
- do not hold fish in containers for more than 10 minutes, unless those containers are dark-colored, lidded, and fitted with a portable aerator; and
- develop a plan for achieving efficient return to appropriate habitat before starting the capture and removal process, and release federally listed specimens first.

Both the FWS and WDFW protocols require that fish salvage operations be overseen by a biologist with fish handing experience and a minimum of 100 hours of electrofishing experience. The FWS expressed concern that typical fish salvage techniques including those described in the FWS and WDFW protocols could be ineffective at capturing larval lamprey, which tend to reside embedded in soft sediments. Therefore, **we recommend that:**

- **Prior to the close of the draft EIS comment period, Northwest should file with the Secretary a Fish Salvage Plan developed in coordination with the FWS and WDFW that includes measures to minimize the impacts on native fish, including lamprey, during open-cut waterbody crossings.**

In addition to entrapment potential, some small fish, larvae, and fish eggs could be entrained by water pumps used during the dam-and-pump process or during water withdrawals for hydrostatic testing and dust control. Larger fish should be able to avoid entrainment. Northwest would minimize these potential effects by adhering to screening measures in its Plan and Procedures. Moreover, Northwest would comply with NMFS and WDFW fish screening criteria for intake hoses, details on locating pump intakes to minimize entrainment, and regulation of the pumping rate to avoid adverse impacts on aquatic resources or downstream flows.

Benthic invertebrates within the stream crossing construction zones would be displaced, stressed, or suffer mortality. Because of the relatively small area of impact at each crossing, benthic invertebrates would repopulate the affected areas quickly following restoration of the streambed, banks, and water flow. Aquatic macroinvertebrates like mayflies, caddisflies, and midge larvae would be likely to recolonize disturbed areas soon after construction. The duration of dewatering necessary to install the pipeline at most open-cut crossings would be short (typically 24 to 48 hours), and some larval stages may survive the temporary isolation from flowing water. Toutle River is the only waterbody currently proposed with in-water construction work that would last longer than 48 hours. Further description of this waterbody crossing is provided below.

Sedimentation and Turbidity

In-stream construction at waterbody crossings would cause increased sedimentation and turbidity downstream of the crossing. In addition, surface runoff during storm events or discharge from trench dewatering or hydrostatic testing water may contribute to soil erosion and result in sedimentation.

As described in section 4.1.5.2 for the Oregon LNG Project, increased sediment loads and associated turbidity can affect fish behavior and physiological processes (e.g., gill function). Sediment entering the stream can bury or smother aquatic macroinvertebrates and other fish food sources. Additionally, downstream sedimentation can adversely affect spawning habitat and reduce survival of incubating eggs, larvae, juvenile fish (Greig et al., 2005), and benthic invertebrates through the alteration of water quality and substrate conditions. However, benthic macroinvertebrates within the area isolated by dams and areas immediately downstream are expected to recover within a few months after pipeline construction (Gartman, 1984). Because of the relatively localized area of each stream that would be affected and the ability of fish to use other food resources (such as terrestrial insects) during the summer months, we do not expect any measurable effect on the growth or survival of the fish that forage on macroinvertebrates.

Northwest would cross the Toutle River using the wet, open-cut crossing method. This crossing technique has the highest potential for generating elevated levels of turbidity compared to other waterbody crossing techniques. The amount of sediment produced by wet, open-cut crossing methods depends on site conditions at the time of construction, including depth and width of the waterbody, water flow and velocity, streambank soil type, stream substrate type, and site topography. Northwest would complete the Toutle River crossing during the summer (i.e., between July 16 and August 15) when flow is at its lowest, which would minimize the width of the stream crossing at this location. Northwest also selected a crossing location where the Toutle River has a relatively slow current that would reduce the distance sediment would be transported downstream. The glacier runoff from Mount St. Helens contributes high levels of sand and silt into the Toutle River that would be mobilized during in-water work. If needed and approved by the EI, Northwest may also divert a portion of the river flow around the work to further reduce the sediment transport. Overall, Northwest expects that in-water work at the Toutle River would take up to 7 days.

Similar to Oregon LNG, Northwest would use the HDD method to cross all other major waterbodies and smaller streams with particularly sensitive fish habitat. An HDD would minimize turbidity because in-water construction would not be required, but impacts could occur during an inadvertent release of drilling fluid. Sedimentation effects and related effects associated with inadvertent releases would be identical to those described in section 4.1.5.2.

Northwest would minimize impacts on surface waters and aquatic resources by implementing its Plan, Procedures, ECRP, and applicable conditions from WDFW and WA Ecology to reduce soil erosion and transport into waterbodies. In accordance to these requirements, Northwest would install sediment barriers, such as silt fence and straw/hay bales, to prevent or significantly reduce runoff into a stream. Construction would be completed as quickly as possible to shorten the duration of sedimentation and turbidity. Northwest would stabilize the construction site, including the streambanks, immediately following installation of the pipeline. If circumstances require a construction delay, adequate site stabilization measures would be employed in accordance with Northwest's Plan, Procedures, ECRP, and applicable permit conditions.

Northwest would follow WDFW's in-water construction timing windows for waterbodies not crossed by trenchless methods to minimize impacts on fish by avoiding construction during sensitive periods (e.g., adult migration, spawning, egg incubation). Work windows for specific fish-bearing waterbodies for each of the WEP crossing sites are provided in table K5-1 in appendix K5. In some cases, Northwest may request that WDFW allow it to deviate from the in-water work timing windows for waterbody crossings near headwaters, where flows are intermittent at the time of construction, or salmonids are not present. In these cases, Northwest would work with WDFW to establish site-specific windows that may be less restrictive than windows recommended by WDFW. Northwest would also need approval from FERC to cross waterbodies outside the timeframe for coldwater fisheries listed in our Plan and Procedures. To ensure that Northwest consults with WDFW regarding timing of in-water work, we have included a recommendation that Northwest file documentation showing justification and approval from state agencies prior to construction.

Fish Passage

Construction associated with stream crossings could interfere with the upstream or downstream movement of fish. Streams crossed with trenchless or aerial methods would not affect fish migration. Wet, open-cut methods would also allow for migration past the construction site; however, dry, open-cut crossing methods (flume or dam-and-pump procedures) would block fish passage during the in-water construction period, generally for a period of 24 to 48 hours.

Flumes would be installed prior to any in-water disturbance, and flumes would be removed as soon as possible after trench backfilling. As construction is proposed to occur during summer to take advantage of low-flow conditions, flumes would be designed to allow fish passage, even during low-flow events. Flumes also would be designed to extend beyond the length of the construction area, and all flow would be directed into the flume to allow for continuous downstream passage. A temporary dam of sandbags and plastic, or other materials, would be constructed at the upstream and downstream end of the flume; the dams would prevent turbid construction water from flowing downstream. All in-water excavation would be done between the dams. As described above, prior to pipeline trenching, any fish trapped in any water remaining in the work area between the dams would be removed and released downstream.

All crossings of fish-bearing waterbodies would occur in the late summer, over a few days (depending on stream size) during in-water work windows stipulated in permits issued by WDFW. This summer timing would avoid periods of adult upstream migration, and peak spring periods of juvenile

outmigration. With the flume method, downstream juvenile salmonid movements would be provided through a bypass flume. With these precautions, the WEP construction would not significantly impede migratory fish passage and existing passage conditions would be maintained.

Riparian Vegetation

As described for the Oregon LNG Project (section 4.1.5.2), pipeline installation would require the removal of riparian vegetation within the construction right-of-way. Loss of riparian vegetation along the banks would reduce shade, potentially increasing water temperatures, and remove an important source of terrestrial food for aquatic organisms.

Soil stockpiling, pipe stringing, pipe bending, and welding would occur at least 50 feet from the edge of waterbodies as required by Northwest's Plan and Procedures. Northwest would minimize the amount of riparian clearing to the extent practicable and attempt to save significant-sized trees at the margins of the construction right-of-way and ATWS. Any existing LWD would be salvaged for reinstallation following construction. Upon completion, the streambanks would be restored and stabilized, and the riparian area would be replanted with native vegetation, such as red-osier dogwood, willow, and western red cedar, in accordance with Northwest's ECRP.

A wider riparian clearing width would be needed to cross streams in steep terrain to account for larger trench backslopes and provide space for temporary structures for equipment access. However, clearing for steep-terrain crossings would be limited to the minimum clearing width to safely perform access and construction. Following pipe installation and trench backfilling, the streambanks would be regraded and stabilized, and the riparian area would be restored with native vegetation similar to surrounding undisturbed areas.

Water Temperature

Construction across waterbodies would necessitate removal of riparian trees and shrubs at the crossing locations. However, most waterbody crossings locations lack taller canopy trees to provide shade because many of those trees were removed during previous pipeline construction along the existing Northwest pipeline right-of-way. As such, the riparian clearing for the WEP would be minimized because the construction work area would overlap Northwest's existing right-of-way. The effects of riparian vegetation removal would be similar to those described in section 4.1.5.2, and could include minor, localized increases in stream temperature, which could stress coldwater fish. Northwest would restore riparian vegetation outside of the 30-foot maintained strip over the pipeline by replanting disturbed areas following construction.

Habitat Modification and Loss of Large Woody Debris

Long-term degradation of aquatic habitats could occur if the disturbed stream channel is not restored to a stable and functional condition. For example, modification of stream contours could lead to channel incision and loss of floodplain connection. Erosion of the streambed, banks, or adjacent upland areas could also introduce sediment into the waterbody beyond the temporary short-term construction period, which could result in the loss of suitable spawning habitat. Loss of riparian vegetation along the banks could also decrease existing root stock used to stabilize banks. Additionally, the removal of boulders, LWD, streambank vegetation, and undercut banks could decrease habitat value for fish that utilize these features for cover, spawning habitat, and feeding.

As described in section 4.1.5.2, LWD is an important feature in stream habitat because it provides cover for fish and contributes to stream complexity, which is beneficial to salmonids (Sedell et al., 1988; Bisson et al., 1987). At some locations, construction of the WEP would result in long-term, permanent

clearing of woody riparian vegetation and in short-term, localized shifting of LWD in the stream channel to allow equipment access for trenching, pipeline installation, and backfilling. However, the pipeline construction at most waterbody crossings would occur within Northwest's existing right-of-way, where most vegetation consists of emergent vegetation, shrubs, and small saplings. Northwest would attempt to reestablish preconstruction conditions to the extent practicable at all crossing locations in accordance with its ECRP (see appendix J1), Plan, and Procedures. Northwest would provide additional stream habitat enhancements by preserving LWD that is present at the time of construction, and incorporating new LWD into its stream restoration, using Douglas-fir and Western red cedar removed during construction.

Site-specific placement of LWD should be determined with agency input and not every waterbody may require LWD as enhanced mitigation. Therefore, **we recommend that:**

- **Prior to construction, Northwest should file with the Secretary, for review and written approval by the Director of OEP, a plan for placement of LWD or other waterbody habitat improvement features. The LWD plan should be developed in consultation with the WDFW, FWS, and NMFS and include, at a minimum, details of when, where, and what structures (e.g., LWD) would be placed instream, and describe the process for making those decisions.**

In most cases, site restoration would not involve additional bank stabilization measures. However, if additional bank stabilization is needed or required as a permit condition (e.g., HPA) for a particular site, the methods of bank stabilization would be consistent with the USACE Seattle District Regional General Condition No. 4, which requires the incorporation of the least environmentally damaging practicable methods and revegetation with native riparian plant species (USACE, 2012b).

Remaining impacts would be mitigated through several efforts to restore or enhance affected habitat. For example, placement of LWD on the banks and in the stream could compensate for loss of shade and diminished bank stability, as well as provide substrate for macroinvertebrates, while vegetation planted for site restoration is maturing. As appropriate, Northwest would follow WDFW's Integrated Streambank Protection Guidelines and Stream Habitat Restoration Guidelines to design and carry out the streambank and streambed restoration work (WDFW 2002 and 2012b, respectively).

There may be reasonable opportunities to enhance fish habitat that may have been degraded by the original pipeline installation. Northwest would work with WDFW and NMFS to identify such opportunities and would implement agreed-upon enhancement measures via the HPA process and per our above recommendation.

Landslides and Mass Failures

The WEP would cross a variety of terrain including steep slopes that could be susceptible to landslides. In the event of a landslide at a pipeline crossing, potential effects on aquatic resources would be similar to those described in section 4.1.5.2, and would primarily include those associated with sedimentation and the creation of potential passage barriers. However, Northwest would implement specific measures to minimize the effects of pipeline construction and operation on landslide hazards, as well as measures to protect the pipeline from exposure to landslide effects, should they occur (see section 4.2.1.4). We conclude that these measures, would also minimize the potential for adverse effects from landslides on aquatic resources.

Water Withdrawals and Discharges

After construction of each loop, the completed pipelines would be hydrostatically tested to ensure structural integrity. Northwest would withdrawal water for hydrostatic testing from selected municipal

sources, and surface waters. As discussed in section 4.1.5.2, water withdrawals and discharges to surface waters can impact fisheries resources. Removal of water during summer low-flow conditions can dry up stream channels, reduce available migratory habitat, and negatively affect stream temperatures. Discharge of water into stream channels can result in water quality changes, scouring of streambeds, bank erosion, increased turbidity, or rapid changes in water levels that can strand fish. To minimize these potential impacts, Northwest would use only major waterbodies for the primary hydrostatic test water sources and most water withdrawals for the WEP pipeline testing would occur in the fall and winter, after seasonal stream flows have increased.

Hydrostatic testing would occur as each loop is completed and before the pipeline is placed in service. The amount of water required would vary, depending on the length of pipeline being tested. Anticipated test water sources, volumes and discharge sites are presented in section 4.2.3.2. Discharge sites would typically be near withdrawal sources to provide for recharge, including to ground and surface waters. Environmental impacts from the withdrawal and discharge of test water would be minimized by applying the measures indicated in Northwest's Plan and Procedures, including not using waterbodies which provide habitat for federally listed species unless appropriate federal and/or state agencies grant written permission, and maintaining adequate flow rates to protect aquatic life, provide for all waterbody uses, and provide for downstream withdrawals of water by existing users.

Northwest would discharge all surface water for hydrostatic testing either to upland infiltration areas or back to the same stream basin from which it was withdrawn. This would be done to prevent the inadvertent transfer of aquatic pathogens or nonnative species between basins. Because of the short residence time of the test water in each loop (typically less than 24 hours), the use of biocides or other hydrostatic test water additives would not be required. Dirt and scale from inside the pipe would be filtered out by the use of the dewatering structure.

The potential effects of water withdrawals on physical fish habitat for spawning, rearing, and migration would be further minimized by limiting the rate of water withdrawal from each stream to less than 10 percent of the stream's flow at the time of withdrawal up to a maximum of 2,500 gpm (5.6 cfs). Of the 15 streams proposed for source water withdrawal only four (Coweeman River, Deschutes River, Issaquah Creek, and East Fork Nookachamps Creek) have typical summer base flows less than 56 cfs.

The potential impacts on fish habitat from water withdrawals are not only a function of stream flow reduction but also the duration of withdrawal. In most cases, each test segment would take less than 12 hours, assuming a 2,500 gpm withdrawal rate. For example, at this withdrawal rate, it would require only 6.7 hours to meet a 1 million gallon testing need. Northwest would use municipal sources or larger rivers for filling test segments that require more than 1 million gallon to minimize effects on fish habitat.

Blasting

Underwater blasting is not anticipated for the WEP; however, if unrippable subsurface rock is encountered along the pipeline trench, in-water blasting may be necessary for excavation. As described for the Oregon LNG Project (section 4.1.5.2), in the event blasting becomes necessary, potential impacts on fishery resources would include short-term impacts of increased sedimentation and turbidity within the water column, as well as injury or death of fish caused by acoustic shock or damage to internal organs.

If in-water blasting is required, Northwest would consult with appropriate regulatory agencies prior to conducting any blasting in or near waterbodies, and obtain all necessary authorizations. Northwest would require that the pipeline contractor develop a detailed blast plan for in-water blasting, which would include best management practices that would be implemented to prevent damage to aquatic resources.

Hazardous Material Spills

Releases of diesel fuel, lubricants, hydraulic fluid, and other contaminants contained in construction equipment or storage areas could result in acute negative impacts on fish, invertebrates, and in-stream habitat. In addition, long-term effects could result if a spill were not remediated properly. The only potential sources of contaminants along the WEP pipeline would be the construction equipment itself (lubricating oils and fuel).

Northwest has prepared a *Spill Plan for Oil and Hazardous Materials* that outlines commitments for spill prevention and containment, meets state and federal agency requirements, and provides BMPs to reduce the possibility of a spill during construction and to respond to any spills that could occur. In addition, measures in Northwest's Plan and Procedures prohibit re-fueling of equipment or storing hazardous materials within 100 feet of a wetland or waterbody unless the location is designated for such use by an appropriate governmental authority.

Operational Impacts and Mitigation

Maintenance of the WEP pipeline would require periodic vegetation mowing, as necessary and in accordance with Northwest's Plan and Procedures, to allow for visual pipeline inspections. The effects of such maintenance on aquatic resources would be insignificant, and similar to those described in section 4.1.5.2 for the Oregon LNG Project.

Over time, if not properly designed, pipelines can become exposed in a streambed, and create barriers to flow and passage of aquatic organisms. To address this issue, Northwest assessed pipeline scour potential for perennial streams, streams with ESA-listed salmonids, and waterbodies with ESA-designated critical habitat. Based on the scour analysis, Northwest determined that all waterbody crossings would have at least 5 feet of cover from the top of pipeline to bottom of streambed. In addition, during final design, each waterbody crossing would be further evaluated using the information in the stream crossing scour assessment to determine if additional depth of cover is required for specific crossings. We conclude that these measures would minimize the potential for channel migration and vertical scour at the pipeline crossings, and prevent long-term pipeline exposure.

Northwest would cross several streams by span, aerial span or the HDD method, which would eliminate operational impacts from potential stream scour. Further, HDD would eliminate the need for operational clearing between the entry and exit locations.

4.2.5.3 Essential Fish Habitat

The EFH assessment for the WEP, as required under the MSA (see section 4.1.5.3) will be included along with the Biological Assessment prepared by FERC for the WEP and the Oregon LNG Project. The only EFH fishery designated in the project area for the WEP is the Pacific Salmon Fishery, which consists of Chinook, coho, and pink salmon. The MSA describes EFH as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NMFS, 1997b). At waterbody crossings, the EFH for the salmon species includes freshwater habitats for spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors. All anadromous fish-bearing streams listed in table K5-1 in appendix K5 are known or assumed to provide EFH to one or more species of the Pacific Salmon Fishery.

Pacific eulachon is a species within the Coastal Pelagic Fishery, and Pacific eulachon are known to spawn in three waterbodies that would be crossed by the WEP. However, EFH for the Coastal Pelagic Fishery is defined as all marine and estuarine waters from the shoreline along the coasts of California,

Oregon, and Washington offshore to the limits of the EEZ and does not include freshwater (PFMC, 1998). Therefore, the project would not cross Coastal Pelagic Fishery EFH.

The WEP would cross 54 waterbodies that contain EFH for Pacific salmon. Of those, 46 waterbodies would require in-water work and 8 would not. The in-water work would consist mostly of dry, open-cut crossings and only one crossing using a wet, open-cut (Toutle River). Eight EFH waterbodies would be crossed without in-water work, using trenchless or span methods.

Northwest has not identified any waterbodies along the WEP that contain pink salmon. This is because the waterbody crossing locations are upstream of reaches known to be occupied by pink salmon. The in-water work windows would most likely avoid Chinook salmon use, thereby limiting the effects on their habitat, while occupied. Coho salmon, however, are the most prevalent anadromous salmonid in all the waterbodies along the WEP, and there is a high probability that juvenile coho would be present in many waterbodies that would be crossed.

Impacts and Mitigation

The potential effects on aquatic habitat discussed in section 4.2.5.2 also are applicable to the freshwater EFH for spawning, rearing, and migration of the members of the Pacific Salmon Fishery. Potential effects on spawning habitat could include increased sedimentation, potential changes in water temperature, potential water contamination, and temporary water withdrawals. Effects on rearing habitat would include waterbody crossings used for spawning habitat as well as alteration of riparian vegetation and changes to in-water habitat elements such as LWD. The potential source of effects on migration corridors is the temporary impediment to fish passage resulting from construction activities at stream crossings.

Virtually all of the potential effects on EFH at the waterbody crossings along the WEP would likely be temporary in nature, and Northwest would restore in-water conditions to preproject levels where practicable.

EFH Determination

Given the number of in-water crossings and the high likelihood that EFH for coho salmon of the Pacific Salmon Fishery would be affected, albeit temporarily, we conclude that the WEP would be likely to have an adverse effect on EFH for the Pacific Salmon Fishery. However, given the mitigation measures that are proposed by Northwest, we conclude that the project would not have a substantial adverse impact on EFH in the project area.

4.2.6 Vegetation

4.2.6.1 Existing Environment

As shown in table 4.2.6-1, the WEP would cross four Level III ecoregions: Puget Lowland, Willamette Valley, Cascades, and North Cascades (Pater et al., 1998).

Table 4.2.6-1

Ecoregions Affected by the WEP Pipeline

Ecoregion	Loops	Total Miles
Willamette Valley		
Portland-Vancouver Basin	Woodland	0.9
Puget Lowland		
Cowlitz/Chehalis Foothills	Woodland, Chehalis	38.5
Cowlitz/Newaukum Prairie Floodplains	Woodland, Chehalis	16.5
Eastern Puget Riverine Lowlands	Sumner South, Sumner North A, Snohomish, Mt. Vernon North A, Mt. Vernon B	13.8
Southern Puget Prairies	Chehalis, Sumner South	10.9
Eastern Puget Uplands	Sumner North A, Sumner North B, Snohomish, Mt. Vernon South, Mt. Vernon North A	23.6
Fraser Lowland	Sumas	2.9
Cascades		
Western Cascades Lowlands and Valleys	Woodland, Chehalis, Sumner North B	13.7
North Cascades		
North Cascades Lowlands Forests	Mt. Vernon North B, Sumas	10.9

Willamette Valley Ecoregion

The southernmost end of the Woodland Loop falls within the Willamette Valley ecoregion. This ecoregion lies primarily within Oregon, with a small extension into neighboring southwestern Washington. Terraces and floodplains of the Willamette River system and scattered hills, buttes, and adjacent foothills are contained in this ecoregion. Originally, it was covered by prairies, oak savannas, coniferous forests, extensive wetlands, and deciduous riparian forests. The fertile soils and temperate climate have made it the center of Oregon's cropland, and—by extension—of its population, industry, and commerce. The WEP would cross one subdivision of the Willamette Valley ecoregion: the Portland/Vancouver Basin. This subdivision is characterized by undulating terraces and floodplains. Water features include low-gradient, meandering streams and plentiful oxbow lakes, wetlands, and ponds. Oregon white oak, Douglas-fir, Oregon ash, alder, and western red cedar are commonly found throughout the subdivision. Soils are usually deep, silty clay loam to loam.

Puget Lowland Ecoregion

A portion of each loop occurs in the Puget Lowland ecoregion. This ecoregion, known for its mild maritime climate, is located within a continental glacial trough and has many islands, peninsulas, and bays in the Puget Sound area. Coniferous forests originally grew along the area's ground moraines, outwash plains, floodplains, and terraces, but the area has been extensively logged. The rain shadow of the Olympic Mountains affects the distribution of forest species throughout the ecoregion. Native grasslands and oak woodlands found in this ecoregion are considered imperiled and are tracked by the Washington National Heritage Program. Within the Puget Lowland ecoregion, the WEP would traverse

six Level IV subdivisions: Cowlitz/Chehalis Foothills, Cowlitz/Newaukum Prairie Floodplains, Eastern Puget Riverine Lowlands, Eastern Puget Uplands, Fraser Lowland, and Southern Puget Prairies.

The Cowlitz/Chehalis Foothills subdivision has low, rolling to steeply sloping hills that were not affected by continental Vashon glaciation. Dominant trees include western hemlock, western red cedar, and bigleaf maple, with some Douglas-fir.

The Cowlitz/Newaukum Prairie Floodplains subdivision was not affected by continental Vashon glaciation. This subdivision has rolling terraces and floodplains with meandering streams and oxbow lakes. Western red cedar and western hemlock forests, along with some Douglas-fir and bigleaf maple, oak woodlands, and prairies are dominant vegetation types found here. The Eastern Puget Riverine Lowlands subdivision has many floodplains and terraces with meandering rivers and oxbow lakes. Freshwater and estuarine wetlands were common on the landscape in the past and still occur throughout the area. Soils are deep, fertile silt loams that support western red cedar, western hemlock, and, to a lesser extent, red alder, black cottonwood (*Populus trichocarpa*), bigleaf maple, and Sitka spruce.

The Eastern Puget Uplands subdivision is characterized by rolling moraines and foothills. Water features include lakes as well as winding rivers and streams. Dominant trees include western hemlock and western red cedar, with Douglas-fir scattered throughout. The Fraser Lowland subdivision is typified by glacial drift plains, terraces, and floodplains with low-gradient streams and rivers meandering through them. Silty to sandy loam soil supports western hemlock and western red cedar forests, with the occasional red alder, bigleaf maple, black cottonwood, and Douglas-fir. The Southern Puget Prairies subdivision is composed of nearly level to rolling glacial outwash and till plains. Water resources include low-gradient streams and lakes. Prairies and Douglas-fir forests are the dominant vegetation types, although oak woodlands, as well as western hemlock and red cedar stands, are also found.

Cascades Ecoregion

The southern loop corridor would traverse the Cascades ecoregion. This ecoregion contains steep ridges and river valleys in the west, a high plateau in the east, and active and dormant volcanoes throughout. Elevations extend up to 14,411 feet, and much of the ecoregion has been affected by alpine glaciations. Subalpine meadows and rocky alpine zones are common at high elevations. Highly productive coniferous forests supported by the moist, temperate climate are managed intensively for logging. The WEP would cross one Level IV subdivision (table 4.2.6-1). The Western Cascades Lowlands and Valleys subdivision has U-shaped, glaciated valleys in the east, and ridges and valleys in the west. Rivers and streams are of medium gradient and feed several reservoirs. Deep loamy soils support forests of western hemlock, western red cedar, and Douglas-fir.

North Cascades Ecoregion

The northernmost loop would lie within the North Cascades ecoregion. This ecoregion is characterized by high, rugged mountains and contains the greatest concentration of active alpine glaciers in the conterminous United States. Climatic zones are variable: a dry continental climate occurs in the east, and mild, maritime, rainforest conditions are found in the west. The WEP would pass through one Level IV subdivision: North Cascades Lowland Forests (table 4.2.6-1). This subdivision is characterized by low mountains and broad, glaciated valleys. Water features include medium-gradient, glacially-fed rivers and streams, glacial lakes, and reservoirs. Western hemlock, western red cedar, and Douglas-fir are the dominant trees.

Invasive Species

Invasive vegetation may occur along each loop, and Northwest would conduct preconstruction surveys to delineate areas of noxious weeds prior to vegetation clearing. Noxious weeds lack natural enemies, resulting in highly aggressive and destructive growth that is difficult to control. These species can reduce crop yields, destroy native plant and animal habitat, damage recreational opportunities, clog waterways, lower land values, and poison humans and livestock. Under Title 17 of the *Revised Code of Washington*, prioritization and implementation of weed control strategies are the responsibility of the Washington State Noxious Weed Control Board. Specifically, the board was created to "limit economic loss and adverse effects on Washington's agricultural, natural, and human resources due to the presence and spread of noxious weeds on all terrestrial and aquatic areas in the state" (RCW 17.10.007).

Noxious weeds in Washington are placed into one of three categories.

- Class A weeds are usually recent introductions to the state and have yet to establish large, widespread populations. Landowners are required to completely eradicate all Class A weeds to prevent further spread. Northwest identified 25 species on the Class A list that may occur in the project area.
- Class B weeds are widespread in certain parts of the state but absent in others and are designated at the local level by county weed control boards. Control of Class B weeds is intended to contain or reduce populations in currently infested areas and to prevent their spread to new areas. Up to 54 species on the state list of Class B weeds may occur in the project area.
- Class C noxious weeds are generally widespread. Although control is not required at the state level, county weed boards may require control if the weeds pose a significant threat to resources. Up to 33 species of Class C weeds may occur in the project area.

Invasive vegetation and noxious weeds occur within the project area, but individual species and their distribution have not been determined to date. Northwest would coordinate with applicable County Weed Boards or local Weed Districts regarding noxious weeds that may occur within various counties that would be crossed by the WEP.

4.2.6.2 Impacts and Mitigation

Construction of the pipeline would involve clearing and grubbing the construction work area and permanent conversion of vegetation types within a portion of the right-of-way. Table 4.2.6-2 summarizes the associated permanent and temporary impacts on upland vegetation. Wetland vegetation is discussed in section 4.2.4.1.

Table 4.2.6-2

Upland Vegetation Types Affected by the WEP Pipeline

	Coniferous Forest (acres)		Deciduous/ Mixed Forest (acres)		Cropland and Pasture (acres)		Maintained Herbaceous (acres)	
Loop	**Permanent [a]**	**Temporary [b]**	**Permanent**	**Temporary**	**Permanent**	**Temporary**	**Permanent**	**Temporary**
Woodland	2.5	10.0	28.0	80.2	1.2	6.5	320.0	95.9
Chehalis	6.0	4.2	8.4	35.5	3.3	18.5	140.7	43.9
Sumner South	2.3	2.9	6.7	5.6	9.5	16.3	41.2	33.5
Sumner North A	<0.1	1.3	7.9	8.1	0.3	1.7	32.0	5.7
Sumner North B	3.9	2.6	17.3	12.5	0.0	0.0	49.5	8.8
Snohomish	0.0	0.0	31.1	22.4	2.9	9.1	71.7	26.0
Mt. Vernon South	0.8	1.0	2.0	3.0	0.02	0.0	28.2	7.9
Mt. Vernon North A	4.2	7.1	0.0	0.0	0.0	1.7	33.2	7.0
Mt. Vernon North B	1.6	2.8	14.3	6.7	8.3	12.6	29.4	11.5
Sumas	0.0	0.0	2.8	3.2	22.6	46.7	16.0	7.2
Total[c]	**21.3**	**31.9**	**118.5**	**177.2**	**48.1**	**113.1**	**761.9**	**247.4**

[a] Permanent impacts for the pipeline include areas within the permanent right-of-way.

[b] Temporary impacts include the construction right-of-way and ATWS, excluding permanent right-of-way.

[c] Acres of nonvegetated lands or developed areas are excluded from this table; therefore, the table total is less than the total acreage for the entire project.

Overall, most of the vegetation removal (80 percent) would occur in Northwest's existing right-of-way, which would reduce the need for timber clearing and disturbance to agricultural lands during construction. Clearing in the construction right-of-way would generally occur in narrow strips (typically 20 feet wide) adjacent to the existing right-of-way. Northwest would remove trees and shrubs within the construction right-of-way and mow herbaceous vegetation to facilitate construction traffic. Most clearing for construction work areas, including ATWS, would affect upland forest, and there would be long-term impacts on about 209 acres of upland forest. Herbaceous vegetation and some shrubs would grow back to preconstruction conditions within 1 to 3 years. Where practicable, Northwest would locate ATWS in nonforested areas to reduce the time required to restore disturbed areas to preconstruction conditions. Portions of Northwest's existing right-of-way outside of the maintained areas (within 15 feet of either side of the 30 inch pipeline) may have coniferous or deciduous trees that would be cleared for the WEP. According to general land cover types (see table 4.2.6-2), about 140 acres of upland forest would be cleared for construction and remain cleared for the operation of the WEP. Overall, the vegetation clearing associated with construction and operation of the pipeline would be minimized because the WEP would be sited in an existing pipeline right-of-way.

The primary impact from the pipeline and associated aboveground facilities on vegetative communities would be the cutting, clearing, and/or removal of existing vegetation within the construction work areas. The magnitude of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction, and the frequency of vegetation maintenance conducted during operation of the project.

Secondary effects associated with disturbances to upland vegetation could include increased soil erosion, increased potential for the introduction and establishment of invasive weedy species, and a local reduction in available wildlife habitat (see section 4.2.7). Short-term effects would occur in the agricultural areas (e.g., pastures and row crops), which would typically regenerate quickly after cleanup and reseeding of the right-of-way.

Long-term impacts on upland forested habitats (i.e., coniferous, deciduous, and mixed forests and corresponding scrub-shrub) would occur because of the time required to restore the woody vegetation to its preconstruction condition. Permanent impacts would occur on woody species where vegetation is maintained within the permanent right-of-way because the species would not be allowed to regenerate the woody canopy present before construction due to periodic right-of-way maintenance activities.

Following the completion of construction activities, upland vegetation would be restored to prevent erosion and facilitate site restoration. Northwest has consulted with the NRCS about the most appropriate seeding mixtures, seeding dates, and practices to optimize the success of restoration. Table 4.1.6-2 lists the acreages of expected temporary and permanent impacts by land cover type. Temporary impacts are those areas that would be cleared for construction and rehabilitated after construction is complete. Northwest would revegetate the noncultivated portions of the construction right-of-way in accordance with its Plan and Procedures; the *Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000); restoration plans developed with federal, state, and local agencies; and landowner requests. Because restoration plans would vary by habitat type and milepost along the pipeline, **we recommend that**:

- **Prior to construction, Northwest should file with the Secretary, for review and written approval by the Director of OEP, a Vegetation Restoration and Monitoring Plan developed in coordination with NRCS, WDFW, FWS, and other applicable agencies. The plan should be milepost-specific and based on the regional habitat types along the WEP.**

Because the project would largely be constructed within existing disturbed rights-of-way and site restoration would be conducted following construction within the permanent and temporary rights-of-way following Northwest's Plans and Procedures, the Oregon and Washington Guide for Conservation Seedings and Plantings (NRCS, 2000), and our recommended Restoration and Monitoring Plan, we conclude that the project would have minimal impacts on upland vegetation.

Northwest would minimize establishment of noxious weeds by implementing its noxious weed control plan within its ECRP (see appendix J1), which outlines measures it would implement throughout the construction process to prevent the spread of any invasive plant materials to the project area. Northwest would apply weed-free straw to exposed soils to prevent erosion, and construction equipment would be washed before entering construction areas to avoid biological contamination from other sites. Site-specific weed control actions would be defined through easement agreements with landowners. Northwest would also develop and implement restoration plan to help control the spread of noxious weeds by using native seed mixes and native trees and shrubs. Northwest would use mechanical and chemical means to minimize the spread of noxious weeds in compliance with its plans and procedures. Herbicide use on state forest land would abide by provisions of the Forest Practices Act and its attendant rules, WDNR administrative rules, and other applicable state laws. Specific measures to control the spread of noxious weeds on state forest land during construction and operation would be defined in WDNR easement agreements. Northwest would inspect the construction area annually for any new infestations, and appropriate management actions taken.

We conclude that the implementation of the noxious weed control plan and above measures would minimize the introduction of noxious weeds to the pipeline corridor and minimize impacts on vegetation.

4.2.6.3 Forest Practices

Vegetation clearing for construction on forest lands may generate merchantable forest products. Forest practices involving commercial harvest of forest products would comply with the Washington Forest Practices Act and its attendant rules, which provide resource protection and set standards for planning forestry practices. The Washington Forest Practices Act governs all forest practices on nonfederal lands that are conducted within Washington, although not all forest practices are regulated by the state. A forest practice permit is required from the state or county jurisdiction whenever more than 5,000 board feet of merchantable timber is harvested from an area or property. Forest practice permits are designed to protect public resources while ensuring that the state of Washington continues to be a productive timber growing area. Where applicable, Northwest would submit an application for timber harvesting to the DNR prior to timber clearing.

Merchantable timber occurs within each loop with most forest lands occurring along the Woodland and Chehalis Loops. Table 4.2.6-3 summarizes the miles of merchantable timber that would be crossed within the WEP by loop based on parcel boundaries where more than 50 percent of the parcel meets Washington Forest Practices Act criteria (WAC 629-600-0100).

Table 4.2.6-3

Miles of Merchantable Timber Crossed within the WEP

Loop	Miles [a]
Woodland	24.1
Chehalis	15.4
Sumner South	2.4
Sumner North A	2.2
Sumner North B	3.9
Snohomish	5.8
Mt. Vernon South	1.9
Mt. Vernon North A	2.6
Mt. Vernon North B	3.8
Sumas	1.1
Total	**63.1**

[a] Based on parcel boundaries where more than 50 percent of the parcel meets Washington Forest Practices Act criteria.

Methods used to remove merchantable timber would vary according to stand age and contractor preferences. Northwest would harvest merchantable timber using a variety of tools and machinery, including but not limited to, chainsaw, feller buncher, harvester, forwarder, skidder, delimber, loader, grinder, and chipper. Merchantable timber would be stacked (yarded) along the cleared right-of-way or within ATWS. Trucks would haul merchantable timber to market from the yards.

4.2.7 Terrestrial Wildlife

4.2.7.1 Existing Environment

As described in section 4.2.6.1, the WEP would cross four Level III ecoregions: Puget Lowland, Willamette Valley, Cascades, and North Cascades, and three major drainage basins that provide habitat for a variety of wildlife species, including full-time residents and seasonal or migratory species. Wildlife habitat, in the context of land cover type in the vicinity of the WEP includes: cropland and pasture, deciduous forest, evergreen forest, mixed forest, wetlands, maintained herbaceous, streams and canals, industrial and commercial complexes, mixed urban or built-up land, residential, transportation, and utilities and communication infrastructure. Table 4.2.7-1 identifies some of the wildlife species associated with land cover types that would be crossed by the WEP.

Table 4.2.7-1

Wildlife Species Occurring Within the Land Cover Types in the Vicinity of the WEP

Vegetative Community	Typical Wildlife Species
Forested [a]	**Amphibians:** western redback salamander, roughskin newt, Cascade torrent salamander, Northwestern salamander, long-toed salamander, tailed frog, Cope's giant salamander, Pacific giant salamander, ensatina, Van Dyke's salamander, Pacific tree frog, Western toad, and red-legged frog. **Reptiles:** Northern alligator lizard, rubber boa, ringneck snake, sharptail snake, common garter snake, and northwestern garter snake. **Mammals**: beaver, big brown bat, black bear, bobcat, California myotis, coast mole, Columbian black-tailed deer, coyote, creeping vole, deer mouse, Douglas' squirrel, elk, ermine, forest deer mouse, fringed myotis, Gapper's red-backed vole, gray wolf, grizzly bear, hoary bat, little brown myotis, long-eared myotis, long-legged myotis, long-tailed weasel, marten, montane shrew, mountain beaver, mountain lion, mule deer, northern flying squirrel, Pacific jumping mouse, porcupine, raccoon, red fox, shrew-mole, silver-haired bat, snowshoe hare, spotted skunk, Townsend's big-eared bat, Townsend's chipmunk, Townsend's mole, Trowbridge's shrew, vagrant shrew, Virginia opossum, western gray squirrel, and white-tailed deer. **Birds:** American goldfinch, American kestrel , American robin, bald eagle, barred owl, belted kingfisher, Bewick's wren, blue grouse, black-capped chickadee, Brewer's blackbird, brown-headed cowbird, pine siskin, red crossbill, white-crowned sparrow, darkeyed junco, downy woodpecker, hairy woodpecker, northern flicker, pileated woodpecker, great blue heron, great-horned owl, olivesided flycatcher, osprey, peregrine falcon, red-breasted nuthatch, red-tailed hawk, ruby-crowned kinglet, ruffed grouse, rufous hummingbird, song sparrow, spotted towhee, Steller's jay, Swainson's thrush, varied thrush, willow flycatcher, winter wren, and yellow-rumped warbler, Bewick's wren, western screech owl, great horned owl, short-eared owl, wood duck, common merganser, hooded merganser, and common nighthawk.
Wetlands [c]	**Amphibians:** western red-backed salamander, roughskin newt, Cascade torrent salamander, northwestern salamander, long-toed salamander, Pacific tree frog, western toad, Oregon spotted frog, and red-legged frog. **Reptiles:** western painted turtle, northwestern pond turtle, western terrestrial garter snake, northwestern garter snake, common garter snake, and slider. **Mammals**: beaver, nutria, Bendire's shrew, deer mouse, ermine, forest deer mouse, long-tailed vole, mink, muskrat, raccoon, red fox, river otter, Townsend's vole, water shrew, and Yuma myotis. **Birds:** American coot, belted kingfisher, Bewick's wren, northern harrier, Virginia rail, streaked horned lark, purple martin, black-bellied plover, black-capped chickadee, Canada goose, cinnamon teal, cliff swallow, common snipe, dunlin, great blue heron, greater yellowlegs, mallard, marsh wren, northern harrier, northern pintail, northern shoveler, purple finch, red-winged blackbird, short-billed dowitcher, song sparrow, sora, tree swallow, violet-green swallow, Virginia rail, western sandpiper, pied-billed grebe, ringed-neck duck, northern shoveler, cinnamon teal, blue-winged teal, Canada goose, gadwall, and mallard.

Table 4.2.7-1

Wildlife Species Occurring Within the Land Cover Types in the Vicinity of the WEP

Vegetative Community	Typical Wildlife Species
Streams and Ponds	**Amphibians:** western redback salamander, roughskin newt, Cascade torrent salamander, northwestern salamander, long-toed salamander, tailed frog, Cope's giant salamander, Pacific giant salamander, ensatina, Van Dyke's salamander, green frog, Oregon spotted frog, Pacific tree frog, western toad, bullfrog,[b] and red-legged frog. **Reptiles:** western painted turtle, northwestern pond turtle, western terrestrial garter snake, northwestern garter snake, common garter snake, and slider. **Mammals**: beaver, Bendire's shrew, black bear, California myotis, deer mouse, coyote, hoary bat, little brown myotis, long-eared myotis, long-tailed weasel, long-tailed vole, mink, muskrat, nutria,[b] raccoon, river otter, raccoon, silver-haired bat, Townsend's big-eared bat, water shrew, Virginia opossum,[b] Yuma myotis. **Birds:** American robin, bald eagle, merlin, Brewer's blackbird, wood duck, osprey, Bewick's wren, black swift, black-capped chickadee, black-throated gray warbler, common yellowthroat, olive-sided flycatcher, peregrine falcon, rufous hummingbird, song sparrow, spotted towhee, yellow warbler, American dipper, band-tailed pigeon, barn/cliff swallow, belted kingfisher, Bullock's oriole, common merganser, great blue heron, green heron, hooded merganser, mallard, mourning dove, red-eyed vireo, ruffed grouse, spotted sandpiper, warbling vireo, willow/alder flycatcher, Wilson's warbler, wood duck, yellow-breasted chat, white-crowned sparrow, Townsend's warbler, blue-winged teal, cinnamon teal, northern shoveler, Canada geese, lesser scaup, pied-billed grebe, coot, osprey, and Virginia rail.
Agriculture (e.g., cropland and pasture)	**Amphibians:** Pacific tree frog, roughskin newt, western toad, and bullfrog.[b] **Reptiles:** common garter snake, northwestern garter snake, western terrestrial garter snake. **Mammals**: beaver, big brown bat, Columbia black-tailed deer, black rat, California myotis, coast mole, coyote, creeping vole, deer mouse, fox squirrel, hoary bat, elk, Norway rat, house mouse, little brown myotis, long-eared myotis, long-legged myotis, long-tailed vole, mule deer, muskrat, shrew-mole, silver-haired bat, snowshoe hare, striped skunk, Townsend's big-eared bat, Townsend's mole, Townsend's vole, Trowbridge's shrew, vagrant shrew, Virginia opossum, white-tailed deer, Yuma myotis. **Birds:** American bittern, European starling, brown-headed cowbird, red-winged blackbird, California quail, northern harrier, vireo species, American crow, Canada goose, common yellowthroat, barn swallow, Brewer's blackbird, common snipe, house finch, house sparrow, killdeer, mourning dove, northern harrier, red-tailed hawk, ring-necked pheasant, rock dove,[b] Savannah sparrow, song sparrow, spotted towhee, western meadowlark, plus additional passerines on migration.
Developed (e.g., industrial and commercial complexes, mixed urban or built-up land, residential, transportation, and utilities and communication)	**Reptiles:** common garter snake and northwestern garter snake. **Mammals:** black-tailed deer, Norway rat, black rat, white-tailed deer, coyote, deer mouse, raccoon, California ground squirrel, red squirrel, raccoon, Virginia opossum, and myotis species. **Birds:** American crow, house sparrow,[b] killdeer, mourning dove, rock dove,[b] song sparrow, spotted towhee, red-tailed hawk, peregrine falcon, robin, and domesticated ducks.

[a] Forested communities include coniferous, deciduous, and scrub-shrub upland vegetation communities.

[b] Nonnative species or invasive species.

[c] Wetland communities include palustrine scrub-shrub wetlands, forested and aquatic bed wetlands, estuarine intertidal emergent wetlands, high and low marsh, and intertidal unvegetated wetlands.

The majority of the project would be constructed within Northwest's existing pipeline right-of-way, which has been previously cleared and is currently managed in herbaceous or low-shrub conditions. Consequently, many of the species that occur within the project area are associated with open, low growing vegetation. However, there may be wildlife species that inhabit the surrounding forested habitats that could be disturbed by construction activities. In some instances, pipeline corridors provide essential wildlife travel and dispersal routes (Hay, 1994), and some studies suggest that pipeline corridors have beneficial effects on game animals (McCaffery et al., 1981) and passerine species diversity (Bramble et al., 1992; Dolorey, 1992).

Aboveground facilities, including pig launcher/receivers and MLV sites, would be within Northwest's existing pipeline right-of-way or compressor station sites. Therefore, the wildlife that

currently occur at the proposed aboveground facilities locations are generally species associated herbaceous vegetation.

The contractor and pipe storage yards would be located at sites with existing industrial uses that have been previously graded and graveled. Northwest has identified four contractor and pipe storage yards to support the construction of the WEP and these facilities would comprise about 32 acres total of previously disturbed land (predominantly gravel and graded areas). Wildlife use of these areas is limited to urban-adapted species such as raccoons, deer, rodents, killdeer, or other ground-nesting species that are adapted or adaptable to industrial or urban lands.

4.2.7.2 Unique or Sensitive Habitats

Some of the sensitive wildlife habitats that would be crossed by the WEP have special status, conservation emphasis, or designation. The WDFW has mapped the following ten Priority Habitat types that would be within the WEP:

- oak woodlands in the Sumner South Loop;
- wetlands in the Woodland, Sumner South, Sumner North A, Sumner North B, Snohomish, Mt. Vernon South, Mt. Vernon North B, and Sumas Loops;
- elk concentrations in the Woodland, Chehalis, Sumner North A Loop, and Mt. Vernon North B Loop;
- a snag-rich area for roosting and nesting habitat in the Woodland Loop;
- waterfowl concentration in the Chehalis and Sumner South Loops;
- cavity-nesting duck habitat in the Sumas Loop;
- urban natural open space areas in the Sumner South, Sumner North B, and Mt. Vernon North A Loops;
- Townsend's big-eared bat communal roosts in the Sumner North B Loop, Mt. Vernon South Loop, and Mt. Vernon North A Loops;
- an Oregon spotted frog breeding area in the Mt. Vernon North B Loop; and
- a northern spotted owl management buffer in the Woodland Loop.

General information about each of these sensitive resources is provided in table 4.2.7-2, and additional information on state and federally listed species, including Oregon spotted frog and northern spotted owl is provided in section 4.2.8. Wetlands are discussed in section 4.2.4. A table of species listed by WDFW as PHS that potentially occur in or near the project is presented in Appendix L, along with known habitat, possible impact by the project, and mitigation measures Northwest would use to minimize the project affects on these species.

Table 4.2.7-2

Sensitive Habitat Features Crossed by the WEP

Loop Name	Milepost	Sensitive Habitat/Feature	General Description of Features
Woodland	1246.0-1259.0	Elk concentration	Winter range for Rocky Mountain elk and Roosevelt elk from the Mount St. Helens and Mount Rainier herds.
	1275.3-1274.5	Snag-rich area	Snag-rich areas have the potential to support cavity-nesting bird species and cavity-roosting bats.
	1253.0-1259.0	Northern spotted owl buffer management area	Historical observation (1993) of northern spotted owl nest. Habitat is currently not suitable to support northern spotted owl.
	NA [a]	Raptor nests	Northwest observed three nests during aerial surveys: a new osprey nest, a PHS-documented nest, and a likely crow's nest.
Chehalis	1301.0 – 1313.0	Elk concentration	Year-round habitat for Skookumchuck elk herd and winter range for Rocky Mountain elk and Roosevelt elk from the Centralia mine herd would be crossed by this section of the right-of-way. These two elk concentrations are designated as Fish and Wildlife Habitat Conservation Areas under critical areas ordinances by Lewis and Thurston Counties.
	1306.0-1307.0	Waterfowl concentration	A small waterfowl concentration occurs in the vicinity of agricultural and wetland habitat. This area supports concentrations of waterfowl during winter, spring, and fall.
Sumner South	1338.0-1349.0	Waterfowl concentration	Agricultural and nonagricultural areas support small concentrations of waterfowl during winter, spring, and fall.
	1346.9-1347.3	Pierce County Urban Natural Open Space	Pierce County urban natural open space lands consists of forest land with some developed areas, open range areas, oak woodlands, wetlands, and riparian habitat. It, along with other urban natural open space areas, provides important refuges of wildlife habitat for species on the urban-rural interface.
	1347.0-1348.0	Carbon River Urban Natural Open Space	The Carbon River urban natural open space consists of steep slopes along the valley terrace that are covered with native mixed forest. Designated as biodiversity and wildlife corridor areas by WDNR.
Sumner North A	1356.0 – 1358.0	Elk concentration	Roosevelt elk winter range associated with the Green and Cedar Rivers. Designated as Wildlife Habitat Conservation Areas by Pierce and King Counties.
Sumner North B	1373.0 – 1376.0	Tiger-Mountain-Tradition Plateau Urban Natural Open Space	The Tiger Mountain area is included in the *West Tiger Mountain Natural Resources Conservation Area Management Plan*, which provides direction for protection of the natural ecosystems of West Tiger Mountain (WDNR, 1997). It is mainly second-growth Douglas-fir and mixed forests that provide habitat for a wide array of forested species.
	1373.1-1373.3	Squak Mountain State Park	The Squak Mountain State Park parallels the Sumner North B Loop to the west and is vegetated with predominantly older second-growth mixed conifer/deciduous forest that are part of the regional park system that connects to the Tiger Mountain area.
	1376.0-1377.0	King County Open Space	Steep and forested areas near Evans Creek that serve as wildlife corridor for animals living on the urban-rural interface.
	NA [a]	Raptor nest	One active bald eagle nest was observed in the Sumner North B Loop during aerial raptor surveys. This nest corresponds with PHS data for nest 1479 (Issaquah Creek).
Snohomish	1400.6 – 1401.6	Wetlands	Snohomish River wetlands and Snohomish/Lake Stevens wetlands are designated as Fish and Wildlife Habitat Conservation Areas by Snohomish County.
Mt. Vernon South	1440.0	Wetlands	Nookachamps Creek wetlands are designated as Fish and Wildlife Habitat Conservation Area by Skagit County
	1437.4 – 1444.9	Townsend's Big-eared bat Communal Roost	Area has a known communal roost site for Townsend's big-eared bats. The area is heavily forested and provides habitat for this species.
Mt. Vernon North A	1443.0-1445.0	Mt. Vernon Urban Natural Open Space	Mt. Vernon urban natural area open space includes steep forested areas near Mt. Vernon and Burlington/Sedro Woolley and is expected to support species associated with forested habitats.

Table 4.2.7-2

Sensitive Habitat Features Crossed by the WEP

Loop Name	Milepost	Sensitive Habitat/Feature	General Description of Features
Mt. Vernon North B	1458.0-1462.0	Wetlands	The Samish Wetlands (MP 1458.0 to 1460.0) and the South Fork Nooksack Wetlands a (1460.0 to 1462.0) are designated as Fish and Wildlife Habitat Conservation Area by Skagit and Whatcom Counties. Several known populations of Oregon spotted frog occur along this loop. It appears mostly adjacent to the west within the wetland areas.
	1457.0-1459.0; 1461.5-1461.8	Elk concentration	Winter range for the Nooksack herd of Rocky Mountain elk occurs at MP 1457.0 to 1459.0. Elk are expected to forage and overwinter along this section of the right-of-way. Field surveys (driving and aerial) conducted by Northwest indicate significant winter use of the existing habitat.
	NA [a]	Raptor nests	Northwest observed three nests during aerial surveys: two active bald eagle nests and one unoccupied nest of an unknown species.
Sumas	1478.0-1479.0	Cavity nesting area	The Breckenridge Creek cavity nesting area supports cavity-nesting ducks in the summer. This area at MP 1478.0 to 1479.0 is composed of mixed forest habitat along the creek with large conifer snags within the riparian area.
	NA [a]	Raptor nest	One active bald eagle nest was observed in the Sumas Loop during aerial raptor surveys, which may correspond to PHS database record number 3901.

[a] Raptor nest location information is not made public in order to protect the nests.

4.2.7.3 Impacts and Mitigation

We received comments concerning impacts on terrestrial wildlife resources from pipeline construction, specifically within Natural Resource Conservation Areas; managed buffers of sensitive species (including birds, amphibians/reptiles, and mammals); and removal of wildlife habitat during construction. Specific impacts and mitigation measures related to federally and state-listed species and other sensitive species are addressed in sections 4.2.8.1 and 4.2.8.2.

Construction would impact wildlife species and habitat to some degree along each loop. To avoid and minimize construction related impacts, Northwest would overlap the construction right-of-way with its existing permanent right-of-way and locate contractor and pipe storage yards at existing industrial sites. At most wetland and waterbody crossings, the width of the construction right-of-way would be reduced to 75 feet to reduce impacts on riparian habitat. Likewise, ATWS associated with HDD locations would be placed outside sensitive and riparian areas to the extent practicable (see appendix I4 for a list of ATWS that would need to be located within 50 feet of waterbodies).

Construction and operational impacts, as well as mitigation measures for those impacts, are described below.

Construction

Similar to the Oregon LNG Project (see section 4.1.7.2), the effects of construction activities associated with the WEP that would affect wildlife include temporary and short-term displacement from the immediate vicinity of the construction zone and adjacent areas as a result of habitat modification and loss, as well as from temporarily increased noise and visual disturbance. The degree of impact on wildlife species and their habitat would vary depending on the requirements of each species and the existing habitat long the pipeline. Overall impacts on wildlife habitat would be minimized by constructing the

WEP within Northwest's existing right-of-way, which would reduce the need for forest clearing. Noise and presence of construction equipment would cause wildlife, such as birds and larger mammals, to leave the vicinity of the construction activities. Depending on the season, construction could also disrupt bird courting or nesting and breeding of other wildlife on and adjacent to the right-of-way. Many of these animals may relocate into similar habitats nearby; however, in some areas, there is a lack of adequate territorial space which could force some animals into suboptimal habitats. Additionally, some smaller, less mobile wildlife, such as small mammals and burrowing species (e.g., opossums, mice, voles, weasels, and beaver), amphibians, and reptiles, could be crushed by construction equipment or trapped in trenches.

Bird nests within the construction work area could be destroyed by clearing activities. The loss of these species could result in a decrease in the food stock available for predators of these species. These effects, however, would cease after construction, and wildlife would return to the newly disturbed areas and adjacent, undisturbed habitats after right-of-way restoration is completed. The existing right-of-way has been maintained as herbaceous or low shrub community for more than 50 years, therefore, construction and operation of the WEP would not substantially alter the local wildlife populations.

The birds in the project area are primarily migratory and not solely dependent on the existing right-of-way to provide all of their life history requirements. Species inhabiting the existing developed areas in the pipeline corridor are adaptive to disturbed habitat conditions and possess the capability to temporarily expand or shift their home ranges to find alternative sources of food, water, and shelter until the WEP right-of-way becomes reestablished (Taulman, 1998; ODF, 2010). While some individual birds may be displaced, no effects are expected on any migratory species at the population level. Additional discussions on migratory birds are included in section 4.2.7.4 below.

Early spring and summer timber clearing could adversely affect birds that are actively nesting. Removal of mature trees and shrubs would be minimized because the WEP would be constructed in Northwest's existing right-of-way. Where feasible, existing large trees and shrubs in the construction right-of-way would not be removed if they are known nesting trees or are within defined buffers; instead, the temporary construction workspace would be shifted. Because the WEP would be primarily within the existing right-of-way, the effects on migratory birds from habitat loss or alteration would be relatively minor, given that most of these areas are in an early seral stage that mostly attracts species adapted to edges and open habitats (e.g., most passerines and certain species of raptors).

Impacts on big game habitat and associated species, including black-tail deer, mule deer, and Roosevelt and Rocky Mountain elk are similar to those addressed in section 4.1.7.4. Impacts would be limited to temporary construction effects such as the presence of construction crews, noise from equipment, fugitive dust, and clearing of vegetation. Construction activities would occur in relatively small areas compared with the surrounding available habitat for these species. Grass, shrub, and other early successional vegetation used for browsing and movement would return soon after construction, within one to three growing seasons. The summer construction period would occur prior to dispersal to wintering areas as elk build energy reserves and after elk calving season (May-June), limiting the overall effect of project impacts. The linear nature of the project would minimize its effects by allowing wildlife species to pass back and forth across the right-of-way and would not result in a permanent impediment. The pipeline would be constructed in sections, and effects would be localized to those areas and not hinder the movements of game species and other wildlife in areas outside the active construction zone. All construction activities would take place during daylight hours, allowing elk and deer movement during dusk and evening hours. In locations with evidence of high wildlife activity (such as, visual observations, wildlife tracks, or PHS mapped resources), Northwest would minimize the length of open trench and duration of opening, and provide temporary crossings to allow movement of amphibians and mammals

After construction, wildlife use and habitat in areas temporarily affected by clearing and grading are expected to return to preconstruction conditions within 1 to 3 years in most cases, but take longer where large trees were removed. Because of its collocation within an existing right-of-way, habitat fragmentation and the resulting effects on edge habitat are not expected to increase. Restoration of the construction right-of-way and ATWS would occur immediately after construction has been completed in accordance with Northwest's Plan and Procedures; the *Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000); restoration plans developed with federal, state, and local agencies; and landowner requests. Following construction and restoration, Northwest would monitor the revegetation of the right-of-way in upland areas the year following construction and again during the second growing season to ensure adequate revegetation. Additional revegetation efforts would be conducted until revegetation is deemed successful. In wetland and riparian areas, Northwest would monitor revegetation for 3 years in accordance with its Plan and Procedures. Additionally, Northwest has developed noxious weed control measures to prevent the introduction and proliferation of noxious weeds during and after construction (see appendix J1).

Operations

Operational impacts on wildlife and wildlife habitat related to the WEP pipeline would occur from maintenance activities in the right-of-way, inspections, repair, and cleaning of the pipeline. Maintenance of the WEP pipeline would require periodic vegetation mowing as necessary to maintain the corridor and allow for visual pipeline inspections, and would be done in accordance with Northwest's Plan and Procedures. The effects of such maintenance on wildlife resources would be similar to those described in section 4.1.7.2 for the Oregon LNG pipeline and would be minor. As described above, the grass and low shrub corridor created by the pipeline provides browse and movement opportunities for wildlife, particularly large mammals that inhabit the surrounding forested areas. Timing of vegetation maintenance would occur outside of bird nesting period (April 15 to August 1) according to Northwest's Plan to minimize impacts on nesting and breeding wildlife. Northwest would limit public access to the permanent right-of-way through a series of measures that are already in place and include signage, fences, and gates where appropriate.

Operational noise disturbances along the pipeline would be limited to relatively infrequent maintenance activities, including aerial inspection, driving the alignment to perform visual inspection, mowing, and the use of chainsaws and other equipment. These noise effects would be temporary and localized to the area of the pipeline where activities are taking place. Species currently using the right-of-way are expected to return shortly after maintenance activities or inspections are complete. In addition, inspections and maintenance activities would only occur during daytime, and wildlife use of the pipeline corridor could resume at night. Wildlife would be allowed to use the right-of-way and operation of the WEP would not alter existing migration routes or wildlife movement.

The proposed modifications at the existing, fenced-in compressor station yards would not result in additional operational impacts on wildlife and wildlife habitat. The gas-turbine-driven compressors generate continuous background noise. Continuous background (or ambient) noise would not increase significantly from existing conditions and through the employment of noise mitigation measures effects on wildlife species would be negligible. Typical response to continuous noise usually causes birds to adjust the amplitude of their vocalizations or results in habituation by certain species. However, bursts of noise usually result in startle effects. This could be caused by an alarm or short-term venting; typically, this causes a physical response that result in animals flushing from the location. This effect is minimized by available habitat adjacent to the WEP and as with alarms, short-term venting from compressor stations is expected to be infrequent.

4.2.7.4 Migratory Birds

As described in section 4.1.7.5, migratory birds are protected by the federal MBTA of 1918, as amended (16 U.S.C. 703-712). In accordance with our MOU with the FWS (FERC and FWS, 2011), Northwest conducted an information and literature review and determined that 138 migratory bird species may occur within the project area. Of these, seven species are considered migratory birds of concern by the FWS. These include: bald eagle, black swift, Caspian tern, olive-sided flycatcher, vesper sparrow, Williamson's sapsucker, and willow flycatcher.

Northwest also conducted raptor surveys in 2013 and identified eight raptor nests within 1.5 miles of the WEP. Observations included four bald eagle nests, one osprey nest, and three stick nests belonging to unknown raptor species. The PHS database revealed that one of the three unknown nests is an osprey nest location, record number 1684 (WDFW, 2010). Of the eight nests identified by Northwest, six were active nest sites with either an adult observed at the nest or where evidence of an actively maintained nest was observed. At each of the four bald eagle nest locations, an adult bald eagle was observed sitting in the nest. The remaining two nests were old nests of unknown species that were unoccupied. Raptors incidentally observed during the aerial surveys included bald eagle, red-tailed hawk, and turkey vulture.

Northwest would construct the WEP over multiple years to minimize winter and spring construction during the migratory breeding periods. If construction would occur during the breeding season, Northwest would conduct preconstruction nest surveys immediately prior to land clearing. If nesting birds are observed within the construction right-of-way, Northwest would contact WDFW for guidance on appropriate nest buffers and delay construction. If there is any lapse greater than 1 week between vegetation clearing and commencement of construction activities, surveys would be repeated. The project would also result in a temporary loss of habitat available to migratory birds. However, this effect would be mitigated by Northwest's proposal to restore disturbed areas following construction and make them available for use by migratory birds during the next nesting season following construction.

Northwest has not finalized the conservation measures it would implement to protect birds listed under the MBTA and BGEPA and offset impacts on habitats of bird species of special concern as outlined in the MOU between FWS and FERC. Therefore**, we recommend that:**

- **<u>Prior to construction</u>, Northwest should file with the Secretary a Migratory Bird Conservation Plan, along with documentation of consultation and approval by the FWS.**

Because most of the WEP would be constructed within Northwest's existing pipeline right-of-way, thus minimizing disturbance to migratory bird habitat, preconstruction surveys would be conducted, and we are recommending that Northwest prepare a Migratory Bird Conservation Plan that would specifically address measures to avoid, reduce, or mitigate impacts on bird species of special concern, we conclude that the overall impact of the project on migratory birds would be minor.

4.2.8 Threatened, Endangered, and Other Special Status Species

4.2.8.1 Federally Listed Threatened and Endangered Species

Similar to Oregon LNG (see section 4.1.8), the WEP may affect several species that are federally listed under the ESA. As discussed in section 1.5.1.3, FERC will submit a combined BA for the Oregon LNG and the WEP to the NMFS and FWS. In cases where a species range overlaps with both projects (i.e., marbled murrelet; northern spotted owl; streaked horned lark; yellow-billed cuckoo; lower Columbia River Chinook, coho, and steelhead; Columbia River chum; eulachon; Nelson's checkermallow; and water howellia), we present effect determinations specific for each project; these effect determinations may differ between the projects depending on the likelihood of species occurrence and the proposed work. We consider the combined effects of both projects on overlapping federally listed species in section 4.3. Our consultation with NMFS and the FWS and preparation of the BA is in progress, and our final determinations regarding the effects on species are pending; therefore, **we recommend that:**

- **Northwest should not begin construction activities until FERC staff completes any necessary Section 7 ESA consultation with NMFS and the FWS, and Northwest receives written notification from the Director of OEP that construction may begin.**

FERC staff, along with Northwest as our nonfederal designee, has informally consulted with NMFS, FWS, and WDFW regarding the potential occurrence of federally listed species on lands and in waterbodies affected by the WEP. We have reviewed relevant databases, including FWS's county lists (FWS, 2014d), WDFW's PHS database (WDFW, 2010; 2014), and the Washington Natural Heritage Program (WNHP, 2013a) to assess historical or current ranges of listed species. Based on this review, we have determined that 12 federally listed or proposed terrestrial species may occur in the project area, including: 2 mammals, 4 birds, 1 invertebrate, 1 amphibian, and 4 plants (see table 4.2.8-1). Seven of these listed species have federally designated critical habitat (Taylor's checkerspot butterfly, marbled murrelet, streaked horned lark, northern spotted owl, gray wolf, Kincaid's lupine, and Mazama pocket gopher), and one has proposed critical habitat (Oregon spotted frog). Of these species, only proposed critical habitat for the Oregon spotted frog falls within the project area (see table 4.2.8-1). Based on agency input, Northwest is revising its applicant prepared BA; therefore, the effect determinations we present below for these federally listed species are preliminary and may be modified after we review the applicant's BA and submit the FERC BA to NMFS and FWS.

In addition, six federally listed fish species occur in the project area (see table 4.2.8-1), two of which have two different ESUs or DPSs that occur along the pipeline corridor. Each ESU or DPS of a particular species is addressed separately in this section because individual ESUs and DPSs are afforded their own listing status and protection under the ESA due to differences in range of distribution and life history characteristics.

Table 4.2.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the WEP

Species	Status [a]		Loop	Preferred Habitat	Determination [b]		Survey Status
	Federal	State			Species	Critical Habitat	
Mammals							
Gray wolf (*Canis lupus*)	E	E	Sumner North A Sumner North B Snohomish Mt. Vernon South Mt. Vernon North A Mt. Vernon North B Sumas	Suitable habitat includes mountainous forested habitats with abundant year-round prey, low road density, low numbers of domestic livestock and sheep, low agricultural use, and few people. Suitable gray wolf habitat occurs throughout the state except in Columbia Basin and Puget Trough lowlands.	NE	NL	Not required
Mazama pocket gopher (*Thomomys mazama ssp. Glacialis, pugetensis, tumuli, yelmensis*)	T	T	Woodland Chehalis Sumner South	Open meadows, pastures, prairies, and grassland habitats with porous, well-drained soils. In Washington, habitat sites include grassy fields at airports, pastures, fields, Christmas tree farms, and occasionally clear-cuts. In the south Puget Sound region, pocket gopher populations are predominately found in areas with prairie soils that retain some prairie vegetation.	NLAA	NE	Prior to construction, survey suitable habitat/soils
Birds							
Marbled Murrelet (*Brachyorampus marmoratus*)	T	T	All loops except Woodland	Forage in the Pacific Ocean. Nest in old-growth forests up to 50 miles from the coast, as well as younger forested areas with remnant large trees or small patches of potential habitat with suitable nesting platforms.	NLAA	NE	Not required, no suitable habitat
Northern spotted owl (*Strix occidentalis*)	T	E	All loops	Use old-growth forests for nesting, roosting, foraging, and dispersal. Characteristics include complex multitiered, multiple-species canopy forests that have a predominance of large overstory trees with moderate to dense canopy closure.	NLAA	NE	Not required, no suitable habitat
Streaked horned lark *(Eremophila alpestris strigata)*	T	E	Woodland Chehalis	In Washington, known from along the open coast, Puget lowlands, and Columbia River islands. Breeding sites are often in areas of remnant dry prairie, mud flats, or oak savannas; foraging occurs in grassland habitat. Currently, this species is also found in highly disturbed, early successional habitats	NLAA	NE	Not required, no suitable habitat
Yellow-billed cuckoo (*Coccyzus americanus*)	T	C	All loops	Cottonwood dominated floodplains along the Columbia River and Puget South lowlands. Breed in large blocks of riparian habitats, particularly woodlands with cottonwoods and willows	NLAA	NE	Prior to construction, assess and survey suitable riparian habitat

Table 4.2.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the WEP

Species	Status [a]		Loop	Preferred Habitat	Determination [b]		Survey Status
	Federal	State			Species	Critical Habitat	
Amphibians							
Oregon spotted frog (*Rana pretiosa*)	T	E		Associated with emergent wetland habitats in forested landscapes as well as large, shallow, wetland systems connected to a stream or stream network. Occurs in or near perennial waterbodies with zones of shallow water and abundant emergent or floating aquatic plants used for basking and to escape cover.	NLAA	NE	Prior to ground-disturbing activities, conduct preconstruction surveys at wetland crossings where wetlands are greater than 2.5 acres and at crossings of the Toutle, Newaukum, and South Fork Nooksack Rivers.
Fish							
Chinook Salmon (*Oncorhynchus tshawytscha*)							
Lower Columbia River ESU	T	C	Woodland	Anadromous; spawn in freshwater streams with gravel substrate. Rear in stream habitats with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Require migration corridors free of obstruction.	LAA	LAA	Not required
Puget Sound ESU	T	C	All loops except Woodland		LAA	LAA	Not required
Chum Salmon (*O. keta*) Columbia River ESU	T	C	Woodland	Anadromous, spawn in tributaries of the Columbia River. Rear in the estuary before migrating to ocean.	NLAA	LAA	Not required
Coho Salmon (*O. kisutch*) Lower Columbia River ESU	T	NL	Woodland	Anadromous; spawn in the headwater streams in areas with low water velocity and small-sized gravel. Rear in complex stream habitat before migrating to ocean.	LAA	LAA [c]	Not required
Eulachon *(Thaleichthys pacificus)*	T	C	Woodland	Anadromous; spawn in shallow sandy bottom areas in freshwater and migrate to the ocean to forage. Spawns in some waterbodies within the pipeline portions of the WEP.	NE	NLAA	Not required
Bull trout (*Salvelinus confluentus*) Conterminous U.S. DPS	T	C	Woodland Sumner South Snohomish Mt. Vernon North B	Cold water habitat with stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors. Occurs in the Lewis River and potentially other lower Columbia River tributaries that would be crossed by the WEP.	LAA	NE	Not required
Steelhead (*O. mykiss*)							
Lower Columbia River DPS	T	C	Woodland	Anadromous; spawn in freshwater streams with small gravel substrate. Rear in complex stream habitats	LAA	LAA	Not required

Table 4.2.8-1

Federally and State Listed Species Potentially Occurring in the Vicinity of the WEP

Species	Status [a]		Loop	Preferred Habitat	Determination [b]		
	Federal	State			Species	Critical Habitat	Survey Status
Puget Sound DPS	T	NL	All loops except Woodland	with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Require migration corridors free of obstruction.	LAA	LAA	Not required
Invertebrate							
Taylor's Checkerspot Butterfly (*Euphydryas editha taylori*)	E	E	Woodland Chehalis	Open habitat dominated by grassland vegetation throughout their range. In Washington, it is associated with maritime prairies and shorelines along the Strait of Juan de Fuca, post-glacial gravelly outwash and mounded prairies of the Puget Sound trough and south Puget Sound region, and open island prairies with a dominance of original vegetation.	NLAA	NE	Not required
Plants							
Golden paintbrush (*Castilleja levisecta*)	T	E	All loops	Upland prairies and open grasslands in Puget Trough lowlands. Areas are usually moist in the winter but are not inundated. Most populations occur on glacially derived soils.	NLAA	NL	Not required
Kincaid's lupine (*Lupinus oreganus*)	T	E	All loops	Open prairies and woodland borders; inhabits native dry upland prairies and open oak woodlands that were historically maintained by fire, or road rights-of-way that have escaped disturbance.	NLAA	NE	Survey during flowering season prior to construction.
Nelson's checkermallow (*Sidalcea nelsoniana*)	T	E	Woodland	Seasonally wet soils in a variety of open, low-elevation habitats including grass meadows, drier sedge meadows, prairies, and grasslands. Found in border areas between prairies and woodlands, along fencerows, streams, roadsides, and drainage swales, and along the edges of plowed fields adjacent to wooded areas.	NLAA	NE	Survey during flowering season prior to construction.
Water howellia (*Howellia aquatilis*)	T	T	All loops	Small vernal ponds, glacial pothole ponds, and abandoned river oxbows that are fed by spring rains and snowmelt runoff. Roots in firm, consolidated clay and organic soils covered by shallow water or at the edges of deep ponds.	NLAA	NL	Survey during flowering season prior to construction.

[a] T = threatened, E = endangered, C = candidate, NL = not listed

[b] NLAA = not likely to adversely affect; LAA = likely to adversely affect; NE = no effect; NL = not listed

[c] Provisional effect determination

Mammals

The WEP could affect two mammal species currently listed under the ESA: gray wolf and Mazama pocket gopher. The Columbian white-tailed deer, Canada lynx, and grizzly bear are also listed as threatened and occur in Washington State but would be unlikely to occur in the project area. The Canada lynx and grizzly bear inhabit forested areas in the Cascades within large tracks of undisturbed forest. WDFW PHS data does not document the presence of these species or suitable habitat in the project area. The Columbian white-tailed deer's habitat is in the lowland areas of the Columbia River, usually below 100 feet, where they prefer deciduous forest and riparian zones habitat. The Woodland Loop would be within its historic range but outside the known habitat area. We have excluded Columbian white-tailed deer, Canada lynx, and grizzly bear from analysis of the WEP, but we evaluated Columbian white-tailed deer in relation to the Oregon LNG project in section 4.1.8.1.

Gray Wolf

Species Description

The FWS listed the gray wolf as endangered under the ESA in 1978 throughout the lower 48 states, except in Minnesota where they were listed as threatened (FWS, 1978). The Northern Rocky Mountain DPS was delisted in 2011and includes wolves that inhabit eastern Washington (FWS, 2011a). Wolves outside this DPS within other areas of Washington, including the North Cascades, remain listed as endangered. This population of wolves is currently proposed for delisting (FWS, 2013f).

Gray wolves are considered habitat generalists and suitable habitat includes tundra, taiga, grasslands, temperate forests, and coniferous mountain forest. The key elements are abundant year-round prey and areas of low road density and limited presence of humans and agricultural development and livestock (FWS, 2013f; NatureServe, 2013). In Washington, gray wolf habitat occurs throughout the state except in the Columbia Basin and Puget Trough lowlands (where the Woodland and Chehalis Loops would be located) (WDFW, 2013b). Wolves typically have large home territories ranging from 200 to 500 square miles; they could potentially occur many places along the northern portions of the WEP, including the Sumner North A, Sumner North B, Snohomish, Mt. Vernon South, Mt. Vernon North A, Mt. Vernon North B, and Sumas Loops. The PHS database has one record of a gray wolf sighting within the vicinity of the WEP consisting of an observation of three adult gray wolves during a WDFW survey in the North Cascades ecoregion in Skagit County in 1992 (WDFW, 2010). This observation occurred adjacent to where the Mt. Vernon North B Loop would be located.

Sightings of gray wolves in Washington have increased since 2005 (FWS, 2013f). The closest known packs to the WEP are the Teanaway and Wenatchee packs, which are found on the eastern slopes of the Cascade Mountains (WDFW, 2013b).

Impacts

The lack of large intact tracts of wilderness in the project area most likely precludes the presence of gray wolves in the WEP construction right-of-way. Any presence is expected to be limited to transient passage through the project area. Although unlikely to be present, any passing gray wolves could be directly affected by noise and disturbance caused by construction and operation. These effects would be similar to those described for terrestrial wildlife in section 4.2.7.3 and would primarily include temporary displacement into the surrounding/adjacent habitats. This would only occur at areas of active construction or operation and, although unlikely to be present, any wolves in the vicinity would avoid human activities and use surrounding areas. Construction and operation activities would be limited to

daylight hours when the wolves are less active and more reclusive. Transient passage by wolves in the project corridor would most likely occur at night when construction activities have ceased.

Mitigation

No species-specific mitigation or conservation measures would be implemented for gray wolf because the project is not expected to affect individuals or populations and impacts on habitat are anticipated to be insignificant.

Effect Determination

Based on the unlikely presence of gray wolves in the project area as described above, we determined that the WEP would have ***no effect*** on gray wolves and would cause no long-term effects that would affect the survival and/or recovery of the species.

Mazama Pocket Gopher

Species Description

In 2007 the FWS determined the eight subspecies of Mazama pocket gopher in the state of Washington were under threat (FWS, 2007b). In April 2014, FWS listed four of the subspecies (Olympic pocket gopher, Tenino pocket gopher, Yelm pocket gopher, and Roy Prairie pocket gopher*)* as threatened and designated critical habitat in Thurston County (FWS, 2014e; 2014f). The closest designated critical habitat area would be about 3.5 miles northwest of the Chehalis Loop, near the town of Rainer, Washington (FWS, 2013m).

Mazama pocket gopher is a medium-sized, burrowing rodent with light brown to black fur. They are rarely seen aboveground and seldom stray from their home territories and burrow systems. In western Washington Mazama pocket gophers inhabit the south Puget Sound region in areas with prairie soils that retain some prairie vegetation (Stinson, 2013; FWS, 2013m) and are often found in open meadows, pastures, prairies, and grassland habitats with porous, well-drained soils. In developed areas of western Washington they inhabit grassy fields at airports, pastures, fields, Christmas tree farms, and occasionally clear-cuts. Areas with dense forests of Douglas fir and other evergreens and shrubs like Scot's broom do not provide suitable habitat for this species, which typically inhabit areas of 10 percent or less cover of shrubs and trees (Marsh and Steel 1992; Olson, 2011).

The biggest threat to this species is loss and modification of habitat. The prairies in the south Puget Sound area are some of the rarest habitats in the United States, much of them being converted to agriculture and urban development and infrastructure. Current Mazama pocket gopher subpopulations continue to be threatened by loss of prairie habitat due to residential and commercial development, invasive plants, and encroachment of nonprairie plants due to an altered fire regime; small-population effects; trapping and poisoning; predation by domestic dogs and cats; and trampling and crushing of burrows due to heavy equipment use (FWS, 2013m).

The PHS database has no record of Mazama pocket gophers within the project area (WDFW, 2010). The closest PHS record is about 4.1 miles from the northern end of the Chehalis Loop, between MP 1315.2 and MP 1315.6, where it would pass through pasture and agricultural land in an area considered the eastern edge of historic prairie habitat. WDFW conducted surveys in this area, with a dozen survey locations within 1 mile of the WEP's right-of-way, but pocket gophers were not observed at these locations (WDFW, 2013c). However, these WDFW surveys used a stratified random sample approach to detect pocket gopher distribution over a large area and results suggest a lack of presence in the area but are not an assurance of absence within the construction right-of-way.

Impacts

If present in the project area, the pocket gopher could be directly affected by noise or vibration and ground disturbance related to construction and operation, which could result in reduced reproductive success or survival. Temporarily displaced pocket gophers would be more vulnerable to injury and/or could be killed because of a lack of area to move into due to adjacent development or habitat type.

It is unlikely the Mazama pocket gopher and associated listed subspecies are present in the project area. Furthermore, dispersal from known locations to the pipeline construction area is unlikely given their poor dispersal capability and the known distance of the nearest population. However, their presence cannot be ruled out because of potential suitable habitat near the northern portion of the Chehalis Loop.

Mitigation

Northwest would conduct habitat suitability surveys for prairie species (Taylor's checkerspot butterfly and Mazama pocket gopher) a year prior to construction to document the current conditions and determine if prairie species are actively using the construction right-of-way. Northwest would coordinate with the WDFW and FWS regarding the timing and need for surveys.

Effect Determination

Based on the unlikely presence of Mazama pocket gopher in the project area and limited overall effects of construction and operation on the species, as described above, we have determined that the WEP ***may affect, but would not likely adversely affect*** Mazama pocket gopher and the WEP would cause no long-term effects that would affect the survival and/or recovery of the species. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for Mazama pocket gopher.

Birds

Construction of the WEP could affect four bird species currently listed under the ESA: marbled murrelet, yellow-billed cuckoo, northern spotted owl, and streaked horned lark (see table 4.2.8-1).

Marbled Murrelet

Species Description

The FWS designated the Washington, Oregon, and California population of marbled murrelet as threatened under the ESA in 1992 (FWS, 1992a). Critical habitat was first designated in 1996 and was revised in 2011 (FWS, 2011b). The project area does not occur in critical habitat and the closest critical habitat would be about 5.3 miles east of the Mt. Vernon North B Loop. The FWS' Recovery Plan for this species identified six key conservation areas; the WEP would not be within any of these conservation areas.

A number of contributing factors have been linked to the decline of marbled murrelet, including the loss and modification of nesting habitat through timber harvests, human-induced fires, oil spills, gill-net fishing, and marine pollution.

For general life history information on marbled murrelet, see section 4.1.8.1. FWS sea surveys estimate about 21,000 birds inhabit Washington, Oregon, and California, and about a third of the marbled murrelets in the Northwest live in Washington. According to Huff et al. (2006), the largest population is in the area of the Puget Sound and the Strait of Juan de Fuca, near the northern end of the WEP.

The PHS database has no records of nesting marbled murrelets within 0.25 mile of the WEP (WDFW, 2010; 2014). The closest recorded occurrence of nesting marbled murrelets is about 0.9 mile from where the Mt. Vernon North B Loop would be located (WDFW 2010; 2014). This recorded observation was in 2002; no recent surveys have been completed. Marbled murrelet are not expected to occur within the area of the Woodland Loop because this loop is more than 50 miles from the ocean.

The project would occur along an already cleared pipeline corridor that lacks old-growth trees or younger forest stands with suitable habitat or nesting platform trees. Furthermore, the adjacent habitat is fragmented by agriculture, rural and urban development, and industrial timber harvesting. Murrelets typically prefer late successional forests with open space below the canopy for nesting opportunities. This is not typical of the habitat in the project area, which is a mixture of fairly tightly packed younger trees that may have been logged within the past 20 to 40 years. Murrelets could fly over the WEP right-of-way while moving between nests and marine environments but they are not expected to nest in the WEP right-of-way. Flyover areas are concentrated at major river systems, but could include some smaller systems and where habitat exists upstream of the project.

Impacts

Marbled murrelets in the vicinity of the WEP may be directly affected during the critical breeding period (April 1 through August 15) by increased noise levels during construction up to 0.25 mile away. Many of the same impacts outlined in section 4.1.8.1 for marbled murrelet along the Oregon LNG Project would be the same for the WEP, including direct impacts caused by the construction and operation of the WEP. This would include vegetation disturbance within the existing right-of-way during construction and regular right-of-way maintenance activities, the limited habitat removal in the construction footprint at the stream and river crossings, and noise disturbance from construction and operation during the breeding season.

Noise and visual disturbance from construction activities could directly affect marbled murrelets during the critical breeding period. Northwest stated that the WEP would require standard construction and logging equipment and it anticipates the noise from the loudest equipment used for construction to range from 80 to 90 dBA at 50 feet from the source. According to WSDOT (2014), point source construction can be expected to dissipate at about 7.5 dB per distance doubled over soft ground. Therefore, construction noise would attenuate to below the marbled murrelet disturbance threshold of 70 dBA within 315 feet of the construction activity (WSDOT, 2014). Construction noise is not expected to exceed the threshold of 92 dBA for injury. The PHS has no reports of marbled murrelets within 0.25 mile of the WEP and review of aerial images by Northwest indicated the surrounding habitat lacks old-growth forests preferred by murrelets. In addition, the construction activities would occur during the daytime and not when murrelets typically travel between nest to marine foraging locations (at dawn and dusk), which would further limit the overall impact of the project related to construction noise.

Visual disturbances could also affect marbled murrelet behavior if human activities occur within 130 feet of an active nest site (FWS, 2006b). The presence of marbled murrelet is not expected and has not been documented within the proposed construction right-of-way. Although marbled murrelets could be present outside the construction footprint, either nesting or traveling to and from foraging grounds, the likelihood of visual disturbance would be minimized at several major waterbodies because HDD would be used.

Timber clearing along the edges of Northwest's existing right-of-way could indirectly affect marbled murrelet by further fragmenting habitat and delaying the formation of late successional forests. The WEP would deviate from the current right-of-way at six locations to better align for waterbody crossings. None of the habitat at those crossings is considered suitable for marbled murrelet nesting. As

a result, the WEP is not expected to result in any new effects due to habitat fragmentation beyond the current condition. Plus, tree removal for the construction right-of-way would not result in clearing of large- diameter trees, as most tree removal would be deciduous or young conifers that have grown into Northwest's existing right-of-way over the last 40 years. Thus, the construction footprint and associated right-of-way maintenance and stream and river crossings, including temporary work areas, is not expected to contribute to significant habitat fragmentation.

Operation of the WEP, including right-of-way maintenance and pipeline maintenance, would not impact marbled murrelet because marbled murrelet would be unlikely to occur within the permanent right-of-way. Also, proposed modification to the compressor stations would not disturb marbled murrelet, as no suitable habitat surrounds the compressor stations and operational noise is not expected to change from existing conditions.

Mitigation

No species-specific mitigation or conservation measures would be implemented for marbled murrelet for the WEP because they are not expected to occur within or near the construction right-of-way. Northwest would coordinate with the FWS and WDFW on preconstruction surveys, and if a nesting murrelet is discovered prior to or during construction then Northwest would consult with the WDFW and FWS on the appropriate conservation measures.

Effect Determination

Based on available data marbled murrelet are unlikely to occur in the construction right-of-way for the WEP. Forest clearing along the existing right-of-way may incrementally contribute to the loss of forest habitat that could be used by marbled murrelet but these impacts would be less than significant as vegetation clearing would occur along an existing right-of-way. Therefore, we conclude that the WEP ***may affect, but would not likely adversely affect*** marbled murrelet. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for marbled murrelet.

Northern Spotted Owl

Species Description

The FWS listed the northern spotted owl as threatened under the ESA in 1990 (FWS, 1990). Critical habitat was revised and designated in 2012 (FWS, 2012a). The size of northern spotted owl activity centers varies based on provincial home range, which differs from location to location. In western Washington, the provincial home range size is a radius of 1.8 miles around the nest patch (FWS, 2008a). Critical habitat does not fall within the project area. The closest critical habitat unit is about 10.9 miles east of the Mt. Vernon South Loop.

For general life history information on northern spotted owl, see section 4.1.8.1. Northern spotted owls generally nest in mature late successional forests that provide the structures and characteristics necessary to support nesting, roosting, and foraging. In Washington, nesting, roosting, and foraging habitat is defined as forest stands that meet the definition of old forest habitat, sub-mature habitat or young forest marginal habitat per Washington Forest Practices Regulations (FWS, 2011c). Forests with moderate to high canopy cover and a multilayered canopy that is generally open with large trees greater than 2.5 feet in diameter are the preferred nesting habitat. Nesting habitat generally has an abundant amount of fallen trees and other woody debris on the ground.

The main threats to northern spotted owls include competition with and displacement by barred owls, past habitat loss, and current habitat loss (FWS, 2008d). Habitat loss due to conversion of forest

lands to urban and rural developments has contributed to the decline of northern spotted owl across its range. In Washington, rates of decline range from 4.4 to 10.4 percent per year, indicating an overall steep decline in numbers of spotted owl across Washington (FWS, 2013h). The PHS database has no documented observations for northern spotted owls near the project area (i.e., within 1.8 miles) (WDFW, 2010), but includes two historic nest sites (Lacamas Creek and Eddy's Mountain) near the Woodland and Mt. Vernon North Loops.

The Lacamas Creek site is about 0.5 mile east of the Woodland Loop and surrounded by a matrix of rural residential and agricultural land uses as well as evergreen and mixed forest land cover. A total of 43 acres of the WEP-related construction footprint and ATWS are within the 1.8-mile buffer of the Lacamas Creek site. The majority of this acreage (40 percent) is maintained herbaceous right-of-way and emergent wetlands (27 percent); only 10 percent consists of evergreen or mixed forest land cover that could be considered suitable for spotted owl. Remaining land cover within the construction footprint and ATWS includes residential (6 percent), cropland and pasture (3 percent), deciduous forest (4 percent), and streams and canals (8 percent). Historical aerial photographs (1990, 2005, 2006, 2009, 2011, and 2012) indicate that the parcel where the nest site was located was logged or cleared in 2005, while the parcels directly adjacent to the east were logged or cleared sometime between 2011 and 2012. These clearings have reduced the overall quality of spotted owl habitat at this location. As a result most, if not all, suitable habitat within the home range for this site has been removed.

The Eddy's Mountain site is about 1.5 miles east of the Mt. Vernon North Loop and has been deemed historical and is not considered an active owl activity center (WDFW, 2010). Review of conditions around the Eddy's Mountain site determined the area does not contain suitable habitat.

Aerial imagery and land use review of habitat within 1.8 miles of the WEP indicates no old-growth or mature forests that could provide suitable nesting, roosting, and foraging habitat for northern spotted owls. The majority of the forested habitat alongside the majority of the right-of-way consists of young, tightly packed forest stands with limited understory openings. Patches of older forests do exist in the project area that meet habitat requirements for dispersal, but this is tempered because of the lack of known northern spotted owl nest sites or suitable nesting habitat within 1.8 miles of the centerline from which young would disperse.

Impacts

Northern spotted owl could be directly affected by noise and visual disturbance related to the WEP activities during construction and operation. Many of the same effects and analysis outlined in section 4.1.8.1 for northern spotted owl along the Oregon LNG portion of the project are the same as the WEP, including the potential for direct effects caused by the construction and operation of the WEP.

Construction disturbances would include visual and noise disturbances from the use of standard construction equipment during vegetation clearing, pipeline placement, and right-of-way restoration. The likelihood of spotted owl disturbance is expected to be low because the existing conditions along Northwest's existing right-of-way are maintained herbaceous vegetation and small shrubs and not considered suitable nesting, roosting, and foraging habitat for northern spotted owls. Nevertheless, due to the proximity of suitable habitat near the Woodland Loop, northern spotted owls could be present as they disperse to other suitable habitat adjacent to the project area. Short-term visual and noise disturbance effects could result from the project construction and operation. Construction and operation of the WEP is not expected to impact nighttime foraging because construction would be done during the day.

As discussed in the marbled murrelet section above, general construction noise disturbance is expected to attenuate below the disturbance threshold (70 dBA) within about 315 feet. Given this short

distance, and lack of known or suitable spotted owl habitat within 0.25 mile of the WEP, we expect the effects of noise to be insignificant. Operational noise resulting from such activities as pipeline maintenance, right-of-way mowing, or compressor station operation are also not expected to result in adverse effects because the right-of-way is already disturbed and has been maintained as a pipeline corridor since the 1950s. Thus, because of the overall lack of habitat and documented presence of northern spotted owls within 0.25 mile, the species would not be affected by noise or visual disturbance during construction or operations.

Indirect effects on northern spotted owls may include removal of trees that, if left undisturbed, could become suitable nesting, roosting, and foraging habitat in the future. However, vegetation clearing within the construction right-of-way would generally be limited to the 20-foot-wide area along the edge of the existing permanent right-of-way, plus clearing associated with the six areas where the route would leave the existing right-of-way to accommodate waterbody crossings. We expect this vegetation removal would have only minor effects on spotted owl habitat as the WEP's right-of-way has already been cleared and maintained over the last 50 years. This has already limited the formation of suitable habitat in the project area. Vegetation removal at the Lacamas Creek site would not result in removal of suitable habitat.

Mitigation

Northwest has not proposed species-specific mitigation or conservation measures for northern spotted owl because no suitable habitat occurs in the project area.

Effect Determination

Based on available data on owl distribution and assessment of the current habitat condition adjacent to the WEP, it is unlikely that northern spotted owl occurs in the project area. Forest clearing associated with construction of the WEP may incrementally result in the loss of habitat for spotted owl. These impacts would be minor compared to available habitat, and vegetation clearing would occur along an existing right-of-way which is not preferred habitat for spotted owl. Therefore, we conclude that the WEP ***may affect, but would not likely adversely affect*** northern spotted owl. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for northern spotted owl.

Streaked Horned Lark

Species Description

In 2012, the FWS proposed a rule to list streaked horned lark as threatened with proposed critical habitat (FWS, 2012c). Designation of final listing status for streaked horned lark as threatened as well as final critical habitat was issued in 2013 (FWS, 2013i; FWS, 2013j). Critical habitat for the streaked horned lark does not fall within the project area. The closest critical habitat would be about 3.2 miles from the Woodland Loop.

For a general life history description for streaked horned lark, see section 4.1.8.1. The PHS database had no record of streaked horned lark observations near the WEP (WDFW, 2010). The nearest documented population is about 5.7 miles from the Sumner South Loop. This PHS occurrence consists of a cluster of breeding streaked horned larks in 2003 and 2004. No new data is available at this location.

The current range of streaked horned lark in Washington is limited to south Puget Sound, the coast, and lower Columbia River islands. Of these three regions, south Puget Sound is closest to the project and includes six known sites in Mason, Pierce, and Thurston Counties. Four of the sites are on a Joint Base Lewis-McChord facility (about 10 to 15 miles west of the southern end of the Sumner South

Loop). The other two sites consist of small populations at the Olympic Regional Airport (about 15 miles west of the northern end of the Chehalis Loop), and the Port of Shelton's Sanderson Field (about 35 miles west of the Chehalis Loop).

Most of the existing right-of-way is surrounded by forests, urban development, active agricultural, and other higher structure vegetation that would preclude use by this species because of its affinity to wide open spaces. The few areas where streaked horned lark could occur would be where the WEP would cross flat, agricultural areas with little or no vegetation, such as fallow fields, pastures, or Christmas tree farms. In these areas, streaked horned lark could use the project area to some degree for foraging or nesting, although vegetation within the project area is generally too dense to be considered high quality nesting habitat, and the likelihood of nesting streaked horned lark within the construction right-of-way is low.

Impacts

As a ground nesting bird, streaked horned larks are most vulnerable to disturbance during their nesting season between March and July. Elevated noise and visual disturbance from construction equipment and workers could temporarily displace individual streaked horned larks to adjacent areas. If displaced individuals abandon their nests, reproductive success could be reduced. Direct mortality could occur if nests were crushed by construction equipment. To avoid disturbing nesting birds, Northwest would conduct preconstruction surveys for streaked horned lark prior to ground disturbing activities.

Streaked horned larks may use the agricultural fields that would be crossed by the WEP. Disturbed agricultural areas would be restored at the discretion of the individual landowners, but are expected to return to preconstruction conditions. Therefore, we conclude that there would not be significant habitat loss due to project construction or operation. Operational noise from compressor stations is not expected to disturb streaked horned lark due to the lack of suitable habitat near the compressor stations proposed for modification.

Mitigation

Northwest would conduct habitat suitability surveys for streaked horned lark a year prior to construction to evaluate current conditions. If nesting streaked horned lark are discovered prior to construction, Northwest would consult with the WDFW and FWS on the appropriate conservation measures to implement for construction.

Effect Determination

Based on the unlikely presence of streaked horned lark in the project area, lack of overall suitable habitat adjacent to and within the direct impact corridor, and limited overall effects of the WEP construction and operation on the species, we have determined that the WEP ***may affect, but would not likely adversely affect*** streaked horned lark. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for streaked horned lark.

Yellow-billed Cuckoo

Species Description

In 2014, the FWS listed the western DPS of the yellow-billed cuckoo as threatened (FWS, 2014b). Critical habitat was proposed in 2014 (FWS, 2014c), none of which occurs in the state of Washington. The western DPS includes populations in portions of 12 western states west of the crest of the Rocky Mountains, with the Canadian and Mexican borders constituting the northern and southern boundaries respectively (Pruett et al., 2000; FWS, 2013d). The primary threat to yellow-billed cuckoo is

habitat loss from conversion to agricultural uses (such as crops and livestock grazing); modification and degradation of riparian habitat from dam construction and operations, water diversions, and river flow management; and stream channelization and stabilization (Center for Biological Diversity, 1998).

Yellow-billed cuckoo is a neotropical migrant that inhabits riparian forests. They breed in intact blocks of riparian habitats, mainly woodlands with cottonwoods and willows (Ehrlich et al., 1988). The species prefers habitat that contains a combination of a dense willow understory for nesting and a cottonwood overstory for foraging (Gaines and Laymon, 1984). Suitable breeding sites generally consist of wooded patches of 50 acres or greater (Hughes, 1999) and optimal yellow-billed cuckoo habitat consists of patches greater than 200 acres and at least 1,950 feet wide (Laymon and Halterman, 1989).

This species overwinters in South America and returns to North America in mid- to late May, with nesting from May into August (Hughes, 1999). Historically, the western population of the yellow-billed cuckoo was widespread and locally common in portions of Oregon and Washington, predominantly in willow bottoms along the Willamette and Columbia Rivers in Oregon, and in the Puget Sound lowlands and along the lower Columbia River in Washington (FWS, 2013e). Review of the PHS database indicated no record of yellow-billed cuckoo within the project area (WDFW, 2010). According to PHS, the yellow-billed cuckoo record that would be closest to the WEP is a point observation about 12.2 miles west of the Snohomish Loop. This observation occurred in 2000 and consisted of several birds flying over a roadway (WDFW, 2010).

According to the FWS, the last confirmed records of yellow-billed cuckoo breeding in Washington are from the 1930s (FWS, 2013e). Incidental recordings have been documented in western Washington since that time, indicating the possibility of a remnant breeding population (Wahl et al., 2005). Further surveys have been completed in western counties but no yellow-billed cuckoos have been recorded. WDFW ranks yellow-billed cuckoos as having historical occurrences only but it is still expected to occur in the state (FWS, 2013e).

The majority of the project area would consist of an existing pipeline right-of-way where the original riparian vegetation at stream crossings was removed during original pipeline installation in the 1950s. This limits the available habitat for the yellow-billed cuckoo in the construction area. The existing right-of-way is maintained with a herbaceous or a very low shrub community with no woody riparian vegetation at stream crossings except for a few scattered trees at some of the crossings and some younger saplings where vegetation maintenance was not recently completed. The existing right-of-way does not support wooded patches and the riparian zones at stream crossings are considered suboptimal because they are highly fragmented, are small in size, and do not include dense understories of willows.

Mature cottonwood and willow habitat does exist adjacent to the existing right-of-way within the project area at the six stream crossings where new alignment of the pipeline would occur, but these areas do not meet minimum patch sizes for this species. Suitable riparian habitat does not exist near the compressor stations that would be modified for the WEP.

Impacts

The potential for direct effects on yellow-billed cuckoos would be limited to places where riparian habitat would be cleared within the construction right-of-way. Construction noise would be the main direct effect and if an individual were present, it would be expected to avoid the effects area during construction due to increased levels of noise and activity. Breeding pairs are not expected within the project area because no successful breeding has been recorded in Washington since the 1930s.

Deciduous tree habitat is not present at the Toutle River, Cowlitz River, Newaukum River, Puyallup River, or Snohomish River crossings, but 3.2 acres of deciduous trees and willow shrubs at the South Fork Nooksack River crossing would be removed. The streamside and riparian habitat at this location occurs in a matrix of rural residential and agricultural land uses and is unlikely to support yellow-billed cuckoo due to sparse vegetative cover and small patch size (generally ranging between less than 1 to 20 acres). Of the 3.2 acres, about 1.6 acres would be within the permanent right-of-way and about 1.6 acres would be in the ATWS that would be temporarily affected by the stream crossing and construction activities and would be restored after construction. Therefore, we expect minimal permanent habitat loss. Further, the patch size of the intact adjacent habitat is less than 50 acres and is unlikely to be used by this species other than for migration purposes.

Mitigation

Northwest would implement the following conservation measures for the WEP to avoid or minimize effects on yellow-billed cuckoos.

- Prior to construction, a habitat assessment would be conducted within potentially suitable riparian habitat. If suitable nesting habitat is present, then preconstruction nest surveys would be conducted to identify any nesting birds that could be affected by the proposed action. Surveys would be conducted in the year prior to construction so that conditions at the time of construction are accurately reflected. If a nesting cuckoo is confirmed during the preconstruction nest surveys, the FWS would be contacted for guidance on developing appropriate avoidance measures, which would likely include avoiding construction during the species' sensitive breeding period (about early June through August).
- The results of preconstruction nest surveys would be submitted to the FWS prior to initiation of construction.

Effect Determination

Based on the unlikely presence of yellow-billed cuckoo in the project area, lack of overall suitable habitat adjacent to and within the direct impact corridor, and limited overall effects of the WEP construction and operation on the species, we have determined that the WEP ***may affect, but would not likely adversely affect*** yellow-billed cuckoo. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for yellow-billed cuckoo.

Amphibians – Oregon Spotted Frog

Construction of the WEP could affect one amphibian species currently listed under the ESA, the Oregon spotted frog.

Species Description

In 2014, the FWS listed Oregon spotted frog as threatened and designated critical habitat (FWS, 2014g; 2014h). Washington counties with known occurrences of Oregon spotted frog are Clark, King, Klickitat, Pierce, Skagit, Snohomish, and Thurston Counties (FWS, 2013k). In addition, a reintroduction project was initiated in 2008 at Dailman Lake in Pierce County on Joint Base Lewis-McChord facility (Nisqually River subbasin).

Oregon spotted frog is the most aquatic native frog in the Pacific Northwest (FWS, 2013l) and is associated with emergent wetland in forested landscapes as well as large, shallow, wetland systems connected to perennial streams. Given this association with perennial waterbodies, Oregon spotted frogs

tend to avoid dry uplands (NatureServe, 2013). Overall characteristics of suitable habitat for this species include: 1) the presence of good breeding and over-wintering sites connected by year-round water; 2) reliable water levels that maintain depth throughout the period between egg laying and metamorphosis; and 3) the absence of introduced predators, especially warm-water game fish and bullfrogs (FWS, 2013l). This species generally prefer ponds from 2.5 acres to 9 acres in size, but have been found in ponds as large as 4,915 acres (Natureserve, 2013; Hayes, 1994; Pearl and Hayes, 2004).

Documented threats to Oregon spotted frog include loss of habitat, nonnative plant invasions, and the introduction of exotic predators (FWS, 2013l; 2014f). This species has been extirpated from at least 78 percent of its former range (FWS, 2013l; 2014f). Specific to the state of Washington, the distribution of this species has declined dramatically due to the filling and alteration of wetlands.

The PHS database has no records of Oregon spotted frog within the proposed WEP construction footprint around perennial waterbodies (WDFW, 2010). The closest PHS records include a cluster of observations from 2012 in the Samish River floodplain about 0.1 mile west from the Mt. Vernon North B Loop, near MP 1455.0 and MP 1458.0 (WDFW, 2014). Oregon spotted frogs have been documented just west of the alignment within the same contiguous wetland complex. The wetland at the crossing does not appear to have an open water component, but this species could be present. The other occurrence is a cluster of observations in Beaver Creek about 8.9 miles away from the Chehalis Loop. These occurrences range from 1998 to 2008 and include observations of adults as well as egg masses (WDFW, 2010). Three wetlands with suitable frog habitat would be crossed in the Sumas Loop and four wetlands with suitable habitat would be crossed in the Chehalis Loop, but there are no documented occurrences of this species at those locations. Potential habitat for Oregon spotted frog within the project area would be limited to stream crossings at wetlands and perennial waterbodies.

Oregon spotted frog critical habitat would not fall within the construction right-of-way for the WEP, but portions of critical habitat would occur near the Mt. Vernon North B and Sumas Loops. Critical habitat near the project area consists of aquatic habitats associated with the lower Chilliwack, South Fork Nooksack, and Samish Rivers.

The potential for Oregon spotted frog to occur within the construction right-of-way is limited to the Chehalis, Mt. Vernon North B, and Sumas Loops. Where critical habitat associated with the Samish River would occur near the construction right-of-way (about 106 feet from the pipeline centerline in the Mt. Vernon North B Loop), the right-of-way would be upslope from the Samish River and separated from the floodplain by an existing railroad. This would likely restrict overland movement of Oregon spotted frog between the Samish River floodplain and the project area.

Impacts

Due to its close association with shallow wetland systems, Oregon spotted frog could be impacted by construction in areas near wetlands and perennial waterbodies, and potentially associated stormwater input areas. Oregon spotted frog adults and egg masses/metamorphs could be directly affected by ground disturbance and vegetation removal during construction or operation at wetland crossings, associated buffer areas, and stream crossings with wetland components. These impacts could result in diminished reproductive success or survival of individuals. In addition, due to limited mobility of frogs, some individuals and/or egg masses and tadpoles could be crushed by construction or maintenance equipment and personnel. Construction impacts on wetlands would be temporary and would typically recover within a single growing season.

Mitigation

Northwest would implement the following conservation measures to avoid or minimize effects on Oregon spotted frog.

- Construction and maintenance mowing would not occur during the breeding period (February to March).
- Construction at waterbody crossings would not occur prior to the in-water work windows that start in mid-July, thereby allowing most, if not all, egg masses to hatch into tadpoles.
- Preconstruction surveys for Oregon spotted frog presence would be conducted by a qualified biologist prior to ground-disturbing activities at suitable PFO, PEM, and PSS wetland crossings as well as the six offset locations for waterbody crossings.

Effect Determination

Based on the lack of suitable habitat in the project area, lack of recorded observations in the right-of-way, no permanent loss of habitat, and limited overall effects of the WEP construction and operation on the species, we have determined that the WEP ***may affect, but would not likely adversely affect*** Oregon spotted frog. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for Oregon spotted frog.

Fish

Construction of the WEP pipeline may affect several fish species that are federally listed under the ESA (see table 4.2.8-1). All of these species are also Priority Habitat species as defined by WDFW. The WRIA-specific timing of life stages for species that would be affected by project activities is presented in appendix K5.

Species Description

Chinook Salmon

As discussed in section 4.1.8.1, Chinook salmon exhibit different seasonal run timings (i.e., spring, summer, and fall) based on the timing of adult migration from the ocean to freshwater. Two federally listed Chinook salmon ESUs occur in the project area: the lower Columbia River ESU and the Puget Sound ESU. A brief description of their geographic range and designated critical habitat is presented below. Chinook salmon in the Washington Coastal ESU, which includes the Chehalis River Basin, are not listed under the ESA.

Lower Columbia River ESU. NMFS listed the lower Columbia River Chinook salmon as threatened under the ESA in 1999 (NMFS, 1999b) and reaffirmed the status in 2005 (NMFS, 2005d). The lower Columbia River ESU includes all naturally spawned populations from the Columbia River and its tributaries, from the river mouth at the Pacific Ocean upstream to the crest of the Cascade Range.

Lower Columbia River Chinook are found only in the largest waterbodies that the WEP would cross, including the Kalama, Coweeman, Toutle, and Cowlitz Rivers, South Fork Ostrander, Ostrander, and Lacamas Creeks, and an unnamed tributary to the Cowlitz River. Except for the Kalama and Cowlitz Rivers, the other waterbodies only contain migration habitat for fall or spring-run Chinook salmon. The crossing locations at the Kalama and Cowlitz Rivers contain all three life stages (migration, spawning, and rearing) of lower Columbia River Chinook salmon.

NMFS designated critical habitat for lower Columbia River Chinook in 2005. Critical habitat for lower Columbia River Chinook is present at every waterbody that would be crossed by the WEP where Chinook salmon occur.

Puget Sound ESU. NMFS listed the Puget Sound ESU as threatened under the ESA in 1999 (NMFS, 1999b); that status was reaffirmed in 2005 (NMFS, 2005d). The Puget Sound ESU includes all naturally spawned populations from waterbodies flowing into Puget Sound. In this ESU, adult spring Chinook typically return to freshwater in April and May and spawn in August and September. Summer Chinook begin their freshwater migration in June and July and spawn in September, while summer/fall Chinook begin to return in August and spawn from late September through January. The majority of Chinook salmon from the Puget Sound ESU exhibit an ocean-type life history, and juveniles migrate downstream to the ocean in the first spring or summer as subyearlings. Other than adult upstream migration, the life history for other stages (emigration timing, age at maturation, and ocean migration) is similar among most stocks and runs of Chinook salmon in the Puget Sound ESU.

Puget Sound Chinook salmon occur in the northern portion of the project area, with a total of 13 waterbody crossings: Deschutes, Puyallup, Snohomish, Pilchuck, and South Fork Nooksack Rivers, and Covington, Issaquah, Fifteenmile, East Fork Issaquah, East Fork Nookachamps, Breckenridge and Saar Creeks (two crossings). All of these waterbody crossings contain the fall-run variety of Puget Sound Chinook, while only two waterbody crossings contain the spring-run and two contain the summer-run variety. All of these waterbody crossing sites provide migratory habitat, and six contain spawning and rearing habitat at the crossing locations including the Deschutes, South Fork Nooksack, Snohomish, and Pilchuck Rivers, and Issaquah and East Fork Issaquah Creeks.

NMFS designated critical habitat for Puget Sound Chinook salmon in 2005. Critical habitat is designated at every waterbody crossing where Chinook occur in the Puget Sound area.

Chum Salmon

NMFS listed Columbia River chum salmon ESU as threatened under the ESA in 1999 (NMFS, 1999b) and that status was reaffirmed in 2005 (NMFS, 2005d). This ESU includes naturally spawned chum salmon originating from the Columbia River and its tributaries in Washington and Oregon. Chum spawning is generally concentrated in Columbia River side channels below Bonneville Dam, nearby Columbia Gorge tributaries, and Grays River near the Columbia River estuary. The distribution of chum salmon at waterbodies that would be crossed by the WEP is not well documented; the overall Columbia River population is small and many waterbodies that historically supported chum are unoccupied (NMFS, 2011c).

The WDFW suggests that chum may occur in the Kalama, Coweeman, Cowlitz, and Toutle Rivers, Lacamas Creek, and in two unnamed tributaries to the Cowlitz River along the WEP route. However, chum are not thought to occupy Lacamas Creek, according to recent mapping (WDFW, 2014; StreamNet, 2014b). Only the migration life stage is presumed to occur at waterbody crossings where chum may occur.

Critical habitat was designated in 2005 (NMFS, 2005c) and, in Washington, includes all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream from Bonneville Dam. Each of the crossings described in the previous paragraph is within designated critical habitat for Columbia River chum salmon.

Coho Salmon

In 2005, NMFS listed the lower Columbia River ESU of coho salmon as threatened under the ESA (NMFS, 2005d). The ESU includes all naturally spawned coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia River upstream to and including the Big White Salmon and Hood Rivers.

In the Woodland Loop, the WEP would cross 13 waterbodies containing coho migration habitat, including the Kalama, Coweeman, Toutle, and Cowlitz Rivers, South Fork Ostrander, Ostrander, and Lacamas Creeks, five unnamed tributaries to the Cowlitz River, and one unnamed tributary to the Coweeman River. Of these waterbodies, only five contain habitat to support coho spawning, rearing, and migration life stages, while one contains two of the three life stages (rearing and migration habitat). All but two crossings (the Kalama and Cowlitz Rivers) would require in-channel work.

In 2013, NMFS proposed critical habitat for the lower Columbia River coho ESU. Proposed critical habitat includes waterbodies that would be crossed by the WEP.

Steelhead Trout

Two steelhead DPSs occur within the project area, including the lower Columbia River DPS and the Puget Sound DPS. A brief description of their geographic range and designated critical habitat is provided below.

Lower Columbia River Steelhead

Lower Columbia River steelhead occupy tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon (NMFS, 1996b). NMFS initially listed steelhead in the lower Columbia River DPS as threatened in 1998 and reaffirmed the status in 2005 (NMFS, 2006c). The lower Columbia River DPS has both winter-run and summer-run steelhead.

Lower Columbia River steelhead occurs in all of the major waterbodies crossed in the southern-most portion of the Woodland Loop. Northwest would cross 11 waterbodies where lower Columbia River steelhead occur, and all of them contain the winter-run variety of lower Columbia River steelhead. These waterbodies include the Kalama, Coweeman, Toutle, and Cowlitz Rivers; South Fork Ostrander, Ostrander, and Lacamas Creeks; and four unnamed tributaries to the Cowlitz River. Of these waterbodies, three also contain summer-run lower Columbia River steelhead. While the Kalama and Coweeman Rivers contain migration, spawning, and rearing habitat, all of the other crossing sites only contain migration habitat for lower Columbia River steelhead.

Critical habitat for lower Columbia River steelhead was designated threatened in 2005 and, in Washington, includes all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind Rivers. All waterbodies that the WEP would cross within the geographic range of lower Columbia River steelhead are designated as critical habitat for this stock.

Puget Sound Steelhead

NMFS listed Puget Sound steelhead trout as threatened under the ESA in 2007 (NMFS, 2007). This DPS of steelhead includes all naturally spawned winter- and summer-run steelhead populations in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River and to the north by the Nooksack River and Dakota Creek.

Puget Sound steelhead occur at more of the waterbodies that would be crossed by the WEP (19) than any other federally listed fish species in the project area (see table 4.2.8-2). The majority of the

crossings are at larger waterbodies of the northern loops and their tributaries, which contain migration habitat for both winter- and summer-run fish. Three of the waterbodies that would be crossed contain spawning, rearing, and migration habitat for Puget Sound steelhead, while two provide only rearing and migration habitat.

Critical habitat for the Puget Sound DPS was proposed by NMFS in 2013 and includes waterbodies that would be crossed by the WEP.

Pacific Eulachon

The southern DPS of Pacific eulachon was listed as threatened under the ESA in 2010 (NMFS, 2010). Pacific eulachon are an anadromous smelt with broad geographic distribution from the Klamath River in California north to the Bering Sea in Alaska (Wydoski and Whitney, 2003), but the southern DPS only includes eulachon originating from Washington, Oregon, or California. Pacific eulachon spend most of their lives in coastal water of the Pacific Ocean, where they live for 3 or 4 years. They then migrate to coastal streams to spawn, typically in February and March. Adults deposit eggs on gravel, where they incubate for about 1 month. Adults die after spawning. Hatched larvae drift to estuaries from freshwater systems where they are spawned. Rearing occurs in estuaries, not in freshwater.

Pacific eulachon are found in three lower Columbia River tributaries that would be crossed by the WEP: the Kalama, Toutle, and Cowlitz Rivers. The spawning and migratory freshwater life stages may occur at the crossing locations in each of the rivers.

Critical habitat for the southern DPS of eulachon was designated in 2011 (NMFS, 2011b) and includes the Cowlitz, Toutle, and Kalama Rivers in the project area. Of these waterbodies, the highest incidence of spawning is in the lower Cowlitz River below the confluence with the Toutle River, although individuals have been observed as far upstream as the Barrier Dam (RM 50) near the Cowlitz Salmon Hatchery (NMFS, 2010). Spawning was known to occur in the Toutle River prior to the eruption of Mount St. Helens in 1980, but there has been only one documented occurrence since then, in 2011 (NMFS, 2011b). In the Kalama River, spawning occurs in the lower river up to the confluence with Indian Creek, which would be about 2.5 miles upstream of the WEP aerial span crossing location.

Bull Trout

In November 1999, the FWS defined one DPS for all bull trout within the conterminous United States, and listed that DPS as threatened under the ESA (64 FR 58910). The single DPS is subdivided into six biologically-based recovery units with each recovery unit comprised of several populations. The WEP would cross the Coastal Recovery Unit and specifically the Columbia River Basin and Coastal-Puget Sound populations within this recovery unit. The range of the Columbia River Basin population includes nearly all of the entire Columbia River Basin in higher elevation tributaries in Washington, Oregon, Idaho, Montana, and a small part of Nevada. In the lower Columbia River, only the Lewis River is known to support bull trout on the Washington side. Historically, bull trout may have inhabited areas within the Cowlitz and Kalama Rivers, but current distribution within those basins is unknown (FWS, 2002). However, StreamNet indicates the potential occurrence of bull trout migration in the lower Kalama River. Based on the identification of potential migration habitat, it is reasonable to assume that rearing habitat may also be present in the lower Kalama River. The Coastal-Puget Sound bull trout population includes individuals that occur in all Pacific coast drainages in western Washington, including Puget Sound, with the exception of the Columbia River. Within the project area, only a few waterbodies are assumed to contain bull trout from this population, and most of the crossing locations contain habitat used only for migration. Occupied waterbodies are in the more northern loops of the WEP and include

the Puyallup, Snohomish, Pilchuck, and South Fork Nooksack Rivers and French Creek. None of these waterbodies contain spawning habitat, only migration and rearing habitat.

Bull trout critical habitat was designated for the Columbia River Basin population in 2005, and includes the Lewis River Basin on the Washington side of the lower Columbia River. Critical habitat for the Coastal-Puget Sound bull trout was designated in 2005 and revised in 2010 (FWS, 2010). Critical habitat is designated for most of the major watersheds in Puget Sound crossed by the WEP except the Deschutes River.

Impacts

The WEP would cross 33 waterbodies that may provide habitat for federally listed fish (see table 4.2.8-2). Three of these waterbodies (Kalama River, Covington Creek, and East Fork Issaquah Creek) would be crossed by aerial span or span, and four (Cowlitz, Puyallup, Snohomish, and South Fork Nooksack Rivers) would be crossed by HDD. No in-water work would be associated with the span and HDD crossing methods, thus avoiding direct impacts on fish. Effects on listed fish from pipeline construction and operation would primarily be related to open-cut waterbody crossings and associated construction activities necessary to bury the pipeline under and next to waterbodies. Impacts on aquatic species discussed in section 4.2.5.2, as well as those discussed for Oregon LNG pipeline installation (see sections 4.1.5.2 and 4.1.8.1) would also apply to listed fish in the project area.

Pipeline installation would occur in the summer and early fall (see table 4.2.8-2), when the most sensitive life stages of federally listed fish (i.e., spawning adults, incubating eggs, and newly hatched juveniles) are not typically present in waterbodies that would be crossed by the WEP. For this reason, impacts would primarily be restricted to rearing juveniles and resident bull trout (if present), and in some cases, to early runs of adult salmonids. The summer timing of pipeline installation should avoid all life stages of eulachon.

Table 4.2.8-2

WEP Waterbody Crossings Where Federally Listed Fish May be Present and Associated In-water Work Periods

Milepost	Waterbody	Federally Listed Fish Present and ESU/DPS	Crossing Method	In-Water Work Period [a]	
				Start Date	End Date
Woodland Loop					
1253.4	Kalama River	LCR Chinook, bull trout, CR chum LCR steelhead, LCR coho, eulachon	Aerial span	August 1	August 15
1260.5	Coweeman River	LCR coho, LCR steelhead, LCR Chinook, CR chum	Dry, open cut	July 16	September 30
1260.8	Unnamed	LCR coho	Dry, open cut	August 1	August 31
1264.9	South Fork Ostrander Creek	LCR Chinook, LCR steelhead, LCR coho	Dry, open cut	July 16	September 30
1265.3	Ostrander Creek	LCR coho, LCR steelhead, LCR Chinook	Dry, open cut	July 16	September 30
1274.4	Toutle River	LCR Chinook, LCR steelhead, LCR coho, CR chum, eulachon	Wet, open cut	July 16	August 15
1275.7	Unnamed	LCR coho	Dry, open cut	July 16	August 15
1281.5	Unnamed	CR chum	Dry, open cut	August 1	August 15
1282.5	Cowlitz River	CR chum, LCR Chinook, LCR steelhead, LCR coho, eulachon	Trenchless	August 1	August 15
1283.7	Unnamed	LCR steelhead, LCR coho	Dry, open cut	August 1	August 15
1284.6	Unnamed	CR chum, LCR steelhead, LCR coho, LCR Chinook	Dry, open cut	August 1	August 15

Table 4.2.8-2

WEP Waterbody Crossings Where Federally Listed Fish May be Present and Associated In-water Work Periods

Milepost	Waterbody	Federally Listed Fish Present and ESU/DPS	Crossing Method	In-Water Work Period [a]	
				Start Date	End Date
1285.4	Lacamas Creek	CR chum, LCR steelhead, LCR coho, LCR Chinook	Dry, open cut	August 1	August 15
1288.6	Unnamed	LCR steelhead, LCR coho	Dry, open cut	August 1	August 15
1288.9	Unnamed	LCR steelhead, LCR coho	Dry, open cut	August 1	August 15
Chehalis Loop					
1315.1	Deschutes River	PS steelhead, PS Chinook	Dry, open cut	July 16	August 31
Sumner South Loop					
1348.0	Puyallup River	bull trout, PS steelhead, PS Chinook	Trenchless	July 16	August 31
Sumner North A Loop					
1359.6	Covington Creek	PS steelhead, PS Chinook	Span	July 16	September 30
Sumner North B Loop					
1371.1	Issaquah Creek	PS steelhead, PS Chinook	Dry, open cut	August 1	August 31
1372.0	Fifteenmile Creek	PS steelhead, PS Chinook	Dry, open cut	August 1	August 31
1373.7	Unnamed	PS steelhead	Dry, open cut	August 1	August 31
1376.1	East Fork Issaquah Creek	PS steelhead, PS Chinook	Span	August 1	August 31
Snohomish Loop					
1397.6	Snohomish River	PS steelhead, PS Chinook, bull trout	Trenchless	August 1	August 15
1402.4	French Creek	bull trout, PS steelhead	Dry, open cut	August 1	August 15
1407.8	Pilchuck River	bull trout, PS steelhead, PS Chinook	Dry, open cut	August 1	August 31
Mt. Vernon North A Loop					
1440.4	East Fork Nookachamps Creek	PS steelhead, PS Chinook	Dry, open cut	Project-specific	
1441.4	Turner Creek	PS steelhead	Dry, open cut	Project-specific	
Mt. Vernon North B Loop					
1457.4	Little Innis Creek	PS steelhead	Dry, open cut	August 1	September 15
1461.3	Landing Strip Creek	PS steelhead	Dry, open cut	July 16	August 15
1461.6	South Fork Nooksack River	PS steelhead, bull trout, PS Chinook	Trenchless	July 16	August 15
Sumas Loop					
1478.9	Breckenridge Creek	PS steelhead, PS Chinook, bull trout	Dry, open cut	July 16	August 15
1479.1	Kinney Creek	PS steelhead	Dry, open cut	July 16	August 15
1482.8	Saar Creek	PS steelhead, PS Chinook	Dry, open cut	August 1	Sept 30
1483.1	Saar Creek	PS steelhead, PS Chinook	Dry, open cut	August 1	Sept 30

[a] WDFW. 2009. Allowable Freshwater Work Times. Northwest may work outside of these times if approved by WDFW and NMFS.

LCR = Lower Columbia River, CR = Columbia River, CPS = Coastal Puget Sound, PS = Puget Sound.

In addition to direct impacts on fish that could potentially result in a "take" of individual fish, ESA requires an assessment of impacts on critical habitat for listed species. For listed fish, NMFS has identified the PCEs of habitat that are essential to their conservation. For salmon and steelhead, these include: (1) freshwater spawning sites, (2) freshwater rearing sites, (3) freshwater migration corridors, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Each of these areas is further defined in terms of water quality and quantity, cover availability, floodplain connectivity, forage, and freedom from obstructions. Only the three freshwater elements could potentially be affected by the

WEP. Impact sources for spawning habitat would include increased sedimentation, changes in water temperature, water contamination, and water withdrawals. Impacts on rearing habitat would include those identified for spawning habitat as well as alteration of riparian vegetation and changes to in-stream habitat elements such as LWD. The potential source of impact on migration corridors would include the temporary impediments on fish passage resulting from construction activities at stream crossings.

Critical habitat for bull trout is designated in several waterbodies that would be crossed by the WEP. Freshwater migration habitat is present at each crossing location where bull trout are present, and temporary dewatering dams used for the dam and pump method would disrupt the function of the migration corridor. Rearing habitat at the Pilchuck River crossing would be temporarily disturbed by sedimentation and the clearing of riparian vegetation from the construction right-of-way. The FWS and WDFW provided comments requesting that Northwest evaluate the feasibility of HDD crossings of waterbodies that support bull trout. There are three waterbodies that support bull trout that Northwest has proposed to cross using the opencut method. Northwest determined that HDD methods would not be feasible for crossing the Pilchuck River due to limited work area and challenging geology. The presence of nearby houses would limit laydown areas and drilling rigs. Northwest has determined that the underlying geology along the alignment would have unacceptably high risks for failure and/or inadvertent release of drilling fluid (see appendix K4 for site specific waterbody crossing plans). We agree with Northwest's assessment that HDD is not the preferred crossing method for the Pilchuck River; however, Northwest has not provided sufficient justification for open-cut crossings of French Creek and Breckenridge Creek, which also support bull trout. Therefore, **we recommend that:**

- **<u>Before the close of the draft EIS comment period,</u> Northwest should file with the Secretary an evaluation of the feasibility of using HDD to cross French Creek (at MP 1402.4 along the Snohomish Loop) and Breckenridge Creek (at MP 1478.9 along the Sumas Loop) to avoid impacts on bull trout.**

Proposed WEP crossing locations at the Cowlitz, Kalama, and Toutle Rivers contain designated critical habitat for the Southern DPS of eulachon, primarily freshwater migration habitat, and potential freshwater spawning and incubation habitat. In-water construction associated with the wet, open-cut method at the Toutle River crossing would temporarily degrade substrates; however, increased flows in the fall would likely flush the majority of sediments from the construction area prior to the typical winter/spring spawning period for eulachon. Therefore, we conclude that project-related effects on eulachon critical habitat would be minor.

Mitigation

Mitigation measures for aquatic species described in section 4.2.5.2 would also apply to federally listed fish species including:

- adherence to agency-approved in-water work windows to minimize impacts on sensitive life history stages of fish species;
- best management practices to limit sediment and turbidity; and
- streambed and bank restoration following pipeline installation, including placement of LWD as appropriate in some locations, in consultation with WDFW during HPA review.

Effect Determinations

Table 4.2.8-3 summarizes the recommended effect determinations for federally listed fish species and critical habitat that may be present in the project area based on the potential effects described in this section and in section 4.2.5.2. Although the proposed project would adversely affect some listed fish

species, these potential effects would not cause long-term effects that would affect the survival and/or recovery of the species or their critical habitat.

Table 4.2.8-3

Federally Listed Fish Species and Critical Habitat Potentially Crossed by the WEP and Effect Determinations

	Determination of Effect		
Species	**Species**	**Critical Habitat**	**Justification**
Chinook Salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River ESU	LAA	LAA	Chinook spawn and rear in eight waterbodies that would be crossed by the WEP and may be adversely affected by in-water work associated with pipeline installation. Critical habitat (migratory PCE) would be temporarily modified during pipeline installation. The channel and riparian zone would be restored following construction activities.
Puget Sound ESU	LAA	LAA	Chinook may occur in several waterbodies that would be crossed by the WEP and may be adversely affected by in-water work associated with pipeline installation. Critical habitat would be temporarily adversely modified during pipeline installation. The channel and riparian zone would be restored following construction activities.
Steelhead (*O. mykiss*)			
Lower Columbia River DPS	LAA	LAA	Steelhead are known to occur at 11 waterbodies that would be crossed by the WEP, and in-water construction would occur at 9 of these crossings. The in-water work associated with pipeline installation could adversely affect juvenile steelhead. Critical habitat (migratory PCE) would be temporarily affected during pipeline installation. The channel and riparian zone would be restored following construction activities.
Puget Sound DPS	LAA	Would adversely modify; Provisional determination – LAA	Steelhead are known to occur at 19 waterbodies in the Puget Sound that would be crossed by the WEP and juvenile steelhead may be adversely affected by in-water work associated with pipeline installation at 14 crossings. Critical habitat would be temporarily adversely modified during pipeline installation. The channel and riparian zone would be restored following construction activities.
Chum Salmon (*O. keta*) Columbia River ESU	NLAA	LAA	The migration timing of adults or juveniles of chum salmon does not coincide with the in-water work windows at the seven waterbody crossings where chum occur. Therefore, we do not expect impacts on chum due to this temporal separation. Critical habitat (migratory PCE) would be temporarily affected during pipeline installation. The channel and riparian zone would be restored following construction activities.
Coho Salmon (*O. kisutch*) Lower Columbia River ESU	LAA	Would adversely modify Provisional determination - LAA	Coho are known to occur in 13 waterbodies that would be crossed by the WEP, and in-water work is required at 11 of these crossings. In-water work associated with pipeline installation would adversely affect juvenile coho present at the time of construction. Critical habitat would be temporarily modified during pipeline installation across 11 waterbodies. The channel and riparian zone would be restored following construction activities.
Bull Trout (*Salvelinus confluentus*)	LAA	LAA	Suitable migration habitat for bull trout occurs in the Kalama River where it would be crossed by the WEP; however adverse effects would be avoided by using an aerial span to cross Kalama River. This species is presumed to occur in five waterbodies crossed by the WEP, but only three waterbodies would require in-water work; the others would be crossed using trenchless methods. In-water work could temporarily displace or otherwise adversely affect bull. Critical habitat would be temporarily affected during pipeline installation at the three crossings requiring in-water work. The channel and riparian zone would be restored following construction activities.

Table 4.2.8-3

Federally Listed Fish Species and Critical Habitat Potentially Crossed by the WEP and Effect Determinations

	Determination of Effect		
Species	**Species**	**Critical Habitat**	**Justification**
Eulachon (*Thaleichthys pacificus*) Southern DPS	NE	NLAA	Eulachon have been documented in the lower reaches of the Kalama, Cowlitz, and Toutle Rivers, and spawning and migration is assumed to occur where the WEP would cross these rivers. However, the eulachon freshwater life phase only occurs in the winter to early spring; therefore, in-water work in the Toutle River during the summer would completely avoid impacts on eulachon. No in-water work would occur at the Kalama and Cowlitz Rivers. Freshwater migratory corridors would be temporarily affected during in-water work at the Toutle River crossing; however, habitat would be unoccupied at the time of in-water work. Freshwater spawning and incubation habitat would be temporarily affected, but should recover prior to the next spawning season in the winter/spring.

NLAA = Not likely to adversely affect; LAA = Likely to adversely affect; NE = No Effect.

Invertebrates–Taylor's Checkerspot Butterfly

Construction of the WEP could affect one invertebrate species currently listed under the ESA, Taylor's checkerspot butterfly.

Species Description

In 2012, the FWS designated Taylor's checkerspot butterfly as endangered as well as final critical habitat (FWS, 2013i; FWS, 2013j). The WEP would not cross critical habitat and the nearest critical habitat is about 3.8 miles from the Chehalis Loop.

Taylor's checkerspot butterfly generally inhabits open grasslands and is associated with maritime prairies and shorelines along the Strait of Juan de Fuca, post-glacial gravelly outwash and mounded prairies of the Puget Sound trough and south Puget Sound region, and open island prairies with a dominance of native vegetation. Historical distribution of this species included those grassland and prairie habitats from southern British Columbia (south Vancouver Island), south through the San Juan Islands and Puget Trough of Washington, and into the Willamette Valley of Oregon (FWS, 2010). Recent surveys in Washington found that most populations have either disappeared or declined sharply between 1996 and 2000 (FWS, 2008e).

Sites selected for breeding typically contain larval food plants and adult nectar sources. Primary larval host plants for Taylor's checkerspot butterfly include narrow-leaved plantain and harsh paintbrush (FWS, 2013j). Golden paintbrush historically has been a host plant but it is known at only four locations, one each in King, Pierce, Skagit, and Thurston Counties (WNHP, 2013b). Secondary larval host plants include blue-eyed Mary, sea blush, dwarf owl-clover, marsh speedwell, American speedwell, and thymeleaf speedwell (FWS, 2013j). They have been known to adapt to different nectar sources, including nonnative plants (Grosboll, 2005).

The PHS database had no record of Taylor's checkerspot butterfly along the route that would be crossed by the WEP. The nearest known occurrence is from 1983 and in rocky prairie habitat about 9.5 miles from the Chehalis Loop (WDFW, 2010). Currently, there are 11 known populations of this species in Washington (FWS, 2012c), and the nearest documented locations are the Joint Base Lewis-McChord population (about 15 miles west of the Sumner South Loop), the Scatter Creek Wildlife Area

population (about 15 miles west of the Chehalis Loop), and the Bald Hills population (about 15 miles east of the Chehalis Loop).

Taylor's checkerspot butterfly habitat is often associated with glacial soils (FWS, 2010). The loops with the greatest potential for crossing glacial soils are the Sumner North A, Sumner North B, Snohomish, and Mt. Vernon South Loops. However, the existing Northwest pipeline right-of-way lacks native prairie habitat and is adjacent to industrial forest, residential and commercial development, and agricultural land that also lack habitat elements needed by Taylor's checkerspot butterfly. Therefore, we conclude that the WEP construction right-of-way would not support the movement of butterflies for mating, egg laying, and adult nectaring.

Impacts

Habitat for this species is believed to be absent from the WEP construction corridor; however, given the diverse number of larval and nectar plants used by this species, it is possible that the project could directly affect this species if individuals or occupied host plants were present within the construction right-of-way. Removal or trampling of occupied host plants containing eggs, larvae, adults, or dispersing Taylor's Checkerspot butterfly could result in direct take. Other than direct take of an individual, construction and operation activities that remove vegetation could cause a temporary reduction in food supply that could reduce survival of larvae and adults. This effect would be temporary in nature as herbaceous vegetation grows back the following year after site restoration. These effects are tempered by no known populations in the project area, with the nearest historic population about 9.5 miles from the Chehalis Loop.

Mitigation

Northwest would conduct habitat suitability surveys for prairie species (Taylor's checkerspot butterfly and Mazama pocket gopher) the year prior to construction to evaluate current conditions. Surveys would be conducted by qualified biologists in consultation with the WDFW and FWS. If a Taylor's Checkerspot butterfly adult or larvae is discovered prior to construction, Northwest would consult with WDFW and FWS to develop appropriate conservation measures.

Effect Determination

Based on the lack of suitable habitat or host plants in the project area and lack of recorded observations in the right-of-way, we determined that the WEP ***may affect, but would not likely adversely affect*** Taylor's checkerspot butterfly. Because no critical habitat occurs in the project area, the WEP would have ***no effect*** on critical habitat for Taylor's checkerspot butterfly.

Plants

Construction of the WEP could affect four plant species currently listed under the ESA: golden paintbrush, water howellia, Kincaid's lupine, and Nelson's checker-mallow.

Species Description

Golden Paintbrush

The FWS listed golden paintbrush as threatened in 1997 (FWS, 1997b) and issued a recovery plan for golden paintbrush in 2000 (FWS, 2000b). No critical habitat has been designated for this species. Historically, golden paintbrush grew in grassland on islands in Puget Sound and the Straits of Georgia in Canada, and south into the Willamette Valley of Oregon. Today, there are only four known

occurrences of golden paintbrush in Washington, in King, Pierce, Skagit, and Thurston Counties (WNHP, 2013b). The WEP would not be near these populations.

Golden paintbrush is a perennial herb with alternating leaves and soft, sticky hairs (WNHP, 2013a). Golden paintbrush inhabits upland prairies and open grasslands and is associated with other plant species, including Roemer's fescue, red fescue, Scot's broom, common velvetgrass, and western brackenfern (WNHP, 2013a; FWS, 1997b). The primary threats to golden paintbrush include habitat loss and changes in land management because much of the original habitat has been converted to residential, commercial, and agriculture developments. Additional threats include fire suppression, fragmentation, consumption by cattle and other species, and recreational picking (FWS, 1997b; FWS, 2010a).

The WEP would cross the potential range of golden paintbrush, which includes sections of each loop that passes through the Puget Trough (WNHP, 2013a; FWS, 2010a). However, there are no historical occurrences of golden paintbrush near the project area (WNHP, 2013b). Native grasslands and prairie would not be present in the construction right-of-way.

Water Howellia

The FWS listed water howellia as threatened in 1994 (FWS, 1994). No critical habitat has been designated for this species. In 1994, water howellia was known from 107 populations scattered across California, Oregon, Washington, Idaho, and Montana. Today, there are 17 known populations of water howellia in Pierce and Thurston Counties (WNHP, 2013b). The WEP would not be near any of these known populations.

Water howellia is a rooted aquatic annual plant with abundant small leaves and diffused or floating branches (WNHP, 2013a). Water howellia has narrow habitat requirements, occurring in small, shallow (typically less than 3 feet deep) ephemeral freshwater ponds and wetlands (FWS, 1994, 2013h; Mincemoyer, 2005). This plant is particularly sensitive to changes in moisture regime because its seeds require exposure to air in the fall for germination and inundation in the spring for growth (Center for Plant Conservation, 2013; WNHP, 2013a) restricting habitat to seasonally inundated zones that dry out toward the end of the growing season, or the fringes of perennial ponds (WNHP, 2013a). It is most often found in small vernal ponds, glacial pothole ponds, and abandoned river oxbows that are fed by spring rains and snowmelt runoff (FWS, 1994; WNHP, 2013a); these types of habitat do not occur along the existing pipeline right-of-way.

The Washington Natural Heritage Program rare plant data indicates no historical occurrences of water howellia near the project area (WNHP, 2013b). Habitat for this species includes low-elevation ponds and wetlands, but because water howellia requires undisturbed wetlands with deciduous forest canopies and specific hydrologic regimes, it is not likely to be found in wetlands within the project area. Northwest surveyed five ponds near the Sumner North B and Snohomish Loops but did not detect water howellia. Wetlands within the existing pipeline right-of-way are generally emergent and have been altered from their natural hydrologic regimes. The existing right-of-way is actively maintained every 2 years to limit tree and shrub growth, which promotes an emergent growth pattern. This maintenance, along with adjacent residential, commercial, industrial, and agricultural development, has increased exposure to nonnative species that could out-compete water howellia.

Kincaid's Lupine

In 2000, the FWS designated threatened status for Kincaid's lupine (FWS, 2000c). Critical habitat was designated in 2006 in Benton, Lane, Polk and Yamhill Counties in Oregon, and Lewis County in Washington (FWS, 2006b). Historically, this species ranged from southern Oregon to Vancouver

Island in British Columbia (Center for Plant Conservation, 2013; FWS, 2000c). In Washington, this species is known to occur at four locations in Lewis County (WNHP, 2013b). The WEP would not be near these populations and would not cross critical habitat.

Kincaid's lupine is a rhizomatous herbaceous perennial with numerous light blue flowers. It inhabits native dry upland prairies and open oak woodlands that were historically maintained by fire. Primary threats to this species include habitat loss, elimination of historical disturbance regimes (fire), and competition from nonnative species (Center for Plant Conservation, 2013; FWS, 2010; WNHP, 2013a).

The historical range of Kincaid's lupine overlaps the project area, but the WEP would not be near any known occurrences of Kincaid's lupine (WNHP, 2013b). Northwest identified four areas along the proposed WEP route with low to moderate habitat potential for Kincaid's lupine. Surveys found no Kincaid lupine in areas that would be disturbed by the WEP but an incidental observation of Kincaid's lupine was recorded outside of the proposed construction right-of-way, about 0.5 mile from MP 1283.0. The project area does not contain native prairie habitat, and adjacent development has altered the remaining remnant prairies (limiting fire). The ongoing maintenance of the existing right-of-way further precludes the development of native prairie because it typically increases the density of plant growth of competing species, limiting the potential for this species to establish.

Nelson's Checker-mallow

The FWS designated Nelson's checker-mallow as threatened in 1993 (FWS, 1993b). No critical habitat has been designated for this species. The historical and the known current range of this species extends from the Willamette Valley in Oregon to Lewis County in Washington. At the time of listing, Nelson's checker-mallow was known to occur at 49 sites, only 2 of which were in Washington (WNHP, 2013b). No WEP facilities are proposed near these populations, which are in Cowlitz and Lewis Counties.

Nelson's checker-mallow is a perennial herb with pinkish lavender flowers and rhizomatous growth pattern (WNHP, 2013a). It prefers habitats that have seasonally wet soils in open, low-elevation areas that include grass meadows, drier sedge meadows, prairies, and grasslands (Center for Plant Conservation, 2013; WNHP, 2013a). It is also found in fringe areas between prairies and woodlands; along fencerows, streams, roadsides, and drainage swales; and along the edges of plowed fields adjacent to wooded areas (WNHP, 2013a).

Portions of the Woodland and Chehalis Loops in Lewis County would cross the historic range of Nelson's checker-mallow but the WEP would not be near any known occurrences of Nelson's checker-mallow (WNHP, 2013b). Northwest surveyed potentially suitable habitat in Lewis County near the proposed construction right-of-way but did not detect Nelson's checker-mallow or open prairie habitat. Potential sites surveyed by Northwest were found to have low suitability for Nelson's checker-mallow due to the prevalence of nonnative species and dense vegetation that is not typical of the prairie habitat preferred by Nelson's checker-mallow. The ongoing maintenance of the existing right-of-way further precludes the development of native prairie because it more often increases the density of plant growth of competing species, limiting the potential for this species to become established. The project area does not contain native prairie habitat and adjacent development has altered the remaining remnant prairies (limiting fire). Based on the lack of prairie habitat near the project and survey results by Northwest, we conclude that it would be highly unlikely for Nelson's checker-mallow to be encountered during the WEP construction.

Impacts

Impacts on federally listed plant species would be similar to those described in the vegetation section (4.2.6). General vegetation disturbance caused by the construction and ongoing maintenance of the right-of-way could directly affect listed species if they are present. The WEP construction would occur in areas that were previously disturbed by pipeline installation and are maintained through maintenance actions like mowing every 1 to 3 years, but it is possible that populations of these species could exist within the project area because the pipeline would cross historical ranges of these rare plants. The WEP construction could damage current populations and prevent the establishment and development of any new populations or suitable habitat in the project area.

Fugitive dust from access roads could impede plant growth, which indirectly could lead to further reduced plant growth in the future and mortality. Other WEP activities that could impact federally listed plants could include the introduction of invasive and noxious weeds through associated disturbances and site maintenance and continued habitat fragmentation caused by the continued use of the right-of-way.

We believe the likelihood that rare plants would be encountered along the WEP right-of-way is low as the existing right-of-way has been in use and maintained for a number of years, establishing a baseline condition that does not meet habitat criteria for any of the listed species. Also, there are no known current or historical records of federally listed plant species in the project area.

Mitigation

Northwest would conduct preconstruction surveys in areas of potential habitat for the listed plant species within the project area. These surveys would be scheduled to encompass the complete range of bloom times for these species in the year prior to pipeline construction. If found, Northwest would consult with the FWS regarding avoidance measures.

Effect Determination

We believe that the presence of federally listed plants within the project area is unlikely but not discountable. Therefore we determined that the WEP ***may affect, but would not likely adversely affect*** golden paintbrush, water howellia, Kincaid's lupine, and Nelson's checker-mallow. The project area is within the historical and current range of each of the species; however, the project area for these species has been previously disturbed and maintained over the last 40 years, limiting the availability of native habitats. Because critical habitat for Kincaid's lupine and Nelson's checker-mallow does not occur within the project area, the proposed action would have ***no effect*** on critical habitat for these species.

4.2.8.2 State Listed and Other Special Status Species

Washington has its own ESA and lists 24 species as endangered and 17 species as threatened statewide. Many of these state-listed species are also federally listed (see table 4.2.8-1) and are discussed in the previous section. In this section, we consider those state-listed species that may occur in the project area but are not addressed above.

The Washington State PHS database contains records of special-status species, including bald eagles. For additional PHS sensitive species and state candidate species, see appendix L. The mitigation measures proposed by Northwest would meet the PHS Management Recommendations, with the following exceptions which are not applicable to the project: limit or eliminate livestock grazing, construct power lines using latest Avian Power Line Interaction Committee standards to avoid electrocution of birds, and remove unused fencing.

Mammals

WDFW lists 25 mammals as threatened or endangered. Two of these species, the fisher and western gray squirrel, may occur in the project area.

The West Coast DPS of fisher is a federal candidate and state endangered species. It is associated with montane forests that have a high percentage of canopy closure, abundant LWD, large snags and cavity trees, and understory vegetation. No potential habitat for this species occurs in the project area.

Western gray squirrel is a federal species of concern and state threatened species. Western gray squirrel is primarily associated with oak woodlands but can also be found in transitional forests of mature Oregon white oak, ponderosa pine, and Douglas-fir. Oak woodlands are limited to one small habitat patch in the Sumner South Loop but this species is not expected in the project area.

Birds

WDFW lists 11 birds as threatened or endangered. Of these species, only marbled murrelet, streaked horned lark, and northern spotted owl could potentially occur in the project area; these species are also federally listed and described above.

Amphibians and Reptiles

Oregon spotted frog and northwestern pond turtle are listed by WDFW and could potentially occur in the project area. Oregon spotted frog is also federally listed and discussed above.

Northwestern pond turtle is a federal species of concern and a state endangered species associated with ponds and lakes. This species is primarily aquatic, but it also requires terrestrial habitat to lay eggs, disperse to new waterbodies, and overwinter. Northwestern pond turtles nest from May to mid-July. There are only four known populations in Washington: two natural populations and two introduced by the WDFW. Suitable pond and lake habitat within the species' range would be in the Woodland, Chehalis, Sumner South, Sumner North A, Sumner North B, and Snohomish Loops. Potential impacts on the pond turtle would be similar to those described for Oregon spotted frog in section 4.2.8.1.

Fish

Pacific and river lamprey are Washington PHS and federal species of concern (FWS, 2009). Both species occur in the general WEP area, but are most likely found in the lower reaches of the large intermediate and major waterbodies. Pacific lamprey is an anadromous fish that spawns in the spring on gravel and sandy stream substrates. Newly hatched individuals move to backwater areas with low water velocities and organic sediments, and they remain in freshwater for 4 to 6 years before migrating to marine waters (Close et al., 1995). Adult Pacific lamprey return to spawn after 1 or more years at sea. River lamprey are smaller than Pacific lamprey, but have a similar life history (Wydoski and Whitney, 2003).

Olympic mudminnow is a state-designated sensitive species of concern due to its restricted range, primarily in the Chehalis and lower Deschutes River basins and in streams on the central Washington coast north of Grays Harbor (Wydoski and Whitney, 2003). The WDFW PHS database indicates that Olympic mudminnows also may be found in the lower Cowlitz and Puyallup watersheds. They are usually found in slow-moving streams, wetlands, and ponds. Within these habitats, Olympic mudminnows require a muddy bottom, little or no water flow, and abundant aquatic vegetation (Mongillo

and Hallock, 1999). Mudminnow spawning occurs over an extended period from November through May, subsiding during the colder winter months (Wydoski and Whitney, 2003). Because of the species' preference for quiet water and its limited range within the project area, it is unlikely that it would occur at any of the WEP stream crossings.

Leopard dace is a candidate species for the state's sensitive species list. It is a Columbia River Basin fish found primarily east of the Cascades, but it is believed to occur in the Cowlitz River Basin. It is unknown whether leopard dace would occur at the WEP stream crossings in the Cowlitz River Basin. However, the Cowlitz River crossing is proposed to be an HDD crossing; therefore, no habitat impacts would be expected.

Kokanee salmon are sockeye salmon that spend their entire life in freshwater. The Lake Sammamish kokanee population is believed to be of natural origin, and spawns in August and early September in Issaquah Creek and the East Fork of Issaquah Creek (Berge and Higgins, 2003). Both of these creeks would be crossed by the WEP. Although kokanee salmon occur in many lakes in Washington, only the population in Lake Sammamish, east of Seattle, is a state species of concern.

Potential impacts on state-listed and other special-status fish, if present in waterbodies crossed by the WEP pipeline, would be identical to those presented in section 4.2.5.2 for Aquatic Resources. Mitigation for impacts on state-listed and other special-status fish would be similar to that described in section 4.2.5.2. The fish protection measures that would be in place to protect salmonids would also be protective for these special-status species, if present.

Invertebrates

WDFW lists three butterflies as endangered: Taylor's checkerspot, mardon skipper, and Oregon silverspot. Taylor's checkerspot butterfly is also federally listed and discussed above. Oregon silverspot butterfly is presumed to be extirpated from Washington. Mardon skipper is a state endangered species that is endemic to the Pacific Northwest. It primarily inhabits open grasslands on glacial outwash prairies, as well as openings and ridgetops within ponderosa pine woodlands. Idaho fescue is the suspected host plant. No potential habitat for Mardon skipper occurs in the project area, and therefore, no impacts would be expected.

Plants

The Washington Natural Heritage Program database indicates the possible presence of a number of listed plant species in the vicinity of the project area, but there are no records of state listed plants within the existing right-of-way. Hairy-stemmed checker-mallow is the only state threatened plant species that could occur along the WEP. This perennial herb is commonly associated with large-leaved lupine, bracken fern, oxeye daisy, oceanspray, and Nootka rose. It blooms from early June to mid-July. This species could potentially be found along the forest and cropland edges outside the exiting right-of-way within the Woodland Loop. Potential impacts on the state-listed hairy-stemmed checker-mallow would be identical to those described above for federally listed plants.

4.2.9 Land Use, Recreation, and Visual Resources

4.2.9.1 Land Use

Northwest's WEP would consist of 10 loops and modifications to existing compressor stations in Cowlitz, Lewis, Thurston, Pierce, King, Snohomish, Skagit, and Whatcom Counties. We received comments regarding fair compensation for timber clearing on private land and effects on property values.

Northwest would minimize impacts on the environment and land uses, including residential areas, by constructing the pipeline within or adjacent to the existing Northwest Pipeline right-of-way, to the extent practicable. Table 4.2.9-1 identifies locations where the pipeline route would be collocated within the existing right-of-way, which would comprise a total of about 132.0 miles (94 percent) of the pipeline.

Land use impacts would include the disturbance of existing land uses within the construction right-of-way during construction and retention of the permanent right-of-way for operation. Northwest proposes to use a 95-foot-wide construction right-of-way for the majority of the pipeline route. The construction right-of-way would partially overlap Northwest's existing permanent right-of-way, which is typically 75 feet wide and contains an abandoned 26-inch-diameter pipeline, an operational 30-inch-diameter pipeline, and in some instances, an operational 36-inch-diameter pipeline.

In some areas, where the right-of-way is constrained, Northwest would remove the abandoned 26-inch-diameter pipeline and place the new 36-inch-diameter pipeline in the same trench, reducing the construction right-of-way to between 60 and 75 feet. When crossing high quality and forested wetlands, the construction right-of-way would be reduced to a width of 75 feet, except where Northwest has requested use of alternative measures. In cases of long wetland crossings where a 75-foot-wide construction right-of-way would pose logistical concerns, Northwest would use an 85-foot-wide construction right-of-way.

Following construction, the existing, permanent 75-foot-wide right-of-way would be maintained for operation and maintenance of the pipeline. Typical right-of-way cross sections for the pipeline route are provided in appendix I2.

In addition to the construction right-of-way, Northwest would require ATWS outside the standard construction right-of-way at locations where additional space is necessary for excavation, soil placement, or equipment management and staging. The size and configuration of each ATWS is unique and dependent on existing site conditions at each work location (e.g., available or accessible space, the presence of buildings and other structures, crossing angle, crossing depth, length of crossing, terrain, the presence of trees or sensitive habitat). Construction of the pipeline would require about 442 ATWS, which would temporarily impact about 418.9 acres of land. The ATWS are listed in appendix I4.

Table 4.2.9-1

WEP Pipeline Collocation within Existing Northwest Pipeline Right-of-way

	Milepost		
Loop	**Begin**	**End**	**Length (miles)**
Woodland	1244.3	1259.0	14.7
	1259.0	1260.2	1.2
	1260.4	1262.2	1.8
	1262.2	1262.4	0.2
	1262.5	1262.6	0.1
	1262.6	1269.5	6.9
	1269.6	1274.2	4.6
	1275.9	1277.8	1.9
	1278.2	1282.3	4.1
	1282.4	1282.4	0.0
	1282.6	1282.6	0.0
	1282.7	1286.4	3.8
	1286.8	1289.5	2.8
Chehalis	1291.3	1293.9	2.7
	1294.3	1294.5	0.2
	1294.5	1295.4	0.8
	1295.4	1309.3	13.9
	1309.4	1309.8	0.4
	1310.5	1311.5	1.0
	1311.9	1315.6	3.8
Sumner South	1338.0	1339.1	1.1
	1339.2	1347.7	8.5
	1348.0	1349.1	1.1
	1349.3	1351.8	2.5
Sumner North A	1356.9	1362.7	5.8
	1362.8	1363.9	1.2
Sumner North B	1370.9	1374.2	3.3
	1374.3	1379.1	4.8
	1379.1	1381.3	2.1
	1381.5	1381.9	0.4
Snohomish	1393.9	1397.1	3.2
	1397.9	1404.4	6.5
	1404.8	1404.9	0.1
	1404.9	1405.0	0.0
	1405.1	1409.4	4.3
Mt. Vernon South	1435.7	1437.2	1.6
	1437.4	1439.0	1.6
	1439.2	1440.1	0.9
	1440.1	1440.2	0.1
Mt. Vernon North A	1440.2	1445.0	4.8
Mt. Vernon North B	1453.5	1453.7	0.1
	1453.7	1461.4	7.7
	1461.9	1461.9	0.0

Table 4.2.9-1

WEP Pipeline Collocation within Existing Northwest Pipeline Right-of-way

	Milepost		
Loop	**Begin**	**End**	**Length (miles)**
Sumas	1478.6	1479.0	0.4
	1479.0	1479.3	0.3
	1479.5	1480.0	0.5
	1480.0	1480.9	0.9
	1481.1	1481.7	0.6
	1481.8	1483.1	1.3
	1483.1	1484.5	1.4
Total			**132.0**

Northwest would construct associated aboveground facilities including MLVs, pig launchers and receivers, and modifications of five existing compressor stations. Section 2.2.1.2 provides a description of the proposed aboveground facilities, which would generally be within Northwest's existing permanent right-of-way.

Northwest would access the construction and operation rights-of-way and aboveground facilities via 221 intersecting existing public and private roads. The majority of these access roads are currently used by Northwest to operate and maintain the existing pipeline and facilities. Of these, 179 are existing roads currently used by Northwest operations personnel for right-of-way, pipeline, or facility maintenance, which would continue to be used during construction and operation. Thirty-five existing roads would be used only for construction. An additional seven existing roads may be used by Northwest for construction and operation. There would be no improvements to these roads. No new permanent access roads would be needed for operation of the WEP. Access roads are listed in appendix I5.

Northwest's construction contractor would need contractor and pipe storage yards outside of the construction right-of-way to store pipe and equipment and for temporary contractor office space. Northwest identified four existing contractor and pipe storage yards for potential use during the construction of the pipeline. The sites were selected because they are existing industrial land uses that have been previously graded and graveled and are proximate to the pipeline route.

The WEP pipeline would cross a variety of land use categories, including forested areas, agricultural lands, wetlands, barren land, existing rights-of-way, open water, commercial/industrial lands, and residential lands. The WEP would also cross about 73.6 miles (52.3 percent) of forest land, including upland and industrial deciduous, evergreen, and mixed forests. About 19.5 miles (13.8 percent) of agricultural land would be crossed, including cropland, pasture, nurseries, and other agricultural lands. The pipeline would cross about 17.4 miles (12.4 percent) of forested and nonforested wetlands; 1.7 miles (1.2 percent) of barren land, including beaches and mines; and 7.3 miles (5.2 percent) of existing rights-of-way for roads, railroads, and utility corridors. About 0.7 mile (0.5 percent) of open water would be crossed. Finally, the WEP would cross about 1.2 mile (0.8 percent) of commercial/industrial land as well as 19.4 miles (13.4 percent) of residential land, including residential yards, residential subdivisions, and planned new residential developments.

The WEP would affect about 2,051.6 acres of land during construction as a result of the temporary and permanent rights-of-way, ATWS, aboveground facilities, compressor station modifications, and contractor and pipe storage yards. About 1,267.1 acres (64 percent) of these areas would be retained permanently during operation, including about 49.4 acres for compressor station

operation. However, most of the land that would be impacted by the WEP would be within Northwest's existing pipeline right-of-way or within the existing compressor station footprints. No additional land would be required or permanently disturbed by the modifications to the existing compressor stations. Only about 676.0 acres of land outside of the existing right-of-way would be disturbed. Because much of the WEP would be within the existing right-of-way, existing land uses would not be affected permanently. -2 summarizes land requirements by land use category during construction for the project and table 4.2.9-3 summarizes land requirements by land use category during operation.

Table 4.2.9-4 lists the above-ground facilities that would be installed or removed as part of the WEP and their associated land uses. These MLVs, pig launchers/receivers, and meter stations would be within the pipeline construction right-of-way or existing compressor station footprints. Therefore, the associated acreages for their construction are already accounted for in -2. During operation, these facilities would be within the permanent operational pipeline right-of-way or existing compressor station footprints and the acreages are accounted for in table 4.2.9-3.

Table 4.2.9-2

Land Requirements Associated with the WEP Construction (Acres)

New Facility	Mileposts	Forest [b]	Agricultural [c]	Wetland [d]	Barren Land [e]	Right-of-way [f]	Open Water [g]	Commercial/ Industrial [h]	Residential [i]	Total
Pipeline [a]										
Woodland Loop	1244.3-1289.5	350.5	54.2	42.7	12.8	10.1	2.1	—	34.2	506.6
Chehalis Loop	1291.3-1315.6	177.8	25.5	52.1	5.8	11.5	0.8	—	3.0	276.5
Sumner South Loop	1338.0-1351.8	33.9	14.6	9.3	—	12.3	0.1	9.3	54.0	133.5
Sumner North A Loop	1356.9-1363.9	31.1	3.8	4.2	—	8.3	—	0.2	27.1	74.7
Sumner North B Loop	1370.9-1381.9	48.2	—	9.4	—	10.0	0.1	2.2	45.7	115.6
Snohomish Loop	1393.8-1409.4	83.8	39.3	18.4	—	7.1	0.9	—	18.7	168.2
Mt. Vernon South Loop	1435.7-1440.2	30.9	6.2	9.7	—	2.6	0.1	—	1.8	51.3
Mt. Vernon North A Loop	1440.2-1445.0	31.7	13.8	6.1	—	2.6	0.1	—	0.1	54.4
Mt. Vernon North B Loop	1453.5-1461.9	49.1	19.7	15.1	—	5.7	0.3	—	1.9	91.8
Sumas Loop	1478.6 -1484.5	16.1	43.9	5.6	—	2.5	0.3	—	0.3	68.7
Pipeline Loop Subtotal		**853.1**	**221.0**	**172.6**	**18.6**	**72.7**	**4.8**	**11.7**	**186.8**	**1541.3**
ATWS										
Woodland Loop	Various	30.6	38.6	4.8	27.7	6.4	4.6	—	3.3	116.0
Chehalis Loop	Various	17.7	26.2	16.7	1.2	1.8	—	—	0.5	64.1
Sumner South Loop	Various	3.5	28.4	9.9	—	9.1	—	4.7	6.5	62.1
Sumner North A Loop	Various	4.0	2.3	0.4	—	2.4	—	—	2.0	11.1
Sumner North B Loop	Various	9.3	0.7	0.4	—	3.1	—	0.2	2.2	15.9
Snohomish Loop	Various	11.0	16.9	4.9	—	6.8	0.2	—	0.2	40.0
Mt. Vernon South Loop	Various	4.2	2.3	0.8	—	11.8	—	—	0.3	19.4
Mt. Vernon North A Loop	Various	2.1	4.5	—	—	1.4	—	—		8.0
Mt. Vernon North B Loop	Various	3.1	10.3	0.4	—	0.9	0.1	—	0.3	15.1
Sumas Loop	Various	1.0	37.2	4.7	—	23.4	—	—	0.9	67.2
ATWS Subtotal		**86.5**	**167.4**	**43.0**	**28.9**	**67.1**	**4.9**	**4.9**	**16.2**	**418.9**
Pipeline Loop and ATWS Total										**1,960.2**
Contractor and Pipe Storage Yards										
Battleground District Office Yard	NA	—	—	—	—	—	—	3.5	—	3.5
Fredrickson Pipe Yard	NA	—	—	—	—	—	—	13.9	—	13.9
Redmond District Office Yard	NA	—	—	—	—	—	—	3.0	—	3.0
Sumas Pipe Yard	NA	—	—	—	—	—	—	11.8	—	11.8
Contractor and Pipe Storage Yards Total		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**32.3**	**0.0**	***32.3***

Table 4.2.9-2

Land Requirements Associated with the WEP Construction (Acres)

New Facility	Mileposts	Forest [b]	Agricultural [c]	Wetland [d]	Barren Land [e]	Right-of-way [f]	Open Water [g]	Commercial/ Industrial [h]	Residential [i]	Total
Compressor Station Modifications [j]										
Chehalis	1289.5	—	4.2	2.2	—	5.2	—	—	—	11.6
Sumner	1351.8	—	—	—	—	5.3	—	—	0.4	5.7
Snohomish	1394.0	1.5	—	—	—	5.3	—	—	—	6.8
Mt. Vernon	1440.1	—	1.1	0.3	—	10.8	—	—	—	12.2
Sumas	1484.5	—	—	—	—	22.8	—	—	—	22.8
Compressor Station Modifications Total		**1.5**	**5.3**	**2.5**	**0.0**	**49.4**	**0.0**	**0.0**	**0.4**	**59.1**
Project Construction Total		**941.1**	**393.7**	**218.1**	**47.5**	**189.2**	**9.7**	**48.9**	**203.4**	**2051.6**

Actual numbers may vary slightly because of rounding

[a] Construction impacts include permanent right-of-way, temporary right-of-way, with the pipeline construction corridor. Assumes a 95-foot-wide construction right-of-way in upland areas; 60- to 75-foot-wide where right-of-way is constrained; 85-foot-wide for long wetland crossings.

[b] Includes deciduous, evergreen, and mixed forests.

[c] Includes cultivated fields/crop lands, nurseries, pastureland, hayfields, and other agricultural land.

[d] Includes agricultural, scrub-shrub, emergent, forested, and estuarine wetlands. Land cover type; not representative of jurisdictional wetlands.

[e] Includes beaches, strip mines, quarries, and gravel pits.

[f] Includes roads, railroads, and utility corridors perpendicularly crossed by the pipeline. Land cover type; not representative of Northwest's right-of-way.

[g] Includes perennial waterbodies greater than 100 feet wide.

[h] Includes manufacturing or industrial plants, commercial, and services.

[i] Includes residential yards, residential subdivisions, and planned new residential developments.

[j] Acreages provided for compressor stations comprise the entire existing compressor station parcel.

Table 4.2.9-3

Land Requirements Associated with the WEP Operation (Acres)

Loop [a]	Mileposts	Forest [b]	Agricultural [c]	Wetland [d]	Barren Land [e]	Right-of-way [f]	Open Water [g]	Commercial/ Industrial [h]	Residential [i]	Total
Woodland Loop	1244.3-1289.5	268.7	45.6	39.9	10.6	8.4	1.9	—	28.6	403.7
Chehalis Loop	1291.3-1315.6	132.1	17.6	43.0	4.0	9.3	0.6	—	2.5	209.1
Sumner South Loop	1338.0-1351.8	26.7	11.4	8.3	—	10.2	0.1	8.3	48.3	113.3
Sumner North A Loop	1356.9-1363.9	23.8	3.0	4.0	—	6.9	—	0.1	24.0	61.8
Sumner North B Loop	1370.9-1381.9	37.5	—	8.4	—	9.3	0.1	2.0	41.9	99.2
Snohomish Loop	1393.8-1409.4	67.6	29.1	14.1	—	5.8	0.9	—	15.6	133.1
Mt. Vernon South Loop	1435.7-1440.2	24.3	5.1	8.0	—	2.1	0.1	—	1.5	41.1
Mt. Vernon North A Loop	1440.2-1445.0	25.0	10.8	5.1	—	1.9	0.1	—	0.1	43.0
Mt. Vernon North B Loop	1453.5-1461.9	38.2	11.7	9.6	—	4.5	0.2	—	1.4	65.6
Sumas Loop	1478.6-1484.5	12.2	28.8	4.7	—	1.6	0.2	—	0.3	47.8
Pipeline Total		**656.1**	**163.1**	**145.1**	**14.6**	**60.0**	**4.2**	**10.4**	**164.2**	**1217.7**
Compressor Station Modifications [j]										
Chehalis	1289.5	—	—	—	—	5.2	—	—	—	5.2
Sumner	1351.8	—	—	—	—	5.3	—	—	—	5.3
Snohomish	1394.0	—	—	—	—	5.3	—	—	—	5.3
Mt. Vernon	1440.1	—	—	—	—	10.8	—	—	—	10.8
Sumas	1484.5	—	—	—	—	22.8	—	—	—	22.8
Compressor Station Modifications Total		**0.0**	**0.0**	**0.0**	**0.0**	**49.4**	**0.0**	**0.0**	**0.0**	49.4
Project Operations Total		**656.1**	**163.1**	**145.1**	**14.6**	**109.4**	**4.2**	**10.4**	**164.2**	**1267.1**

Actual numbers may vary slightly because of rounding

[a] Assumes a 75-foot-wide permanent right-of-way for the pipeline.

[b] Includes deciduous, evergreen, and mixed forests.

[c] Includes cultivated fields/crop lands, nurseries, pastureland, hayfields, and other agricultural land.

[d] Includes agricultural, scrub-shrub, emergent, forested, and estuarine wetlands. Land cover type; not representative of jurisdictional wetlands.

[e] Includes beaches, strip mines, quarries, and gravel pits.

[f] Includes roads, railroads, and utility corridors perpendicularly crossed by the pipeline. Land cover type; not representative of Northwest's right-of-way.

[g] Includes perennial waterbodies greater than 100 feet wide.

[h] Includes manufacturing or industrial plants, commercial, and services.

[i] Includes residential yards, residential subdivisions, and planned new residential developments.

[j] Acreages provided for compressor stations comprise the existing operational area.

Table 4.2.9-4

Land Uses Associated with the WEP Aboveground Facilities

New Facility (Removed Facility) [a]	Mileposts	Forest [b]	Agricultural [c]	Wetland [d]	Barren Land [e]	Right-of-way [f]	Open Water [g]	Commercial / Industrial [h]	Residential [i]	Total
Woodland Loop										
Pig Launcher/Receiver, MLV	1244.3	—	<0.1	0.4	—	—	—	—	—	0.4
MLV	1246.9	0.1	—	—	—	0.1	—	—	—	0.2
(26" MLV)	1247.7	—	—	—	—	—	—	—	—	—
MLV	1255.8	0.1	—	—	—	—	—	—	0.1	0.2
MLV	1262.6	—	—	—	—	—	—	—	0.3	0.3
(26" MLV)	1264.0	—	—	—	—	—	—	—	—	—
MLV	1269.6	0.3	—	—	—		—	—	—	0.3
MLV (26" MLV)	1280.3	—	—	0.1	—	0.1	—	—	—	0.2
Pig Launcher/Receiver, MLV (26" MLV) [j]	1289.5	—	—	—	—	—	—	—	—	—
Chehalis Loop										
Pig Launcher/Receiver, MLV	1291.3	—	0.5	—	—	—	—	—	—	0.5
MLV (26" MLV)	1295.6	—	—	—	—	0.2	—	—	0.1	0.3
MLV (26" MLV)	1309.8	—	—	—	—	0.3	—	—	—	0.3
(36" MLV)	1315.6	0.1	<0.1	—	—	0.4	—	—	—	0.6
Sumner South Loop										
(36" Pig Launcher/Receiver)	1338.0	—	—	—	—	0.4	—	—	—	0.4
(26" MLV)	1339.2	—	—	—	—	—	—	—	—	—
MLV	1343.6	—	—	—	—	—	—	—	0.2	0.2
MLV	1346.9	0.2	—	—	—	—	—	—	—	0.2
(26" MLV) [j]	1351.7	—	—	—	—	—	—	—	—	—
(36" Pig Launcher/Receiver, 26" MLV) [j]	1351.8	—	—	—	—	—	—	—	—	—
Sumner North A Loop										
Pig Launcher/Receiver, MLV	1356.9	—	0.4	—	—	0.1	—	—	—	0.5
MLV	1358.0	0.1	—	—	—	—	—	—	0.1	0.2
(26" MLV)	1361.6	—	—	—	—	0.2	—	—	—	0.2
(36" Pig Launcher/Receiver)	1363.9	—	—	—	—	0.4	—	—	—	0.4
Sumner North B Loop										
(36" Pig Launcher/Receiver)	1370.9	0.4	—	—	—	—	—	—	—	0.4
MLV	1379.2	—	—	—	—	0.7	—	—	—	0.7
(36" Pig Launcher/Receiver)	1381.9	0.4	—	<0.1	—	—	—	—	—	0.4

Table 4.2.9-4

Land Uses Associated with the WEP Aboveground Facilities

New Facility (Removed Facility) [a]	Mileposts	Forest [b]	Agricultural [c]	Wetland [d]	Barren Land [e]	Right-of-way [f]	Open Water [g]	Commercial / Industrial [h]	Residential [i]	Total
Snohomish Loop										
Pig Launcher/Receiver, MLV (26" Pig Launcher/Receiver, 26" MLV) [j]	1394.0	—	—	—	—	—	—	—	—	—
MLV	1398.0	0.3	—	—	—	0.1	—	—	—	0.4
MLV (26" MLV)	1405.2	0.2	—	—	—	<0.1	—	—	—	0.2
(36" Pig Launcher/Receiver)	1409.4	—	—	—	—	0.4	—	—	—	0.4
Mt. Vernon South Loop										
Pig Launcher/Receiver, MLV	1435.7	0.4	—	—	—	0.1	—	—	—	0.5
Pig Launcher/Receiver, MLV [j]	1440.1	—	—	—	—	—	—	—	—	—
Mt. Vernon North A Loop										
Pig Launcher/Receiver, MLV (26" Pig Launcher/Receiver, 26" MLV) [j]	1440.2	—	—	—	—	—	—	—	—	—
MLV	1444.8	0.3	—	—	—	—	—	—	—	0.3
(36" Pig Launcher/Receiver)	1445.0	—	3.1	—	—	1.0	—	—	—	4.1
Mt. Vernon North B Loop										
(36" Pig Launcher/Receiver)	1453.5	—	—	—	—	0.3	—	—	0.1	0.4
MLV (26" MLV)	1456.6	0.1	—	—	—	0.1	—	—	—	0.2
(36" Pig Launcher/Receiver)	1461.9	—	0.1	—	—	0.4	—	—	—	0.5
Sumas Loop										
Pig Launcher/Receiver, MLV	1478.6	—	0.3	—	—	0.2	—	—	—	0.5
Pig Launcher/Receiver, MLV, Meter Station (Meter Station) [j]	1484.5	—	—	—	—	—	—	—	—	—

Actual numbers may vary slightly because of rounding

[a] Installation and removal of MLVs, pig launchers/receivers, and meter stations would occur within the pipeline construction right-of-way or existing compressor station footprints. Therefore, these acreages are already accounted for in the land requirement acreages shown in **Error! Not a valid result for table.** for construction. During operation, these facilities would occur within the permanent right-of-way or existing compressor station footprints and the acreages are accounted for in table 4.2.9-3.

[b] Includes deciduous, evergreen, and mixed forests.

[c] Includes cultivated fields/crop lands, nurseries, pastureland, hayfields, and other agricultural land.

[d] Includes agricultural, scrub-shrub, emergent, forested, and estuarine wetlands.

[e] Includes beaches, strip mines, quarries, and gravel pits.

[f] Includes roads, railroads, and utility corridors perpendicularly crossed by the pipeline.

[g] Includes perennial waterbodies greater than 100 feet wide.

[h] Includes manufacturing or industrial plants, commercial, and services.

[i] Includes residential yards, residential subdivisions, and planned new residential developments.

[j] Construction would occur within existing compressor station.

Forest Lands

Construction of the pipeline and aboveground facilities would require the clearing of trees, affecting about 941.1 acres of forest land. Trees and shrubs within the right-of-way, construction work areas, and aboveground facility yards would be cleared; however, impacts are not expected to differ significantly from existing conditions. About 70 percent of the pipeline and ATWS would be collocated within Northwest's existing permanent right-of-way.

The 298.6 acres of new disturbance to forest land would include the clearing of timber from both public and private lands. As part of pipeline construction, Northwest would sell merchantable timber and related forest products on nonfederal forest lands in Washington. A forest practice permit is required from the applicable state or county whenever more than 5,000 board feet of merchantable timber is harvested from an area or property. Northwest would obtain Class IV-General forest practice permits from the administering counties and follow all applicable policies and procedures prior to conducting commercial harvest of forest products. Northwest would coordinate with landowners and land managing agencies to ensure proper compensation for merchantable timber cleared for construction. Northwest would notify the State Forester prior to each operation on forest land, and it would submit written plans if any operations occur in or near designated sensitive resource areas. Timber removal would follow standard logging practices and Forest Practices Act regulations. Merchantable timber would be stacked along the cleared right-of-way or within ATWS. Trucks would haul merchantable timber to market from the yards (see section 4.2.6.3 for more detail on merchantable timber).

Northwest would compensate landowners and agencies for removal of trees in new rights-of-way and ATWS. This compensation would be worked out through negotiations between the landowners or land managing agencies and Northwest's land representatives. To determine proper landowner compensation, all forested work areas would be analyzed by an authorized timber economist.

Following construction, construction area revegetation would occur in accordance with Northwest's Plan, Procedures, ECRP, the *Oregon & Washington Guide for Conservation Seedings and Plantings* (NRCS, 2000), restoration plans developed with federal, state, and local agencies, and landowner requests. Northwest has consulted with NRCS about the most appropriate seeding mixtures, seeding dates, and practices to optimize the success of restoration.

During operation of the pipeline, Northwest would continue to maintain about 656.1 acres of forest land in an herbaceous state within the pipeline right-of-way and facility areas, consistent with existing conditions.

Herbaceous vegetation and some shrubs would grow back to preconstruction conditions within 1 to 3 years. Permanent impacts would occur on woody species where vegetation is maintained within the permanent right-of-way. Outside of the permanent right-of-way, the loss of large trees would result in long-term impacts. Section 4.2.6.2 provides more information on impacts, restoration, and revegetation of forest lands.

Agricultural Lands

Construction of the pipeline and aboveground facilities would affect about 393.7 acres of agricultural lands, including about 5.3 acres of agricultural lands occurring within compressor station parcels where modifications would be made. Of the agricultural land affected during construction, about 184.4 acres would be new disturbance. About 163.1 acres would be permanently impacted during operation, consistent with existing conditions.

Potential temporary impacts on agricultural land include increased soil erosion, soil compaction and rutting, damage to drain tiles and irrigation facilities, spread of noxious weeds and soil pathogens, and disruption of agricultural activities. Potential long-term effects include reduction in agricultural productivity following construction. Construction impacts would generally be temporary and short term. Northwest would use methods described in its Plan and ECRP to avoid or minimize impacts on, and to restore agricultural lands, prime farmland, and farmland of statewide importance.

In accordance with its Plan, Northwest would segregate topsoil either from the full work area or from the trench and subsoil storage area in parts that are actively cultivated or rotated croplands, pastures, and hayfields. A maximum of 12 inches of topsoil would be segregated, except where topsoil is less than 12 inches deep, in which case the actual depth of the topsoil would be removed and segregated.

Following construction, Northwest would backfill the pipeline trench with the subsoil material, and the topsoil spread over the surface of the topsoil-stripped areas. Compacted subsoil would be disked, and the segregated topsoil returned as nearly as possible to its original horizon. Rocks would be removed from soil in accordance with Northwest's Plan to facilitate farming activities. Drain tiles and irrigation systems affected by construction activities would be inspected beyond the limits of the trench to determine whether damage has occurred, and damaged drain tiles and irrigation systems would be repaired or replaced. Noncultivated construction areas would be revegetated to stabilize the soil and prevent erosion and soils would be fertilized to restore soil fertility and increase success of revegetation. Northwest would implement measures to prevent or limit the introduction and establishment of noxious weeds and soil pathogens to areas where noxious weeds and soil pathogens did not previously occur. Short-term effects would occur in agricultural areas, which would typically regenerate quickly after cleanup and reseeding of the right-of-way.

After construction, Northwest would allow agricultural activities, including production of nonwoody, herbaceous crops, to resume, including within the permanent pipeline right-of-way. Woody and deep-rooted vegetation including trees, shrubs, cane berries, vines, and any crops requiring trellising that have the potential to cause damage to the buried pipeline may be restricted within the permanent pipeline right-of-way. Depending on the nature of the plants cultivated and right-of-way restrictions, operation of the pipeline would have limited to no permanent impacts on crops.

About 118 miles (84 percent) of the pipeline would cross prime farmland soils or farmland of statewide importance. One certified organic farm currently growing grass would be crossed by the pipeline near the beginning of the Sumas Loop between MPs 1478.6 and 1478.7. Northwest would coordinate with the landowner and implement the following BMPs to minimize impacts on operation and certification of the organic farm crossed near the beginning of the Sumas Loop: tire wash stations, weed-free fill, use of only water (not chemical stabilizers) for dust suppression, preservation and replacement reinstallation of topsoil, and restoration to preconstruction conditions following project completion. One nursery is identified by the Washington State Department of Agriculture between MPs 1400.5 and 1400.7 (Washington State Department of Agriculture, 2012). Due to the nature of the plants cultivated, operation of the pipeline would not result in permanent impacts on the nursery. No other specialty cropland, such as orchards or vineyards, would be crossed by the WEP.

Wetlands

Construction of the pipeline and aboveground facilities would affect about 218.1 acres of wetlands, including 67.7 acres of new disturbance. The construction right-of-way would be reduced to 75 feet at forested and other high value wetlands and in some cases reduced to 85 feet for long wetland

crossings. Consistent with existing conditions, about 145.1 acres would be permanently impacted during operation.

The impacts of project-related construction activities on wetlands would vary depending on the timing of construction, construction techniques used, sensitivity and quality of the resources disturbed, and length of time required for wetlands to be restored. Construction would result in short-term disturbances to wetland hydrology, water quality, and, where new permanent right-of-way is required, long-term disturbance in the form of functional conversion of wetlands. In general, Northwest would minimize wetland impacts by avoidance, mitigation of impacts, restoration, and compensation in accordance with federal, state, and local regulations. Measures for construction impact minimization, restoration, and post-construction maintenance are provided in Northwest's ECRP. Section 4.2.4.2 provides more information on wetland impacts and mitigation.

Barren Land

Construction of the pipeline would affect about 47.5 acres of barren land including existing active and inactive quarries and mines, most of which would be new disturbance (43.1 acres). About 14.6 acres would be permanently impacted during operation, consistent with existing conditions. The construction and operation of the pipeline would have minimal impacts on mining operations. Information on mineral resources that would be crossed by the pipeline is provided in section 4.2.1.2.

Existing Rights-of-way

Construction of the pipeline and aboveground facilities would affect about 189.2 acres of existing road, railroad, and utility rights-of-way, including about 49.4 acres for compressor station modifications. Of the right-of-way land affected during construction, 29.2 acres would be new disturbance. About 109.4 acres would be permanently retained for operation, consistent with existing conditions.

Northwest would work individually with counties, railroads, and utility operators to identify and implement mitigation measures to minimize temporary impacts on transportation and utility rights-of-way. No long-term effects are expected on existing rights-of-way following construction, as the right-of-way would be restored to preconstruction conditions.

Generally, Northwest would install the pipeline across major paved highways by boring under the roadbed (conventional bore), thereby minimizing disturbance to the public. If an open-cut road requires extensive construction time, Northwest would implement provisions for detours or other measures to permit traffic flow during construction. To minimize traffic delays, detours would be established before roads are cut. If a reasonable detour would not be feasible, at least one traffic lane of the road would be left open, except for brief periods when road closure would be required. Northwest would maintain roadways in a way that would allow access for emergency and private vehicles. Typically, construction interference at each of these road crossings would last less than 1 day. The pipeline would be buried to a depth of at least 5 feet below the road surface and designed to withstand anticipated external loadings.

The pipeline would cross nine railroads by bore. Northwest would consult early with the railroads, work with railroad owners during land acquisition, and acquire necessary permits for all railroad crossings. All railroad crossings would be designed in accordance with the required engineering specifications, and safety measures would be implemented to ensure the safety of personnel, property, rail operations, and the public. Therefore, we conclude that project construction would not adversely affect railroad operations or safety.

To avoid or reduce impacts on utilities, Northwest would implement BMPs throughout the duration of construction. As a first step in avoidance of impacts on utilities, Northwest's contractor would conduct One-Call notifications to determine the existence and physical location of existing underground facilities that parallel or cross the pipeline. Further, the contractor would implement additional avoidance measures, practices, and actions including:

- coordinating excavation of all existing facilities with utility company;
- inspecting all existing staking and verify the location of all facilities, both identified on existing staking and shown on alignment drawings;
- verifying that all pipelines, fiber, cathodic cables, and other underground facilities have been identified within the work corridor;
- using means necessary to protect adjacent above- or below-grade facilities, including but not limited to, sheet piling, shoring, and barricades such as pipelines, telephone/fiber cables, electric power cables, utility poles, towers, foundations, roadways, waterways, dikes, retaining walls, buildings, or other structures;
- exercising all possible precautions to avoid damage to existing pipelines;
- reporting any damage to existing pipelines or facilities to Northwest immediately; and
- repairing any damage caused by the contractor to existing pipelines or coating.

Northwest would inspect any damage and specify type of repair. During and following construction, Northwest would work in a safe, expedient manner to reduce the duration of temporary service disruptions. Northwest would repair or restore any damaged or disturbed utilities to preconstruction conditions. The contractor would consult with the utility company regarding repair and restoration activities to be aware of additional requirements that may be more stringent.

Open Water

Construction of the pipeline would impact about 9.7 acres of open water, including 7.3 acres of new disturbance. Consistent with existing conditions, about 4.2 acres would be impacted during operation.

To minimize impacts, most major waterbodies would be crossed using the HDD method, exceptions being the Kalama River (which would be crossed via an aerial span) and the Toutle River (which would be crossed via a wet open cut). The dry, open-cut method (the same trench method used in uplands) would be applied to intermittent and ephemeral waterbodies that are dry at the time of construction. A dry open-cut (dam-and-pump or flume) crossing method would be applied to most perennial waterbodies. Northwest would construct waterbody crossings its Plan and Procedures and in accordance with federal, state, and local regulation and permit requirements. Therefore, the impacts on open water would be minimized to the extent practicable and would be temporary. Waterbody crossing impacts and mitigation are discussed in section 4.2.3.2.

Commercial/Industrial Lands

Construction of the pipeline and contractor and pipe storage yards would impact about 48.9 acres of commercial/industrial lands, including 6.6 acres of new disturbance. About 10.4 acres of commercial/industrial lands would be permanently impacted during operation, consistent with existing conditions. The Sumner South, Sumner North A, and Sumner North B Loops would cross some areas of

existing commercial and industrial land uses. Additionally, the contractor and pipe storage yards would be in existing commercial and industrial areas. Impacts on commercial and industrial areas would be limited to the period when construction activities may inconvenience business owners, employees, and customers. Businesses immediately adjacent to the right-of-way may also experience a temporary disruption of normal activities. Northwest would coordinate with business owners to maintain access, decrease construction duration, and generally minimize impacts.

To reduce impacts and minimize construction disturbance to commercial and industrial land uses, Northwest would identify any potential access issues and collaborate with the affected business owner to reach a mutually agreeable resolution and develop a negotiated Construction Workspace Agreement. Business owners would be notified prior to construction, and access and traffic flows maintained during construction activities. Construction of the WEP would result in temporary impacts on industrial/commercial land use. There would be no permanent displacement of any businesses or other permanent impacts on industrial/commercial land use; however, no structures would be permitted on the permanent right-of-way.

Residential Lands

Construction of the pipeline and aboveground facilities would impact about 203.4 acres of residential land, including 39.2 acres of new disturbance. Consistent with existing conditions, about 164.2 acres of residential land would be permanently impacted during operation.

Northwest's existing pipelines were installed primarily in 1956 and 1971; additional pipelines were installed in the 1990s and 2000s. After the pipelines were installed, many residences and other buildings were constructed adjacent to or encroaching on Northwest's existing, permanent right-of-way. About 740 residences would be within 50 feet of the construction right-of-way and ATWS (see table 4.2.9-5 and appendix I6). No residences would be within 50 feet of the existing compressor stations.

Table 4.2.9-5

Residences within 50 Feet of Construction Right-of-way

Loop	Number of Residences
Woodland	50
Chehalis	10
Sumner South	339
Sumer North A	98
Sumner North B	187
Snohomish	47
Mt. Vernon South	3
Mt. Vernon North A	1
Mt. Vernon North B	4
Sumas	1

Construction would not impact permanent residential structures outside of the existing permanent right-of-way. If necessary, Northwest would reduce or offset the construction right-of-way for short distances to avoid houses and minimize impacts, which would be negotiated with the existing landowners during the acquisition phase. Northwest would construct the project within a construction right-of-way narrower than its existing, permanent right-of-way in more than 160 locations to reduce the land requirements by 31.1 acres and to reduce impacts on residential properties.

Residences immediately adjacent to the right-of-way would experience a short-term, temporary disruption of normal activities and access, as well as noise and dust. Construction would proceed quickly through residential areas to minimize exposure to nuisance effects such as noise and dust. Northwest would comply with local noise ordinances listed in section 4.2.12.2. Where there are additional noise concerns, Northwest would work with individuals and local jurisdictions to mitigate the effect. If legitimate noise complaints are received, Northwest would restrict the timing of noisy construction or demolition work to 7 a.m. to 7 p.m. Monday through Saturday. Northwest does not currently plan to work during the nighttime or on Sundays. Dust minimization techniques, such as watering disturbed areas, would be used on-site as described in section 4.2.12.1, and all litter and debris would be removed daily from the construction site. Access and traffic flows would be maintained during construction activities. Temporary rerouting of a driveway or entrance may be required. These actions would be communicated to affected landowners prior to construction activities on their properties, and residents would be able to access their homes when needed.

Construction and operation of the WEP would not result in the permanent displacement of any residences; however, depending on the specific circumstances, Northwest may pay to relocate residents during construction activities. The specific details of temporary relocations would be worked out through negotiations between the landowner and Northwest's land agents. There would be temporary construction disturbances to property features (such as fences, lawns, or outbuildings). If construction requires removal of property features, Northwest would notify the landowner or tenant prior to the action. Northwest would identify existing residential septic systems during the land acquisition phase and take measures to avoid septic systems. According to Northwest's Plan, topsoil in residential areas would be stripped either from the full work area or from the trench and subsoil storage area. A maximum of 12 inches of topsoil would be segregated over the trench. Where topsoil is less than 12 inches deep, the actual depth of the topsoil would be removed and segregated. Following completion of construction, Northwest would restore the property in accordance with its Plan and landowner stipulations. Mature trees, vegetation screens, and landscaping would be preserved to the extent possible while ensuring the safe operation of construction equipment.

In densely populated residential areas, different techniques may be used with smaller crews to limit impacts on landowners. Northwest intends to use methods of construction that limit the duration of construction in one area. Stove-piping (an open trench of only one pipe joint length) would be the primary method of installation, with one or two pipeline sections installed per day. Open trenches on residential properties would be covered using steel (or similar material) plates each night before contract workers leave the construction site and chain-link fencing would surround the covered trench.

In areas where construction would be within 50 feet of a residence, Northwest would restrict the construction right-of-way to the existing, permanent right-of-way, as practicable, to minimize inconvenience to property owners. Crews would place mats or spoil on top of the existing pipeline(s) to provide adequate cover, which would allow construction equipment to pass over the existing pipeline(s), gaining more workspace for equipment. Pipe would be stockpiled at staging areas along the right-of-way. When crews are ready, the pipeline would be welded in double or triple lengths in front of or behind the trenching crew. After the trench is excavated, the trenching crew would move out of the location, and the installation crew would carry each welded length into place and lower it into the excavated trench. It may be necessary to have larger excavation "bell holes" at each pipeline section end to enable safe entry for tie-in crews to weld the sections together. As each section is installed, the backfill crew would backfill the trench as soon as possible leaving bell holes open for x-ray and coating. After x-ray and coating are complete, a right-of-way clean-up crew would follow and backfill any excavations that are still open.

Trench shoring would be used as needed based on OSHA requirements. For sections excavated across public roads, steel road plates would be placed over the trench to allow traffic to cross. Flagmen would also be used during construction for public safety and traffic control.

Northwest would contract with a local home inspection contractor to provide preconstruction inspections for affected landowners with their approval. Inspections would include foundations, driveways, interior walls, and crawl spaces as applicable. An individualized report would be provided to the affected landowner and Northwest. Following construction, another inspection would be completed and compared to the initial inspection, and any damages that can be attributed to construction activities would be remedied.

Landowners would be compensated for removal of trees, including those in Northwest's new right-of-way and ATWS. Immediately after backfilling the trench, Northwest would coordinate with qualified contractors and landowners to ensure that all lawn areas and landscaping within the construction work area are restored. Affected landowners would have use of the right-of-way as they did prior to construction, provided it would not interfere with operation and maintenance of the pipeline system. Structures, including houses, garages, poles, guy wires, catch basins, swimming pools, trailers, leaching fields, septic tanks, or any other objects not easily removed, are not typically permitted on the permanent right-of-way. Grading or removal of cover generally would not be allowed without Northwest's consent.

Northwest would notify landowners, particularly those residences within 50 feet of the construction workspace, in advance of construction. During construction, the edge of the construction work area within 50 feet of a residence would be fenced with temporary chain-link and reinforced orange safety fencing for a distance of 100 feet on either side of the trench to maintain public safety and ensure that construction equipment and materials, including the spoil pile, remain within the construction work area. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Northwest would also limit the period of time the trench remains open prior to backfilling.

For residences within 25 feet of the construction footprint, Northwest has developed site-specific plans (included in appendix I6) depicting how the construction workspaces would be arranged to mitigate impacts on landowners. Northwest would maintain at least a 5-foot buffer between the construction right-of-way and residences, and would make every effort to retain a minimum 10-foot buffer. Temporary chain-link and reinforced orange safety fencing would be placed between the residence and the construction work area at least 5 feet from the foundation of the home and additional areas where needed for safety. Northwest would communicate with residents about the placement, timing, and removal of temporary fencing. Appropriate safety measures would be developed during the land acquisition and construction planning phase to address out-buildings, garages, and sheds present within 25 feet of the right-of-way.

We received a comment regarding potential impacts of the project on the property at MP 1286.9. Based on our review, it appears there may be a residence within 25 feet of the construction right-of-way at this location for which a site-specific plan has not been provided. Also, additional residential construction may occur near the proposed workspace during the period before construction begins. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Northwest should file with the Secretary, for review and written approval by the Director of OEP:**
  - **a. a final site-specific construction plan for each residence identified within 25 feet of a construction work area (including residences in appendix I6 of**

the EIS and any additional identified residences), that includes all of the following:

(1) a dimensioned site plan that clearly shows:

i. the location of the residence in relation to the pipeline;

ii. the boundaries of all construction work areas;

iii. the distance between the edge of construction work areas and the residence and other permanent structures;

iv. equipment travel lanes;

v. location of topsoil and subsoil storage;

vi. safety fencing and other safety features;

vii. other nearby structures and residential features (including decks, fences, driveways, etc.), indicating which would be removed and any areas with restrictions after construction;

viii. trees and other landscaping, indicating which would be removed and where trees would not be allowed after construction;

ix. nearby utilities including wells, water and sewer lines, and septic systems;

x. nearby roads or waterbodies; and

xi. the edge of the permanent right-of-way;

(2) a detailed description of construction techniques that would be used (such as reduced pipeline separation, centerline adjustment, use of stove-pipe or drag section techniques, working over existing pipelines, pipeline crossover, bore, etc.);

(3) an estimate of the amount of time required for construction activities;

(4) a description of how Northwest would ensure the trench would not be excavated until the pipeline is ready for installation and the trench is backfilled immediately after pipeline installation; and

(5) a description of restoration and revegetation measures and procedures for the property;

b. a description of how and when landowners would be notified of construction activities; and

c. documentation of landowner concurrence if the construction work areas would be within 10 feet of a residence.

Landowners crossed by the WEP construction right-of-way would experience temporary impacts during construction such as noise, loss of vegetation, and visual impacts. Our recommendation and implementation of the construction and restoration measures described above would mitigate temporary impacts on residential land use during construction to the extent practicable. Because 90 percent of the WEP would be operated within Northwest's existing pipeline right-of-way, long-term impacts of the project on residential land would be minimal.

4.2.9.2 New and Planned Developments

The WEP would be within 0.25 mile of 14 new or planned developments, as shown in table 4.2.9-6. There are no planned developments within 0.25 mile of the proposed construction right-of-way in the cities of Auburn, Castle Rock, Covington, Issaquah, Kelso, Puyallup, or Sumner or in King, Lewis, Thurston, or Whatcom Counties.

Table 4.2.9-6

New and Planned Developments within 0.25 Mile of the WEP Construction Right-of-Way

New/Planned Development	Milepost	Location (Parcel Number)	Approximate Distance from Centerline (feet)	Development Time Frame	Impact and Proposed Mitigation
Cowlitz County					
Kalama Pipeline	1254.0	(WD3302001)	0	2017	None.
Pierce County					
Manufacturing building	1338.4	5415 189th Street E (419313041)	71	Construction complete.	None; construction right-of-way would not cross parcel.
Manufacturing plant and office space	1338.0	(418062026)	1,006	Construction complete.	None; construction right-of-way would not cross parcel.
Carousel building and attached concrete manufacturing batch plant	1338.5	(419313039)	68	Construction complete.	None; construction right-of-way would not cross parcel.
Residential subdivision (81 lots)	1340.3	7505 170th Street E (419293017)	1,165	Unknown. Awaiting final plat approval; preliminary plat expires January 2016.	None; construction right-of-way would not cross parcel.
Residential subdivision (35 lots)	—	(419301009)	0	Unknown. Awaiting final plat approval; preliminary plat expires January 2015.	Potential impacts unknown due to preliminary nature of subdivision plans. Northwest would coordinate with the landowner to minimize adverse impacts on the proposed subdivision.
Residential subdivision (88 lots)	1340.2	(419296047)	357	Unknown. Awaiting final plat approval; preliminary plat expires January 2015.	None; construction right-of-way would not cross parcel.
Residential subdivision (21 lots)	1338.0	20606 50th Avenue E (2450000170)	4,157	Unknown. Awaiting final plat approval; preliminary plat expires May 2016.	None; construction right-of-way would not cross parcel.
Residential subdivision (114 lots)	1340.1	7210 170th Street E (419293033)	1,078	Unknown. Awaiting final plat approval; preliminary plat expires January 2015.	None; construction right-of-way would not cross parcel.

Table 4.2.9-6

New and Planned Developments within 0.25 Mile of the WEP Construction Right-of-Way

New/Planned Development	Milepost	Location (Parcel Number)	Approximate Distance from Centerline (feet)	Development Time Frame	Impact and Proposed Mitigation
Residential subdivision (124 lots)	1351.8	16515 Forest Canyon Road E (520074028)	560	Unknown. Awaiting final plat approval; preliminary plat expires April 2015.	None; construction right-of-way would not cross parcel.
Snohomish County					
WSDOT widening SR 522 and building new bridge across Snohomish River	1397.0	from Cathcart/ Elliott Road to Monroe (270616-002-022-00)	326	Under construction. Project completion expected late 2014.	None; construction right-of-way would not cross parcel.
10,200 square foot education building/church campus with outdoor recreation area and 278 parking spots	—	(290633-002-009-00)	0	Construction complete.	Temporary impacts on a portion of the driveway and back parking lot are expected; however, Northwest would coordinate with the land-owner to minimize adverse im-pacts on the new development.
Skagit County					
Residential subdivision (23 lots)	—	(P17924)	0	Unknown.	Potential impacts unknown due to preliminary nature of subdivision plans. Northwest would coordinate with the landowner to minimize adverse impacts on the proposed subdivision.
Residential subdivision (137 lots)	1438.0	(P30544)	318	Unknown. Preliminary plat approved April 2013.	None; construction right-of-way would not cross parcel.
City of Woodland					
Scott Hill Park & Sports Complex	1244.3	(508800100)	1,212	Currently in the planning and fundraising stage. No construction is anticipated within next 2 years.	None; construction right-of-way would not cross parcel.
Meriwether residential subdivision	1244.3	Lolo Trail, Meriwether, Clatsop, and Pompey Streets	210	Unknown. Home construction expected to continue until all lots are developed.	None; construction right-of-way would not cross parcel.
City of Sammamish					
244th Avenue sidewalk improvement	—	244th Avenue along Beaver Lake Park	0	Construction complete.	Temporary impacts on a portion of the sidewalk are expected; however, Northwest would coordinate with the City to ensure restoration of area to preproject conditions.
Aster Montessori School	1379.4	2825 244th Avenue SE (2909900010)	71	Conditional Use Permit approved June 2013. Commercial Site Development Plan currently under review.	None; construction right-of-way would not cross parcel.
Lawson Park subdivision	1380.3	24403 SE 14th Street	347	Unknown. Final plat approved December 2013. Associated street widening to be completed by early 2015.	None; construction right-of-way would not cross parcel.

There is one planned development in the vicinity of the WEP in Cowlitz County. The Kalama Pipeline includes a 3.1-mile, 24-inch-diameter natural gas pipeline and related facilities extending from Northwest's mainline to a proposed methanol production facility planned for the Port of Kalama. Construction is expected to occur in 2017. The pipeline rights-of-way would overlap in this area; however, there would be no impacts on the Kalama Pipeline from the WEP.

Pierce County has nine new or planned developments that would be crossed or within 0.25 mile of the project, including a 17,280-square-foot manufacturing structure, a 367,182-square-foot manufacturing plant, and a 41,152-square-foot carousel building with attached batch plant. A number of large residential developments are also planned in proximity to the project. Only one of the nine planned developments (a 35-lot subdivision) would be crossed by the pipeline. Potential impacts on the subdivision are unknown due to the preliminary nature of the subdivision plans; however, Northwest would coordinate with the landowner to minimize adverse impacts on the proposed subdivision.

Snohomish County has one development that would be crossed by the project and one within 0.25 mile of the project. One development includes the widening of State Route (SR) 522 from Cathcart/Elliott Road to Monroe and construction of a new bridge across the Snohomish River. Construction of a 10,200 square foot Christian education facility was recently completed. The Snohomish Loop would cross a portion of the driveway of the education facility and back parking lot. Northwest would coordinate with the landowner to minimize temporary impacts on the new development.

Skagit County has two large residential developments planned within 0.25 mile of the project. One development, which includes plans for 23 residential lots, would be crossed by the pipeline. The other development, which would be about 300 feet from the pipeline, would consist of 137 residential lots. The potential impacts on the crossed subdivision are unknown due to the preliminary nature of the subdivision plans; however, Northwest would coordinate with the landowner to minimize adverse impacts on the proposed subdivision.

Two planned developments would be within 0.25 mile of the project in the City of Woodland. Both of these projects are in the planning/fundraising stage and construction is not expected to begin for another few years.

A newly constructed sidewalk improvement project in the City of Sammamish would be crossed by the pipeline. Impacts would be temporary and Northwest would coordinate with the City to ensure restoration to preconstruction conditions. There is also a planned school development and a residential development within 0.25 mile of the pipeline.

Northwest coordinated with local agencies to identify and address impacts on new/planned developments. Where developing areas have been identified, the design has been reviewed to identify where route variations, pipeline design revisions, or compensation are required for the project to be compatible with new or proposed land uses. Northwest would identify and address any land use changes that occur prior to the start of construction in the Project Implementation Plan, which will be filed with FERC. Northwest would coordinate with each jurisdiction and request notification of any proposed land use changes on parcels adjacent to the existing permanent right-of-way. Because the majority of the WEP would be within or abutting an existing pipeline right-of-way, and Northwest continues to coordinate with the developers and local agencies with regard to planned developments in the project area, we conclude that impacts due to construction and operation of the WEP on planned developments would be minimized to the extent practicable.

4.2.9.3 Schools

Eighteen schools, colleges, or learning institutions would be within 2,000 feet of the WEP (see table 4.2.9-7). Most of the schools in the vicinity of the project area would be more than 500 feet away from the pipeline and would experience no or minimal impact. While construction would occur between 7 a.m. and 7 p.m., the pipeline would not be close enough to the school buildings to be a distraction; therefore, no mitigation for noise would be necessary. The majority of the loops would be constructed in the summer of 2018, which would minimize impacts as none of the schools are year-round.

Table 4.2.9-7

Schools, Colleges, and Learning Institutions Near or Adjacent to the WEP Pipeline

School, City	Nearest Milepost	Distance from Construction Right-of-way to School Property (feet)	Impacts
Sumner South Loop			
Pierce College, Puyallup	1345.1	0	No impact is anticipated as the school property would be 800 feet from the construction right-of-way across a divided highway (Highway 410).
Edward Zeiger Elementary School, Puyallup	1343.1	90	Construction right-of-way would cross an undeveloped portion of school property 700 feet from the school building. Minimal impact on school access off SE 318th Street is anticipated. Northwest would prepare site-specific mitigation plan to address construction on school property.
Kindercare Learning Center, Puyallup	1344.3	380	An ATWS would be 380 feet east of school; however, no impact on school entrance is anticipated.
Ferrucci Junior High School, Puyallup	1345.4	58	A main road is present between the school and right-of-way and minimal impact would be expected as the school entrance is off Wildwood Park Drive to south. Main building would be 763 feet from pipeline.
Wildwood Park Elementary School, Puyallup	1345.6	895	Many houses would be within the 895 feet between school property and construction right-of-way and minimal impact is anticipated on entrance road off 26th Avenue SE.
Shaw Road Elementary School Puyallup	1347.0	55	Construction right-of-way is across a main road (Shaw Road, which would be bored) from school and minimal impact is anticipated on school access. Main building would be 671 feet from pipeline.
Northwest Christian School, Puyallup	1347.1	454	Buildings and Shaw Road would be within the 454 feet between the school and construction right-of-way and minimal impact is anticipated on school access.
Sumner Junior High School, Sumner	1348.3	600	No impact is anticipated as the school property is 600 feet from the construction right-of-way across a divided highway (Highway 410).
Maple Lawn Elementary School, Sumner	1348.3	800	No impact is anticipated as the school property is 800 feet from the construction right-of-way across a divided highway (Highway 410).

Table 4.2.9-7

Schools, Colleges, and Learning Institutions Near or Adjacent to the WEP Pipeline

School, City	Nearest Milepost	Distance from Construction Right-of-way to School Property (feet)	Impacts
Sumner North A Loop			
Lake View Elementary School, Auburn	1359.4	0	Construction right-of-way would cross an undeveloped portion of school property 591 feet from the school building. Minimal impact on school access off SE 318th Street is anticipated. Northwest would prepare site-specific mitigation plan to address construction on school property.
Grass Lake Elementary School, Kent	1361.9	536	Minimal impact is anticipated as school property would be 536 feet from construction right-of-way and access road off 191st Place SE would not be impacted.
Cedar Heights Middle School, Kent	1363.0	260	Minimal impacts are anticipated because a subdivision would be within the 260 feet between the school property and construction right-of-way and access to the school off SE 272nd Street would not be affected.
Cedar Valley Elementary School, Kent	1363.2	910	School property would be 910 feet from construction right-of-way with numerous houses between. No impact is anticipated on school access off Timberlane Way SE.
Sumner North B Loop			
Issaquah Montessori School, Issaquah	1377.7	0	Construction right-of-way is immediately adjacent to the school building and school access may be partially restricted. Northwest would prepare site-specific mitigation plan to address impacts.
Pacific Cascade Middle School, Issaquah	1377.8	25	Construction right-of-way would be 25 feet from undeveloped part of school property. No impact is anticipated on school access off SE Issaquah-Fall City Road. Northwest would prepare site-specific mitigation plan as school property is near construction.
Inglewood Junior High School, Sammamish	1381.8	660	Numerous houses would be in the 660 feet between the school property and construction right-of-way. No impact on school access off NE 8th Street is anticipated.
Samantha Smith Elementary School, Sammamish	1381.9	690	Numerous houses would be in the 690 feet between the school property and construction right-of-way. No impact on school access off NE 14th Street is anticipated.
Rachel Carson Elementary School, Sammamish	1381.8	1,335	Numerous houses would be in the 1,335 feet between the school property and construction right-of-way. No impact is anticipated on school access off 244th Avenue NE.

Northwest would implement standard mitigation measures during construction in the vicinity of these schools, including:

- implementing a Traffic Management Plan;
- boring or providing detours at major road crossings;
- implementing applicable mitigation measures identified for residences within 25 feet (e.g., chain link or safety fences; see Residential Lands under section 4.2.9.1);
- implementing noise mitigation measures (see section 4.2.12.2);

- attempting to complete clear and grade through backfill activities during summer when students are not present; and
- meeting with school officials prior to construction to discuss construction, schedule, and measures to ensure student/school personnel safety and methods to minimize impacts.

Northwest has contacted school officials and prepared site-specific mitigation plans for four schools where the construction right-of-way would be within 25 feet of school property (i.e., Pierce College, Lake View Elementary School, Issaquah Montessori School, and Pacific Cascade Middle School). These plans are provided in appendix I6. Because Northwest would implement the above standard mitigation measures for the remaining listed schools, we conclude that site-specific plans would not be needed for these schools. The disturbance would be temporary and Northwest would work with the schools to minimize impacts on students. Therefore, we conclude that construction and operation of the WEP would have minimal impact on schools.

4.2.9.4 Zoning

In November and December 2014, Northwest attended preapplication conferences with the counties crossed by the WEP to discuss the permitting requirements for each county. The project would be a permitted use across all of the zoning districts crossed in applicable counties because the facilities would be within Northwest's existing right-of-way and adjacent to existing aboveground facility sites. As required under the CZMA, Shoreline Management Act, and GMA, including local critical areas ordinances, prior to construction Northwest would obtain applicable local land use approvals. In addition, Northwest would obtain required development permits, such as building, site development, utility, access, and road closure permits.

4.2.9.5 Coastal Zone Management Act

Approved by the federal government in 1976, Washington's Coastal Zone Management Program gives authority to WA Ecology's Shorelands and Environmental Assistance Program to administer consistency with the CZMA. As described in section 1.5.1.9, the Washington Coastal Zone Management Program applies to all 15 coastal counties that front salt water. The WEP would be within the Washington coastal zone in Thurston, Pierce, King, Snohomish, Skagit, and Whatcom Counties.

To receive a consistency determination with the Washington Coastal Zone Management Program**,** compliance must be demonstrated with the following federal and state laws:

- SEPA (see section 4.1.9.2; WA Ecology is the SEPA Lead Agency for the WEP);
- Shoreline Management Act (including local government Shoreline Management Programs);
- Clean Water Act; and
- Clean Air Act.

WA Ecology has requested that Northwest prepare an overview Consistency Analysis Document to summarize how the WEP would comply with Enforceable Policies within coastal zone counties. This document, in addition to the relevant regulatory documents for CZMA consistency demonstrating compliance with the laws listed above, would be used by WA Ecology to make a single CZMA determination for the WEP. If the WEP is authorized by the Commission, Northwest would need to

demonstrate that its project is consistent with the CZMA before FERC would allow any construction activities to begin. Therefore, **we recommend that:**

> **Prior to construction, Northwest should file with the Secretary documentation of concurrence from WA Ecology that the WEP is consistent with the CZMA.**

4.2.9.6 Washington Shoreline Management Act

The Washington SMA includes three basic policy areas that focus on shoreline use, environmental protection, and public access. Preferred uses along shoreline areas are established for the prevention of pollution and damage to preserve the natural character of shorelines, mitigate adverse environmental impacts, and make provisions for public access for recreational opportunities (RCW 90.58.020). Section 1.5.3.3 includes additional information on the SMA.

According to WA Ecology (2012b), designated shorelines are defined as:

- all marine waters;
- streams and rivers with greater than 20 cubic feet per second mean annual flow;
- lakes 20 acres or larger;
- upland areas called shorelands that extend 200 feet landward from the edge of these waters; and
- the following areas when they are *associated* with one of the above:
  - biological wetlands and river deltas; and
  - some or all of the 100-year floodplain, including all wetlands within the 100-year floodplain.

The pipeline would cross designated shorelines and wetland areas under SMPs in all counties. Various permits for development within these areas would comply with state and local regulations regarding designated shorelines. Northwest might be required to provide mitigation as a condition of the applicable permits. Impacts on these designated shorelines and wetlands, including activities at waterbody crossings, and associated mitigation are discussed in sections 4.2.3 and 4.2.4.

4.2.9.7 Land Ownership

Land ownership along the proposed pipeline route is 88.4 percent private. State and county/local lands constitute 2.4 percent and 9.0 percent, respectively. In addition, 0.2 percent of the lands that would be crossed are tribal. No federal lands would be crossed by the pipeline. A summary of land ownership along the pipeline route, in miles, is presented in table 4.2.9-8.

Table 4.2.9-8

Land Ownership Crossed by the WEP Pipeline (Miles)

Loop	State Land	County/Local Land	Private Land	Tribal Land	Total
Woodland	0.3	2.0	43.0	—	45.3
Chehalis	1.0	0.3	23.1	—	24.4
Sumner South	0.1	1.7	12.0	—	13.8
Sumner North A	<0.1	0.8	6.3	—	7.0
Sumner North B	1.0	3.9	6.2	—	11.0

Table 4.2.9-8

Land Ownership Crossed by the WEP Pipeline (Miles)

Loop	State Land	County/Local Land	Private Land	Tribal Land	Total
Snohomish	0.4	2.5	12.6	—	15.6
Mt. Vernon South	<0.1	0.1	4.4	—	4.5
Mt. Vernon North A	0.1	0.8	4.0	—	4.8
Mt. Vernon North B	0.5	0.6	7.3	—	8.4
Sumas	<0.1	0.1	5.5	0.3	5.9
Pipeline Total	**3.4**	**12.6**	**124.3**	**0.3**	**140.6**

Northwest would secure easements to convey both temporary (for construction) and permanent (for operation) rights-of-way on private lands. The easement acquisition process is designed to provide fair compensation to the landowners for the pipeline company's right to use the property for pipeline construction and operation. Northwest would compensate landowners for loss of value to specific parcels. The easement agreement between the company and landowner typically specifies compensation for loss of use during construction (e.g., crops), loss of nonrenewable or other resources, damage to property during construction, and limits on use of the permanent right-of-way after construction. Landowners have the opportunity to request that site-specific factors and/or development plans for their property be considered during easement negotiations, and that specific measures be taken into account. Other than the easement, construction of the pipeline would not place any restrictions on a landowner's ability to sell or transfer ownership of a property during or after construction.

Northwest could use the right of eminent domain granted to it under Section 7(h) of the NGA to obtain right-of-way and temporary work areas in the event that an easement could not be negotiated and the project is certificated by the FERC. In this case, Northwest still would be required to compensate the landowner for the right-of-way and for any damages incurred during construction; however, the level of compensation would be determined by a court. Eminent domain does not apply to land under federal ownership or management.

4.2.9.8 Scenic Highways

The purpose for establishing State Scenic and Recreational Highways is to develop a plan and implementation strategy to ensure stewardship of the state's most spectacular and diverse landscapes.

Washington State law defines scenic as:

- any state highway within any public park, federal forest area, public beach, public recreation area, or national monument;
- any state highway or portion thereof outside the boundaries of any incorporated city or town designated by the legislature as a part of the scenic system; or
- any state highway or portion thereof outside the boundaries of any incorporated city or town designated by the legislature as a part of the scenic and recreational highway system except for the sections of highways specifically excluded in the law or located within areas zoned by the governing county for predominantly commercial or industrial uses, and having development visible to the highway (RCW 47.42).

The pipeline would cross three State Scenic and Recreational Highways: All-American Road 410 (also known as Chinook Scenic Byway), I-90 (also known as Mountains to Sound Greenway), and SR 2

(also known as Stevens Pass Greenway). The pipeline would also cross SR 504 (known as Spirit Lake Memorial Highway). These highways have also been designated as National Scenic Byways. Although not a state- or nationally designated scenic highway, SR 504 is designated as a memorial highway for its significance in the 1980 eruption of Mount St. Helens. Table 4.2.9-9 lists these highways along with their respective crossing mileposts.

Table 4.2.9-9

Scenic and Memorial Highways Crossed or Within 0.25 mile of the WEP Pipeline

Highway	Loop	Milepost
SR 504 (Spirit Lake Memorial Highway)	Woodland	1272.7
All-American Road 410 (Chinook Scenic Byway)	Sumner South	1349.3
I-90 (Mountains to Sound Greenway)	Sumner North B	1376.1
SR 2 (Stevens Pass Greenway)	Snohomish	1402.9

Each of the scenic roadways would be crossed by boring rather than open-cut crossing methods. For travelers along these highways, exposure to the pipeline features would be brief and minimal because of traveling speeds and existing vegetative cover obscuring the casual motorists' line of sight. To accommodate the road bores, the existing right-of-way may be widened by temporary clearing for extra workspaces, but these areas would be revegetated after construction and the temporary workspaces would be allowed to return to preconstruction conditions. Therefore, we conclude that construction and operation of the WEP would have minimal and temporary impact on scenic roadways.

4.2.9.9 Wild and Scenic Rivers

The Mt. Vernon North A Loop would tie into an existing aerial span that crosses over the Skagit River, portions of which are designated as a Scenic River System under the National Wild and Scenic Rivers Act (NPS, 2012; WSDOT, 2010b). The Skagit Wild and Scenic River System includes a reach of the Skagit River from Bacon Creek downstream to just east of the town of Sedro Woolley, which is classified as Recreational. Northwest's existing aerial span across the Skagit River is west of the Wild and Scenic designated portion of the river. The new pipeline constructed for the WEP would not be installed across the Skagit River. Northwest would conduct modifications to tie-ins on its existing 30-inch-diameter pipeline at both ends of the existing aerial span crossing the river. Therefore, there would be no direct impacts on the river. We conclude that construction and operation of the WEP would have no impact on wild and scenic rivers.

4.2.9.10 Recreation and Public Interest Areas

Recreation and public interest areas crossed by or within 0.25 mile of the pipeline are listed in table 4.2.9-10 and further discussed in the following sections. Recreational uses occur in several designated local, county, and state parks and natural areas in the vicinity of the pipeline. The pipeline would not cross National Natural Landmarks, National Parks, including National Battlefields, or National Forests. Unless otherwise stated, the project pipeline loops would be constructed and operated within or abutting the existing Northwest permanent right-of-way.

Table 4.2.9-10

Recreation and Public Interest Areas Crossed or Within 0.25 mile of the WEP Pipeline

Recreation or Public Interest Area	County	Administering Entity	Milepost		Crossing Distance (miles)	Temporary Construction Impacts
			Begin	End		
Sumner South Loop						
South Hill Park/Nathan Chapman Trail	Pierce	Pierce County Parks and Recreation Department	1342.2	1342.3	0.1	Traffic delays, road/trail detours, temporary closure of the park entrance, parking area, and tails.
Sumner North A Loop						
Crest Airpark		Private	1360.7	1360.9	0.1	Potential temporary restrictions or limited flying schedule at the airport.
Evergreen Park		City of Covington Parks and Recreation	1363.5	1363.5	0.1	Traffic delays, temporarily park closure.
Cedar Downs Park	King	King County Parks	1363.9	1363.9	—	Not crossed; no direct effects.
Sumner North B Loop						
Log Cabin Reach Natural Area	King	King County Parks	1371.0	1371.3	0.3	Access restrictions and recreation restriction within the construction right-of-way.
Squak Mountain/Tiger Mountain Corridor Preserve	King	King County Parks	1373.2	1373.5	0.4	Restriction of trail use within construction right-of-way.
West Tiger Mountain Natural Resource Conservation Area (NRCA)	King	WDNR and City of Issaquah	1374.6	1375.0	0.4	Recreation restriction within the construction right-of-way.
			1375.2	1375.6	0.4	
Tradition Plateau NRCA	King	WDNR and City of Issaquah	1375.0	1375.2	0.2	Potential entrance closure or reroute, recreation restriction within the construction right-of-way.
			1375.6	1375.7	<0.1	
			1375.8	1376.1	0.3	
Issaquah Preston Trail	King	King County Parks	1376.2	1376.2	<0.1	Temporary trail closure.
Klahanie Park	King	Klahanie Community Association, City of Sammamish Parks Department, King County Parks	1379.1	1379.2	0.1	Traffic delays, road/trail detours, trail closures.
Beaver Lake Park	King	City of Sammamish Parks Department	1379.5	1379.7	0.3	Traffic delays, road/trail detours, trail closures.
Snohomish Loop						
Lord Hill Regional Park	Snohomish	Snohomish County Parks	1397.8	1399.9	2.1	Road/trail detours and closures.
Mt. Vernon North A Loop						
Skagit Wild and Scenic River	Skagit	WA Ecology	1444.9	1445.0	0.0	No direct effects.

Table 4.2.9-10

Recreation and Public Interest Areas Crossed or Within 0.25 mile of the WEP Pipeline

Recreation or Public Interest Area	County	Administering Entity	Milepost		Crossing Distance (miles)	Temporary Construction Impacts
			Begin	End		
Mt. Vernon North B Loop						
Pacific Northwest National Scenic Trail	Skagit	U.S. Forest Service	1456.6	1456.6	<0.1	Temporary trail closure.
Innis Creek Local Land Trust	Whatcom	Whatcom Land Trust	1457.0	—	—	Not crossed; no direct effects.
Foxglove Conservation Easement	Whatcom	Whatcom Land Trust	1460.4	1460.5	0.1	Traffic delays, recreational uses restricted within the construction right-of-way.
Catalyst Conservation Easement	Whatcom	Whatcom Land Trust	1460.7	1461.2	0.5	Traffic delays, recreational uses restricted within the construction right-of-way.
Riverstead Conservation Easement	Whatcom	Whatcom Land Trust	1461.2	1461.3	0.1	Traffic delays, recreational uses restricted within the construction right-of-way.
			1461.4	1461.6	0.1	Traffic delays, recreational uses restricted within the construction right-of-way.
South Fork Chinook-Roos	Whatcom	Whatcom County Parks and Recreation	1460.6	—	—	Not crossed; no direct effects.
East Acme Farm Conservation Easement	Whatcom	Whatcom County Parks and Recreation	1461.6	1461.7	0.1	Traffic delays, recreational uses restricted within the construction right-of-way.
South Fork Park	Whatcom	Whatcom County Parks and Recreation	1461.7	1461.9	0.2	Traffic delays, recreational uses restricted within the construction right-of-way.

Temporary construction impacts on public land, recreation, and other designated areas could include removal of natural vegetation within the construction right-of-way, interruption of public use of the construction right-of-way, and temporary visual impacts on public views. Construction activities would temporarily prohibit recreational activities within the construction right-of-way, displacing trails and other recreational users. Park entrances may be temporarily closed; however, Northwest would construct sequentially through the parks to ensure as much of each park remains open as feasible. Northwest would continue to consult with the appropriate city, county, and state departments regarding public safety and minimizing impacts from construction activities within these areas. After completion of construction, Northwest would return the disturbed areas to preconstruction conditions, and recreational activities would continue as before construction.

Overall, construction-related impacts on managed areas would be minimized using the following measures:

- developing site-specific safety plans in consultation with recreation area managers;
- maintaining communication by informing stakeholders and recreational users prior to, and during, construction activities;
- constructing within or parallel to existing rights-of-way;
- utilizing existing public roads and approved private roads to access the right-of-way;
- minimizing construction time in recreation areas and timing construction to avoid peak usage periods, where practical;

- constructing in a sequential manner to ensure as much of the recreation area remains open as feasible;
- staging equipment and materials strategically to minimize impacts on public views and recreation;
- posting signage to indicate to recreational users when a linear resource such as a trail or river would be temporarily closed and, when possible, providing alternate routes around the closure;
- enforcing compliance with local noise ordinances; and
- returning the right-of-way to preconstruction conditions.

Northwest has contacted park administrators to discuss recreation areas crossed by the WEP and developed site-specific plans for each affected recreation area, which include construction methods, schedule, potential construction impacts (including potential temporary traffic delays, detours, and closures), restoration and monitoring, management practices, traffic and trail plans, public notification, and safety measures. These plans would be communicated to recreational users through the administering entities and the media, and be posted at each site. Northwest would continue to actively consult with park administrators. Any additional specific mitigation necessary for public land or recreational areas would be negotiated through the state and local permitting processes. **We recommend that:**

- **Prior to construction, Northwest should file with the Secretary documentation of additional coordination with the land management agencies listed in Table 4.2.9-10 of the draft EIS and the final site-specific plans, including traffic and trail plans, for each affected recreation area listed in Table 4.2.9-10 of the draft EIS.**

Parks

South Hill Park

The Sumner South Loop would cross South Hill Park, in Puyallup, Pierce County, between MPs 1342.2 and 1342.3. South Hill Park is a 40-acre site that includes a playground, picnic tables, restrooms, sports fields, a network of paved walking trails, and engineered wetlands. The Nathan Chapman Memorial Trail connects the park with the Heritage Recreation Center about 0.6 mile to the north. The main park entrances and parking area are on its west boundary along 86th Avenue E. The east half of the park is mostly forested; the west half is partially cleared and includes most of the park infrastructure. The pipeline crosses the northwest corner of the park, entering it along 86th Avenue E immediately north of the parking area and exiting into undeveloped land along the park's north boundary.

Construction would result in temporary impacts on South Hill Park and recreational users, including potential traffic delays; road/trail detours; and temporary closures of the park entrance, parking area, and trails. Northwest would identify convenient times for construction in the South Hill Park area and expedite construction. During construction, Northwest would maintain traffic flow on 86th Avenue and emergency vehicle access. Safety fencing would be installed around construction work areas. Use of the main park trail would be maintained via a detour. Northwest would notify recreational users of detours and closures via publications and signage. Following construction, the area would be restored in coordination with the Pierce County Parks and Recreation Department.

Evergreen Park

The Sumner North A Loop would cross Evergreen Park, in Covington, King County, at MP 1363.5. The 1.7-acre Evergreen Park was obtained by the City of Covington from King County in 2000

and is currently used as an open space/natural area with walking and BMX bike courses. Future development of the park includes plans for installation of a playground and walking path.

Construction would result in temporary construction impacts on Evergreen Park recreational users, including traffic delays and temporary park closure. Northwest would expedite construction in the park area. During construction, Northwest would maintain traffic flow to the park and emergency vehicle and residential access. Safety fencing would be installed around construction work areas. Northwest would notify recreational users of the closure via publications and signage. Following construction, the area would be restored in coordination with the City of Covington Parks and Recreation.

Cedar Downs Park

The Sumner North A Loop would cross about 891 feet of Cedar Downs Park at MP 1363.9 in King County. The main park site consists of 85 acres of mature forest that was originally owned by the DNR and was part of the school trust lands. The largely undeveloped park serves as a habitat for a wide variety of wildlife. The pipeline would not directly impact Cedar Downs Park.

Klahanie Park

The Sumner North B Loop would cross the neighborhood Klahanie Park between MPs 1379.0 and 1379.2. The 64-acre park includes playing fields, a playground, and open space with a peat bog of ecological significance (Queen's Bog), and paths and trails.

Construction would result in traffic delays, road/trail detours, and trail closures. Northwest would identify convenient times for construction in the Klahanie Park area and expedite construction. During construction, Northwest would maintain traffic flow to the park and emergency vehicle access. Safety fencing would be installed around construction work areas. Northwest would notify recreational users of detours and closures via publications and signage. Following construction, the area would be restored in coordination with Klahanie Community Association, City of Sammamish Parks Department, and King County Parks.

Beaver Lake Park

The Sumner North B Loop would cross Beaver Lake Park between MPs 1379.5 and 1379.7. The 54-acre park provides playing fields, playground, hiking, fishing, picnicking, a lodge, and forested areas.

Construction would result in traffic delays, road/trail detours, and trail closures. Northwest would identify convenient times for construction in the park area, construct during daylight hours, and expedite construction. During construction, Northwest would maintain traffic flow to the park and emergency vehicle access. Safety fencing would be installed around construction work areas. Northwest would notify recreational users of detours and closures via publications and signage. Following construction, the area would be restored in coordination with the City of Sammamish Parks Department.

Lord Hill Regional Park

The Snohomish Loop would cross Lord Hill Regional Park between MPs 1397.8 and 1399.9. Recreational opportunities within the 1,463-acre park include horseback riding, hiking, mountain biking, wildlife viewing, and picnicking. The park is mostly forested with several lakes, wetland complexes, and trails.

The park would be temporarily impacted during construction, including temporary road/trail detours and closures. Northwest would identify convenient times for construction in the park area, construct sequentially to minimize trail closures, and expedite construction. During construction,

Northwest would maintain traffic flow to the park, park access, and emergency vehicle access. Safety fencing would be installed as needed around construction work areas. Publications and signage would be used to notify recreational users of detours and closures. Following construction, the area would be restored in coordination with the Snohomish County Parks.

Natural Areas

The Log Cabin Reach Natural Area is a 118-acre site that consists of five contiguous parcels along Issaquah Creek on the west side of Cedar Grove Road SE and an additional 5-acre parcel on the east side of Cedar Grove Road SE. The natural area provides recreational opportunities, including walking, sightseeing, and wildlife viewing. However, most of the site appears to support little use (King County, 2004). The main point of access to the natural area is from a driveway on the west side of Cedar Grove Road SE. There is space to pull at least two cars off the road at that point. From this entrance, an unpaved road winds to a log cabin near Issaquah Creek; however a locked gate prevents public vehicle access past the parking area. There are no other locations that allow general public access to the site and no other trails at the site maintained by park staff.

Summer North B Loop would cross two of the Log Cabin Reach Natural Area parcels at MP 1371.0 for 0.3 mile, temporarily impacting about 4 acres of the 118-acre natural area. The driveway from Cedar Grove Road SE to the pipeline construction right-of-way would be used as an access road during construction, resulting in periodic lane closure. Recreation within the construction right-of-way would be temporarily prohibited during construction. Northwest would schedule construction to avoid rainy periods and expedite construction. During construction, Northwest would control access using signage and flagging. Fencing, gates, or other deterrents would be installed to exclude ORVs during construction. Publications and signage would notify recreational users of closures. Following construction, the area would be restored in coordination with King County Parks.

Natural Resources Conservation Areas

Between MPs 1373.2 and 1376.1, the Sumner North Loop B extends into the forested slopes of the visually sensitive West Tiger Mountain Natural Resource Conservation Area (NRCA). The area was enlarged in 1997 from its original 854 acres to encompass 4,430 acres of the western slopes of the 13,500-acre Tiger Mountain State Forest. The NRCA is jointly managed by the WDNR and City of Issaquah for multiple uses.

According to the WDNR, establishment of NRCAs by the Washington Legislature in 1987 provides protection and management of land for conservation purposes. Criteria for establishing NRCAs includes an emphasis on critical wildlife habitat, prime natural features, conservation, native ecological communities, and environmentally significant sites proposed for additional uses, as well as opportunities for outdoor environmental educational opportunities and low-impact public usage. The West Tiger Mountain NRCA is known for its protection of old-growth forests, caves, lakes, streams, forested wetland, scenic landscapes, and vegetative and wildlife habitats. Recreational opportunities within the NRCA include accessible hiking trails, sightseeing, and wildlife viewing. Recreation within the construction right-of-way would be temporarily prohibited during construction, displacing trail and other recreational users. Additionally, the NRCA provides scenic views for motorists traveling westbound and eastbound along I-90. For travelers using I-90, exposure to the WEP features would be brief and minimal as a result of traveling speeds and existing vegetative cover obscuring the casual motorist's line of site.

The West Tiger Mountain NRCA is part of a chain of Cascade Range foothills known locally as the "Issaquah Alps," which includes Tiger, Squak, and Cougar Mountains. The Squak-Tiger Mountain

Corridor Preserve provides recreational opportunities, including hiking and horseback riding trails, areas for hang-gliding, and wildlife viewing. Trail use would be temporarily restricted within the construction right-of-way.

Land ownership within the NRCA boundary consists mainly of DNR-managed trust lands and the City of Issaquah-designated Tradition Plateau NRCA. The Tradition Plateau NRCA provides walking, hiking, trail running, picnicking, wildlife viewing, and interpretive trails. Recreation would be temporarily prohibited within the construction right-of-way, displacing trail and other recreational users. Park entrances may also be temporarily closed or rerouted.

Temporary impacts on the NRCA during construction include traffic delays, road/trail detours and closures, disruption to hikers and hang/para gliders especially during landing, and parking issues when construction equipment and vehicles are present. Northwest would identify convenient times for construction to avoid times of peak use and expedite construction. During construction, Northwest would maintain traffic flow to the park and emergency vehicle access. Safety fencing would be installed as needed to prevent access to construction areas. Northwest would avoid placing equipment in hang/para glider landing areas, be prepared for possible emergency landings in construction areas, and plan around increased weekend use. Publications and signage would notify recreational users of detours and closures. Following construction, the area would be restored in coordination with King County Parks, WDNR, and City of Issaquah. We received comments concerning possible impacts within NRCA areas, as well as replacement of conservation lands required for new rights-of-way. Following construction, Northwest would restore disturbed areas to preconstruction conditions and recreational activities would continue as before construction. Northwest would continue to consult with land management agencies regarding impacts, restoration, and right-of-way agreements within NRCA areas.

Trails

Sumner North B Loop would cross the Issaquah Preston Trail, also known as the Issaquah Creek Trail or Issaquah-High Point Trail. This trail is a 7-mile-long decommissioned rail bed that provides hiking opportunities on wide dirt and gravel trails and paved pathways. Temporary impacts during construction would include temporary trail closure. Northwest would identify convenient times for construction, schedule the trail closure to occur mid-week, and expedite construction. Safety fencing would be installed around construction work areas. Northwest would notify recreational users of the closure via publications and signage. Following construction, the area would be restored in coordination with King County Parks.

The Pacific Northwest National Scenic Trail is a 1,200-mile hiking trail running from the Continental Divide in Montana, through the northern panhandle of Idaho, to the Pacific coast of Washington's Olympic Peninsula. The trail provides backpacking, camping, hiking, horseback riding, sightseeing, and wildlife viewing. The Mt. Vernon North B Loop would cross the Pacific Northwest National Trail at MP 1456.6. Additionally, about 0.4 mile of the trail would be used as an access road during construction and operation of the pipeline. Construction would result in temporary traffic delays and trail closure. Northwest would identify convenient times for construction, limit the trail closure to one day with a detour if necessary, and expedite construction. During construction, Northwest would maintain traffic flow and emergency vehicle access. Safety fencing would be installed as needed around to prevent access to construction areas. Publications and signage would notify recreational users of detours and the closure. Following construction, the area would be restored in coordination with the U.S. Forest Service.

Conservation Easement Land

Most commonly developed as a tool for conserving private lands, conservation easements are legal agreements established between the landowner and a land trust or government agency in an effort to preserve and protect the land and conservation values by limiting uses and development. In addition to county, local, or private conservation easement programs, several national programs are managed by the NRCS, and the USDA Farm Service Agency (FSA).

County Conservation Easements

Between MPs 1460.4 and 1461.7, the Mt. Vernon North B Loop would cross the Southfork Nooksack River Recreation Area, which is managed for agriculture, open space recreation use, wildlife habitat, and fish enhancement. The area includes the Foxglove, Catalyst, Riverstead, and East Acme Farm Conservation Easements. Foxglove Conservation Easement is mostly forested, with a stream corridor in the western portion, and contains approximately 65 protected species that likely present opportunities for wildlife viewing. Catalyst Conservation Easement includes Landing Strip Creek and hay land, which is being converted to forested wetlands. Riverstead Conservation Easement is a mostly forested area. East Acme Farm was donated to Whatcom County Parks and Recreation for use as a public park. East Acme Farm is mostly forested and was established to preserve the ecological and wildlife habitat and to protect scenic, agricultural, recreational, and open spaces. South Fork Park would be crossed at MP 1461.7. The park includes hay land with proposed future improvements.

Construction would result in temporary traffic delays, closures of open space areas, and disruption to recreational uses, including fishing activities. Northwest would expedite construction and maintain traffic flow and emergency vehicle access. Safety fencing would be installed as needed around to prevent access to construction areas. Publications and signage would notify recreational users of detours and the closure. The permanent right-of-way would remain cleared of trees or other deep-rooted vegetation. Following construction, the area would be restored in coordination with Whatcom Land Trust and Whatcom County Parks and Recreation. Potential mitigation for impacts on wildlife habitat could include purchase of adjacent parcels, specifically in the Wickersham area, in consultation with the appropriate agencies.

The Mt. Vernon North B Loop would also pass within 0.25 mile of two additional Whatcom County Land Trusts: Innis Creek and South Fork Chinook-Roos. These land trusts would not be directly impacted by the WEP.

Conservation Reserve Program/Conservation Reserve Enhancement Program Lands

The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with federal, state, and tribal environmental laws, and encourages environmental enhancement. The CRP reduces soil erosion, protects the nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices (FSA, 2013a). In Washington, CRP parcels are primarily east of the Pacific Crest in the agricultural valley areas (FSA, 2013b).

The Conservation Reserve Enhancement Program (CREP) is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. The program is a partnership among producers; tribal, state, and federal governments; and, in some cases, private groups. CREP is an offshoot of the CRP (FSA, 2013a). In western Washington, CREP parcels are limited to agricultural parcels containing riparian corridors along streambanks of salmon-bearing streams (FSA, 2013b).

Because the list of participating CRP and CREP parcels typically changes frequently prior to construction, Northwest would identify eligible parcels as part of its land acquisition process and a complete list of affected parcels would be provided in the Implementation Plan. Prior to construction, Northwest would contact landowners of agricultural parcels to identify participating CRP or CREP parcels. If active CRP or CREP parcels are identified within the construction workspace, Northwest would coordinate with landowners and the FSA to ensure no negative impact on CRP or CREP benefits to participating landowners. Mitigation would include, but not be limited to, topsoil stripping from actively cultivated areas and replacement following construction, and restoration of parcels to preconstruction conditions**.**

Wetlands Reserve Program Lands

The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, and restoration cost-share agreements. The WRP strives to address the following issues on private and public lands: restoration of the functional role of wetlands in agricultural ecosystems; development of habitat for migratory birds; restoration and preservation of ancient crop areas for traditional, cultural practices, and subsistence; and restoration and connectivity of aquatic and riparian habitat for endangered species (NRCS, 2013b).

The Snohomish Loop construction right-of-way would cross four WRP parcels owned by a single landowner between MPs 1401.1 and 1402.4. These parcels are traversed by Northwest's existing right-of-way and have been participating in the WRP since August 2011. Impacts on these parcels would be temporary and adjacent to Northwest's existing permanent right-of-way. WRP parcels are not maintained for recreational purposes, and any agricultural, habitat, or wetland areas would be restored as described in the ECRP provided as appendix J1. Northwest consulted with the NRCS regarding revegetation efforts for the WEP in 2012. Northwest would continue to consult with the NRCS and the landowner of the WRP parcels identified to ensure that the construction right-of-way is restored to preconstruction conditions. There would be no permanent impacts on these parcels due to construction or operation of the WEP; therefore, WRP benefits to the participating landowner would not be affected.

4.2.9.11 Special Land Use Areas

Airports

The Sumner North A Loop would cross the property of Crest Airpark at MP 1360.7 about 100 feet south of the runway. Crest Airpark is a public airfield in King County with 332 small aircraft. Northwest plans to consult with the FAA to resolve any potential concerns or impacts due to construction or operation of the WEP, and seek compliance and approval of a Notice of Proposed Construction or Alteration (FAA Form 7460-1), if necessary. Northwest would address any needs involving safety lighting that would trigger FAA consultation and approval. **We recommend that:**

- **<u>Prior to construction</u>, Northwest should file with the Secretary documentation of the FAA's approval of a Notice of Proposed Construction or Alteration, if required, and the FAA's approval of Northwest's final plans for construction on the Crest Airpark public airfield property, including safety lighting.**

Hazardous Waste Sites/Landfills

No known EPA National Priorities List (EPA, 2012b) sites or landfills would be within 0.25 mile of the WEP. WA Ecology's Cleanup Site Search database (WA Ecology, 2012c) contains 203 potential contaminant sources within 0.25 mile of the WEP. Of these, 63 sites would be within 250 feet of the pipeline construction right-of-way, and 20 sites would be crossed by the pipeline or within construction work areas (see table 4.2.9-11). Most of the 20 sites are cleanup sites and temporary construction stormwater sites. There are five active hazardous waste generator listings, all of which are pipeline facilities, including four operated by Northwest. However, because the WEP pipeline would be within an existing pipeline corridor, the pipeline would be unlikely to encounter new areas of soil contamination. Additionally, the relatively shallow depth of the pipeline trench reduces the likelihood of encountering contaminated groundwater.

During construction, Northwest would monitor trenching operations to identify potentially contaminated soils by visual inspection for stained soils, groundwater sheen, or suspect odors. In the unlikely event that contaminated soils or groundwater are encountered during construction, Northwest would follow protocol in its Unanticipated Discovery of Contamination Plan (see appendix J2). This plan includes procedures to test for contaminants if suspect soils are encountered as well as management and disposal of contaminated soils at a licensed disposal facility. In addition, if any hazardous waste is encountered during pipeline construction, Northwest would dispose of it at an approved facility in accordance with applicable federal, state, and local guidelines.

Table 4.2.9-11

Potential Contaminant Sources within 250 feet of the WEP Pipeline

Facility Common Name	Description	Closest Milepost	Distance from Construction Right-of-way (feet)
Cowlitz County			
Oil Re Refining Co Woodland	Hazardous Waste Generator	1244.4	216.7
Northwest Pipeline GP Kalama Farm Tap	State Cleanup Site	1251.3	0.0
Angelo Private Road	Construction SW GP	1251.3	190.0
Level 3 Communications Kalama	Emergency/Haz Chem Rpt TIER2	1252.8	0.0
Northwest Pipeline Corp Kelso	Hazardous Waste Generator	1262.5	211.3
Northwest Pipeline Kelso Longview MS	Voluntary Cleanup Sites	1262.6	0.0
Olympic Pipeline Company	State Cleanup Site	1269.8	4.3
Castle Rock Meter Station	State Cleanup Site	1270.4	0.0
Lewis County			
Cowlitz Bend Dairy	Dairy	1281.4	96.6
Toledo Drop Box	Recycling	1283.6	2.9
Northwest Pipeline Corp Toledo	Hazardous Waste Generator	1283.9	0.0
Toledo Meter Station NW Pipeline	Voluntary Cleanup Sites	1284.2	40.6
Northwest Pipeline Winlock MS	Voluntary Cleanup Sites	1286.9	69.4
NW Pipeline Chehalis Comp S Jackson PR Meter Station	Air Qual Oper Permit Source	1289.5	21.4
MacMillan Rest Home Tap	State Cleanup Site	1294.5	0.0
Chehalis Gate Station Puget Sound Energy	State Cleanup Site	1298.2	74.3
Pierce County			
Level 3 Communications Puyallup	Emergency/Haz Chem Rpt TIER2	1338.4	105.8
Southern Painting & Blasting	Hazardous Waste Generator	1338.7	218.1
IDX Seattle	Air Qual Local Authority Reg	1338.9	0.0
Seattle First National Bank	Hazardous Waste Generator	1339.3	173.7
South Tacoma Delivery Meter Station	Voluntary Cleanup Sites	1339.3	0.0
Kuney Const	Urban Waters	1339.5	2.8
Starvation Valley	State Cleanup Site	1339.5	164.7
64th & 176th LLC	Construction SW GP	1339.5	197.5
Tryquest	Energy Recovery	1339.5	204.2
Roy H & Lisa Delavergne	Recycling	1340.6	199.5
Meridian Greens	Construction SW GP	1342.9	123.2
Puyallup Rainier Terrace Meter Station	Voluntary Cleanup Sites	1343.3	0.0
Flash 1 Hour Photo	State Cleanup Site	1343.9	75.1
Goodyear Tire and Rubber Company	LUST Facility	1343.9	179.2
VIP Cleaners	Hazardous Waste Generator	1343.9	81.0
Rainier Enterprises Inc.	Hazardous Waste Generator	1343.9	112.9
US Filter EOS MASCA	Emergency/Haz Chem Rpt TIER2	1344.7	0.0
Microchip Technology INC	Hazardous Waste Generator	1344.7	181.7
Group Health Puyallup	Construction SW GP	1344.7	121.3
Shaw Road Extension	Construction SW GP	1347.1	190.3
Jose's Garage	Urban Waters	1348.5	99.2
Jay Lees Honda of Sumner	Local Source Control	1349.5	229.2
King County			
Blackburn Property	State Cleanup Site	1359.7	118.1
Northwest Pipeline Covington MS	Hazardous Waste Generator	1362.8	0.0

Table 4.2.9-11

Potential Contaminant Sources within 250 feet of the WEP Pipeline

Facility Common Name	Description	Closest Milepost	Distance from Construction Right-of-way (feet)
Cornerstone Plat	Construction SW GP	1362.8	0.0
Kent City Clark Springs	Emergency/Haz Chem Rpt TIER2	1362.9	179.6
Knudsen Oil Environmental SV	Hazardous Waste Generator	1363.4	164.7
Sunset Walk at Issaquah Highlands	Construction SW GP	1376.7	174.0
Black Nugget Mine NE Creek	State Cleanup Site	1377.2	198.8
Lots 21-34 of Issaquah Highlands Division 93	Construction SW GP	1377.4	0.0
Plateau Park	Construction SW GP	1377.7	155.1
Northwest Pipeline North Bend MS	Hazardous Waste Generator	1379.1	0.0
2010 Pavement Program Local Streets	Construction SW GP	1379.7	202.8
Snohomish County			
Northwest Pipeline Snohomish Compressor Station	Air Qual Local Authority Reg	1394.0	176.9
North Seattle Delivery Lateral Expansion Project	Construction SW GP	1397.1	21.7
139th Ave SE Site	Hazardous Waste Generator	1399.8	114.2
Northwest Pipeline Snohomish MS	Voluntary Cleanup Sites	1402.9	50.1
ARB Inc.	Hazardous Waste Generator	1408.5	0.0
Skagit County			
Northwest Pipeline Mt Vernon C/S	Hazardous Waste Generator	1440.1	0.0
Mt. Vernon Compressor Station	Underground Storage Tank	1440.2	168.9
WA AGR M MT Vernon 3	Hazardous Waste Generator	1440.6	217.4
Anacortes Mt. Vernon Meter Station	Voluntary Cleanup Sites	1440.6	0.0
Sedro Woolley Facility Modifications	Construction SW GP	1445.0	0.0
Whatcom County			
Northwest Pipeline Lynden	State Cleanup Site	1478.7	128.6
Bellingham No 2 Delivery Meter Station	Voluntary Cleanup Sites	1480.5	0.0
Jones Rd Dairy	Dairy	1484.5	0.0
Northwest Pipeline Sumas Compressor Station	Hazardous Waste Generator	1484.5	63.8

Cemeteries

No known cemeteries or burial grounds have been identified within 50 feet of the construction right-of-way. The nearest cemetery would be about 325 feet east of the ATWS at MP 1408.5 in the community of Machias. It is unlikely that the cemetery would be affected by project construction or operation. Section 4.2.11 provides additional information regarding sites of cultural or historic significance near the project area and any potential impacts and mitigation.

4.2.9.12 Visual Resources

Typical construction practices with potential to impact visual resources include vegetation removal, trenching, fugitive dust, equipment, and soil storage. Most of these visual changes would be minor and short term; however, there would be some long-term impacts on visual resources, depending on the type of vegetation that is removed. Because the pipeline would be constructed primarily along an existing right-of-way where land disturbance has already occurred, vegetation clearance would be limited.

Efforts would be made throughout the construction phase to reduce the visual impacts on the surrounding residents, such as minimizing the removal of vegetation where practical. Stockpiled materials would be removed or reused on site as soon as practicable.

Visual impacts are expected to occur within the Sumner North Loop B where the pipeline would traverse the West Tiger Mountain NRCA. Summits of the NRCA are also visually important along Issaquah-Hobart Road west of Tiger Mountain State Forest, which the pipeline would cross at MP 1371.9 and immediately adjacent to MP 1372.9. Of the three summits within the NRCA, the Poo-Poo Point area is the summit would be closest to the pipeline, about 0.5 mile east. Hiking trails provide recreational users western-facing views along an existing east-west transmission line corridor (WDNR, 1997). Casual observers and hikers in the area would have the potential to see the pipeline; however, because of the temporary nature of surface disturbance during construction activities, the views from this area are not likely to be permanently impacted. No other areas along the pipeline have been designated as visually sensitive, are managed for the protection of visual resources, or have been designated for Visual Resource Management classification.

Forest and natural landscape would be present along the project. However, about 94 percent of the loops would be collocated within Northwest's existing right-of-way, and linear utilities (including pipelines, transmission lines, and roads) are common visual intrusions in the project area. The minor offsets from the existing pipeline right-of-way would be generally adjacent to the existing right-of-way and unlikely to result in visual impacts. About 70 percent (4.1 miles of the total 5.8 miles) of the deviations would occur within nonforested areas or occur immediately adjacent to the existing right-of-way, which would minimize tree clearing and potential associated visual impacts.

No visual impacts would be associated with the modifications at the compressor stations. These are all large, existing facilities and the existing views into the stations are of a large, fenced, graveled, or paved area containing assorted buildings and equipment. The compressor station tie-in assemblies would be primarily at, or immediately adjacent to, existing aboveground facilities operated by Northwest within the compressor station yards, which would minimize changes to the existing visual setting of the area. Pipe storage and contractor yards would be in existing commercial and industrial facilities or on vacant lots. Their use during construction would therefore not result in visual impacts.

Aboveground piping surfaces and structures would be sandblasted and painted in accordance with Northwest's construction specifications. Northwest would use dark green, nonreflective paint to blend into landscape backdrops. A reflective material may be used to reduce hazards that occur when such structures are near roadways. This material would conform to any coloring and screening requirements outlined by the OSHA. All paint inspection and cleanup would be conducted in accordance with regulatory requirements and best engineering practices.

After construction, Northwest would return the pipeline right-of-way to its preconstruction condition. The construction area has been constricted in several places to avoid effects on large trees and other vegetation that currently serve as a visual screen to residences. In some instances, areas adjacent to the existing right-of-way support mature timber, which would be cleared during construction. This would result in longer-term visual impacts as it would take many years to regenerate mature trees. Northwest would revegetate these areas in compliance with state and local permits and landowner agreements.

4.2.10 Socioeconomics

4.2.10.1 Population

The counties that would be crossed by the WEP vary widely in their population totals and densities (see table 4.2.10-1). The least populated county is Lewis County, with a total population of 75,445 and a population density of 31.4 persons per square mile. The second most rural county is Skagit County, with a total of 116,901 residents and a density of 67.5 persons per square mile.

The population shows highest increases in King County, which includes the cities of Seattle and Bellevue, with a population of 1,931,249 and a density of 912.9 persons per square mile.

From 2000 to 2010, each of the counties that would be crossed by the WEP experienced noticeable growth in population (see table 4.2.10-1). In particular, the rural counties of Skagit and Whatcom experienced population increases of 13.5 and 20.6 percent, respectively. Snohomish County, on the northernmost edge of the Seattle-Bellevue-Everett population center, experienced a noticeable increase of 17.7 percent.

Table 4.2.10-1

Socioeconomic Conditions in the Areas Crossed by the WEP

State/County	Population (2010) [a]	Population Change (percent) (2000–2010) [a]	Population Density (persons/square mile) (2010) [a]
Washington State	6,724,540	14.1	101.2
Cowlitz	102,410	10.2	89.8
Lewis	75,445	10.0	31.4
Thurston	252,264	21.7	349.4
Pierce	795,225	13.5	476.3
King	1,931,249	11.2	912.9
Snohomish	713,335	17.7	341.8
Skagit	116,901	13.5	67.5
Whatcom	201,140	20.6	95.5

[a] Source: U.S. Census Bureau, 2010.

Northwest would begin construction in the third quarter of 2017 and be completed by the fourth quarter of 2018. The total peak labor requirement during construction would be about 1,400 workers, with a maximum of 350 people working on any one spread at any one time. The workforce would include both local and nonlocal workers. Northwest estimates that up to 30 percent of the workforce would consist of local hires and 70 percent nonlocal hires. Additional nonlocal workers would temporarily relocate to the project area and would include construction specialists, supervisory personnel, and various inspectors (e.g., welding, utility, and environmental) hired by either Northwest or the construction contractor.

Impacts on the local populations as a result of construction would be localized and temporary. The total population change would result from an influx of nonlocal workers and any of their family members who may also relocate temporarily. Given the brief construction period, most nonlocal workers are expected to relocate without family members and then return to their place of residence following completion of construction. Assuming 70 percent of the workers are nonlocal hires and about 20 percent of the nonlocal hires would bring 3 family members each, a total of about 1,568 nonlocal personnel,

including family members, may temporarily relocate to the area during peak construction. If up to 20 percent of the 210 (average) to 245 (peak) nonlocal workers brought 3 family members with them, the total temporary increase in population along any one spread would be about 336 to 392 persons. The total impact on any one county would be a population increase of 0.3 percent or less. Therefore, as pipeline construction would be distributed along eight counties, the project is not expected to have a significant impact on the local population in any of the eight counties.

Operation of the WEP would not require additional permanent employees as existing Northwest staff would operate the new loops and compressor station modifications along with the existing Northwest pipeline system. As a result, operation of the pipeline would not affect the local population.

4.2.10.2 Economy and Employment

Personal per capita income is relatively consistent across the project area, with the notable exceptions of Lewis and King Counties (see table 4.2.10-2). Lewis County has the lowest personal per capita annual income ($21,695) and King County has the highest ($38,211). The remaining counties range between $22,948 and $30,635. Of all the counties traversed, only King and Snohomish Counties have higher personal per capita incomes than the statewide average of $29,733.

The available labor pool in the project area is directly related to the population within each county. Lewis County has the smallest labor pool (29,930), and King County has the largest labor pool (1,125,290).

Unemployment rates in each of the counties crossed by the WEP range between 7.6 and 12.3 percent. Lewis County has the highest unemployment rate (12.4) and Whatcom County has the lowest unemployment rate (7.6). Thurston, King, and Whatcom Counties have unemployment rates below the statewide average of 8.4 percent. Cowlitz, Lewis, Pierce, Snohomish, and Skagit Counties have unemployment rates above the statewide average. According to the U.S. Census Bureau (2010), in each of the counties crossed by the WEP, the industry with the greatest number of employees is Educational Services, Healthcare, and Social Assistance (see table 4.2.10-2).

Table 4.2.10-2

Economic Characteristics of Counties Crossed by the WEP

State/County	Personal Annual Per Capita Income (2010) [a]	Civilian Labor Force (2012) [b]	Percent Unemployed (2012) [b]	Top Industries by Employment (2010)
Washington State	$29,733	3,528,190	8.4	Educational Services, Healthcare, and Social Assistance (21.0%); Professional, Scientific, Management, Administrative, and Waste Management Services (11.8%); Retail Trade (11.6%)
Cowlitz	$22,948	43,170	10.8	Educational Services, Healthcare, and Social Assistance (23.4%); Manufacturing (14.7%); Retail Trade (11.5%)
Lewis	$21,695	29,930	12.3	Educational Services, Healthcare, and Social Assistance (21.7%); Retail Trade (13.2%); Manufacturing (10.4%)
Thurston	$29,707	127,320	7.8	Educational Services, Healthcare, and Social Assistance (21.4%); Public Administration (19.0%); Retail Trade (10.5%)

Table 4.2.10-2

Economic Characteristics of Counties Crossed by the WEP

State/County	Personal Annual Per Capita Income (2010) [a]	Civilian Labor Force (2012) [b]	Percent Unemployed (2012) [b]	Top Industries by Employment (2010)
Pierce	$27,446	385,690	9.0	Educational Services, Healthcare, and Social Assistance (21.9%); Retail Trade (12.3%); Manufacturing (10.0%)
King	$38,211	1,125,290	7.8	Educational Services, Healthcare, and Social Assistance (19.4%); Professional, Scientific, Management, Administrative, and Waste Management Services (17.1%); Manufacturing (11.3%)
Snohomish	$30,635	391,530	8.8	Educational Services, Healthcare, and Social Assistance (18.7%); Manufacturing (15.2%); Retail Trade (12.2%)
Skagit	$26,925	57,640	8.8	Educational Services, Healthcare, and Social Assistance (20.1%); Retail Trade (13.7%); Manufacturing (11.9%)
Whatcom	$25,407	108,280	7.6	Educational Services, Healthcare, and Social Assistance (21.4%); Retail Trade (13%); Arts, Entertainment, Recreation, Accommodation and Food Services (11.3%)

[a] Source: U.S. Census Bureau, 2010.
[b] Source: Workforce Explorer, 2012.

A total of about 1,400 construction jobs (skilled and unskilled labor) would be created during peak construction. About 420 jobs (30 percent of the required project workforce total) would be created for local workers already living in counties where construction is occurring. Northwest would attempt to maximize the number of local workers hired, given levels of experience required, union agreements and contractor hiring practices at the time of construction. Construction-related jobs are expected to last for about 3 to 12 months, although some functions may last for slightly longer periods. Local contracting firms hired to perform specialty functions, such as right-of-way restoration, may create additional local jobs. Employment of workers during construction would result in a total estimated payroll of about $135 million. The total direct construction costs, including payroll and expenditures on goods, equipment, and services would be almost $1.1 billion.

Construction of the WEP would stimulate indirect jobs and associated labor income. Additionally, construction workers would purchase goods and services at local businesses, generating induced jobs and income. Northwest does not plan to hire additional full-time personnel and therefore, while beneficial, employment impacts are expected to be primarily short term.

4.2.10.3 Tax Revenues

Construction workers would purchase goods and services at local businesses, generating about $204,000 in sales tax revenue. In addition, state and local governments would receive increased property tax revenues for the life of the project, resulting in long-term economic benefits. Northwest estimates that property tax would generate about $12.9 million in annual revenue. Table 4.2.10-3 presents the projected annual property tax benefit by county crossed by the WEP. These taxes would be assessed at the county level and are based on the percentage of total pipeline mileage in a given county.

Table 4.2.10-3

Projected Annual Property Tax by County

County	Revenue (millions of dollars)
Cowlitz County	$2.2
Lewis County	$1.9
Thurston County	$0.6
Pierce County	$1.9
King County	$1.5
Snohomish County	$1.7
Skagit County	$1.3
Whatcom County	$1.8
Total	**$12.9**

4.2.10.4 Housing

Housing statistics for the counties crossed by the WEP are presented in table 4.2.10-4. During 2010, most of the counties had a rental vacancy rate less than that of the state (5.5 percent), with the exception of Lewis (11.8 percent) and Pierce (5.9 percent) Counties. The highest median gross monthly rent rates were in King and Snohomish Counties ($1,037 and $1,036, respectively). Monthly rent rates in the remaining counties were similar to the state ($953) with the exception of Cowlitz and Lewis Counties, which had the lowest rates ($683 and $689, respectively).

Table 4.2.10-4

Existing Housing Characteristics in Counties Crossed by the WEP (2010)

State/County	Total Housing Units	Total Vacant Housing Units	Total Vacant Housing Units (percent)	Rental Vacancy Rate (percent)	Median Gross Monthly Rent
Washington State	2,901,351	276,662	9.5	5.5	$953
Cowlitz County	43,303	3,696	8.5	5.5	$683
Lewis County	33,806	4,553	13.5	11.8	$689
Thurston County	107,121	7,305	6.8	4.5	$960
Pierce County	324,110	26,130	8.1	5.9	$931
King County	846,773	57,148	6.7	4.7	$1,037
Snohomish County	284,997	18,107	6.4	4.9	$1,036
Skagit County	51,145	5,678	11.1	4.1	$875
Whatcom County	90,225	10,973	12.2	4.4	$809

Source: U.S. Census Bureau, 2010.

Temporary housing is also available in the form of daily, weekly, or monthly rentals in hotels, motels, campgrounds, and trailer parks. There are about 5 trailer courts or mobile home parks and 12 recreational vehicle campsites within 10 miles of the project, in addition to numerous hotels and apartment complexes available for short-term lease to house workers temporarily.

Because the construction period would be relatively short and most nonlocal workers would temporarily relocate without their families, most workers would be expected to use temporary housing such as hotels, motels, apartments, and campsites/recreational vehicle sites within commuting distance of the project area. There is a greater demand for temporary housing during the summer months when

tourism is highest. Construction would commence during the peak tourism season and temporary housing may be either more difficult to find or more expensive during this time. Should housing become limited in the immediate vicinity, workers may have to commute greater distances or move to larger cities such as Seattle and Portland. Temporary camps would not be necessary to accommodate construction workers.

Construction may affect the availability of temporary housing in the project area; however, the number of vacant units and the vacancy rates within counties crossed by the WEP suggests the project area could absorb the estimated temporary workforce over the construction period, some of which would be drawn from the local workforce. Temporary housing availability would vary, but because the estimated workforce is small relative to the overall population and housing availability in the project area, pipeline construction would not have a significant effect on the local housing markets. Construction of the project would provide the benefit of increasing occupancy of vacant housing units, hotel/motel rooms, and campsites/recreational vehicle sites. Project construction would also provide a temporary increase in rental income and local spending.

4.2.10.5 Property Values

The potential impact that an infrastructure or pipeline project might have on the value of a particular tract of land depends on the current characteristics of the property, such as the size of the tract, the presence of other utilities, the current property value (excluding improvements), and the current land use. Decisions to purchase a property are often based on the purchaser's plans for the property, such as use for agriculture, future residential development, a second home, or commercial/industrial development. If the presence of the pipeline interferes with those future plans, the potential buyer may decide against acquiring the property with a pipeline easement. In 2001, the Interstate Natural Gas Association of America conducted a study of four communities (in various locations around the United States) and determined that the presence of a pipeline had no significant impact on the sale price or demand for properties along pipeline rights-of-way. This trend holds true for the project area, as evidenced by a study conducted by Whatcom County, which determined that the presence of a pipeline had little effect on future sales, even in an area where a pipeline incident had occurred (Whatcom County, 2001).

Further, the project includes the installation of a pipeline within an existing right-of-way, wherever possible; therefore, potentially affected landowners already have existing natural gas pipeline(s) of similar size and operating pressure as the pipeline on their property and the pipeline would not further restrict a property owner's ability to make improvements beyond the limitations already placed on the property by the existing right-of-way. The potential for impacts on property values is related primarily to construction activities that result in impacts that cannot be restored in the short term, principally large tree removal and changes in fence lines. Northwest would make every effort to work with property owners to retain large trees and tree screens where practicable. The impact of replacement of other items (such as landscaping, lawns, fences, and decorative features) is typically short term in nature and would be addressed with each affected landowner. Agreements between Northwest and individual landowners with regard to construction damages would mitigate potential property value impacts. As the pipeline would be almost exclusively within the existing right-of-way, there would be no significant operational impacts on property values.

4.2.10.6 Public Services

Utilities

A list of major utilities currently crossed by the existing permanent right-of-way along the WEP loops is provided in appendix I7. During construction temporary interruptions of services may occur; however, these disruptions would have only minor, temporary impacts.

Temporary service from local utilities, including electricity, would be needed at the contractor and pipe storage yards if not already present. Water for hydrostatic testing and dust control would also be required for pipeline construction and operation (see section 4.2.3.2). However, no construction or expansion of wastewater and stormwater treatment facilities would be required for the project.

Government and Emergency Services

Table 4.2.10-5 summarizes public services available in the larger cities that would be near the WEP, including Longview, Olympia, Tacoma, Seattle, Bellevue, Everett, Mt. Vernon, and Bellingham. There would be 8 local police departments, 8 sheriff's offices, and 8 fire departments with 83 stations.

Table 4.2.10-5

Emergency Services in Larger Cities Near the WEP

City	City Fire	No. of Fire Stations	City Police Departments	County Law Enforcement
Longview	City of Longview Fire Department	2	Longview Police Department	Cowlitz County Sheriff's Office
Olympia	City of Olympia Fire Department	4	City of Olympia Police Department	Thurston County Sheriff's Office
Tacoma	Tacoma Fire Department	17	Tacoma Police Department	Pierce County Sheriff's Office
Seattle	City of Seattle Fire Department	36	Seattle Police Department	King County Sheriff's Office
Bellevue	City of Bellevue Fire Department	9	City of Bellevue Police Department	King County Sheriff's Office
Everett	City of Everett Fire Department	6	Everett Police Department	Snohomish County Sheriff's Office
Mt. Vernon	City of Mt. Vernon Fire Department	3	Mt. Vernon Police Department	Skagit County Sheriff's Office
Bellingham	City of Bellingham Fire Department	6	Bellingham Police Department	Whatcom County Sheriff's Office

Table 4.2.10-6 provides information for the 45 fire districts that would be crossed by the WEP.

Table 4.2.10-6

Fire Districts Crossed by the WEP

County	Fire District	Approximate Mileposts
Cowlitz	Woodland	1244.3 to 1246.3
	Kalama	1246.3 to 1254.8
	Cowlitz 2 Fire and Rescue	1254.8 to 1266.2
	Castle Rock	1266.2 to 1279.3
Lewis	Toledo	1280.2 to 1283.9
	Winlock	1283.9 to 1284.5
	Toledo	1284.5 to 1286.4
	Winlock	1286.4 to 1289.5

Table 4.2.10-6

Fire Districts Crossed by the WEP

County	Fire District	Approximate Mileposts
	Napavine	1291.3 to 1294.9
	Chehalis	1294.9 to 1298.4
	Centralia	1298.4 to 1307.4
Thurston	Gibson Valley	1307.4 to 1307.4
	Tenino	1309.1 to 1310.9
	South East Thurston Fire/EMS	1313.9 to 1315.6
Pierce	Central Pierce Fire and Rescue	1338.0 to 1338.5
	Graham Fire and Rescue	1338.5 to 1340.7
	Central Pierce Fire and Rescue	1340.7 to 1347.3
	East Pierce Fire and Rescue	1347.3 to 1351.8
King	Mountain View Fire and Rescue	1356.9 to1361.7
	Kent	1361.7 to 1362.0
	Maple Valley Fire and Life Safety	1362.0 to 1362.8
	Kent	1362.8 to 1363.9
	Maple Valley Fire and Life Safety	1363.9 to 1363.9
	Eastside Fire and Rescue	1370.9 to 1375.0
	Issaquah	1375.0 to 1375.2
	Eastside Fire and Rescue	1375.2 to 1375.4
	Issaquah	1375.4 to 1376.1
	Eastside Fire and Rescue	1376.1 to 1376.5
	Issaquah	1376.5 to 1377.1
	Eastside Fire and Rescue	1377.1 to 1379.2
	Sammamish	1379.2 to 1381.9
Snohomish	Snohomish County FD 07	1393.8 to 1397.7
	Monroe	1397.7 to 1398.1
	Snohomish Fire-Rescue	1398.1 to 1401.0
	Monroe	1401.0 to 1401.4
	Snohomish Fire-Rescue	1401.4 to 1408.0
	Lake Stevens	1408.0 to 1409.4
Skagit	Big Lake	1435.7 to 1438.6
	Clear Lake	1438.6 to 1440.2
	Clear Lake	1440.2 to 1444.9
	Sedro-Woolley	1445.0 to 1445.0
	Sedro-Woolley	1453.5 to 1456.5
Whatcom	Acme/Van Zandt	1456.5 to 1461.9
	Everson/Deming/Nooksack	1478.6 to 1480.4
	Whatcom County FD 14	1480.4 to 1484.5

Source: FEMA, 2012.

Table 4.2.10-7 lists the 40 fire stations that would be within 5 miles of the pipeline and table 4.2.10-8 lists the 37 police and sheriff stations that would be within 5 miles of the pipeline.

Table 4.2.10-7

Fire Districts and Stations within 5 Miles of the Pipeline Loops

County	Fire District/Station	Distance to Pipeline	Nearest Milepost
Clark County	Clark County Fire Protection District #2	3.4	1244.3
Cowlitz County	Cowlitz County Fire District #1	2.4	1244.3
	Woodland Fire Department	1.8	1244.3
	Cowlitz County Fire District #5	2.5	1252.4
	Cowlitz 2 Fire and Rescue	1.9	1262.2
	Longview Fire Department Station 81	3.8	1262.2
	Castle Rock Fire and EMS	1.2	1270.4
	Cowlitz County FPD #6	1.2	1270.4
Lewis	Lewis County Fire District #5	1.6	1292.2
	Lewis City Fire District #6	3.3	1298.0
	Chehalis Fire Department	4.9	1298.3
	Centralia Fire Department	4.2	1301.6
Thurston	Bucoda Volunteer Fire Department	4.5	1305.5
	Thurston County Fire District #4/Rainier	2.5	1315.6
Pierce	Central Pierce Fire & Rescue-Pierce County	2.1	1338.4
	Pierce County Fire District #21	2.6	1340.3
	Pierce County Fire District #18	3.3	1344.1
	Puyallup Fire and Rescue	2.5	1346.9
	Pierce County Fire District #11	2.2	1347.4
	Sumner Fire Department	0.8	1348.1
	Pierce County Fire Protection District	1.9	1349.6
	Pierce County Fire District #8	4.0	1351.7
King	Pacific Fire Department	3.0	1351.8
	Auburn Fire Department	4.0	1357.0
	Black Diamond Fire Department	0.7	1358.5
	King County Fire District #44	0.7	1358.5
	Maple Valley Fire and Life Safety	2.4	1363.9
	Eastside Fire and Rescue	1.4	1375.8
	King County Fire Protection District #45	4.6	1393.8
Snohomish	Snohomish County Fire District #7	3.0	1397.4
	Monroe Fire-Snohomish County Fire District	3.0	1398.9
	Snohomish Fire and Rescue	2.5	1404.9
	Snohomish County Fire District #8	2.2	1409.1
Skagit	Skagit County Fire Protection District	4.8	1437.5
	Skagit County Fire District #9	1.4	1438.7
	Mt. Vernon Fire Department	4.7	1440.9
	City of Sedro-Woolley Fire Department	2.1	1445.0
	Skagit County Fire District #8	4.1	1453.5
Whatcom	Whatcom County Fire District #16	0.3	1461.1
	Whatcom County Fire District #14	1.6	1483.2

Source: FEMA, 2012.

Table 4.2.10-8

Police and Sheriff Stations within 5 Miles of the Pipeline Loops

County	Police/Sheriff Station	Distance to Pipeline	Nearest Milepost
Cowlitz	Woodland Police Department	1.8	1244.3
	Kalama Police Department	2.4	1252.4
	Cowlitz County Sheriff's Office	3.2	1262.3
	Longview Police Department	3.3	1262.3
	Longview Police Department	4.6	1262.3
	Cowlitz Sheriff Chaplain	2.1	1262.3
	Kelso Police Department	1.3	1262.3
	Castle Rock Police Department	1.2	1270.4
Lewis	Toledo Police Department	1.6	1283.2
	Napavine City Police Department	1.7	1292.3
	Lewis County Sheriff Department	4.8	1298.3
	Chehalis Police Department	4.9	1298.3
	Centralia Police Department	4.3	1301.6
Thurston	Rainier Police Department	2.4	1315.6
Pierce	Pierce County Sheriff	1.6	1342.3
	Orting Police Department	4.6	1342.9
	Puyallup Police Department-Jail	2.0	1346.9
	Sumner Police Department	0.8	1348.3
	Bonney Lake Police Department	1.9	1349.6
	Pierce County Sheriff	3.6	1349.6
	Edgewood Police Department	4.0	1351.7
King	Pacific City Police Department	3.0	1351.8
	Algona Police Department	3.8	1351.8
	Auburn Police Department	3.9	1356.9
	Black Diamond Police Department	4.8	1361.6
	Maple Valley Police Department	1.8	1363.9
	King County Sheriff	1.9	1363.9
	Issaquah Police Department	1.2	1375.9
	Fall City Police Department	5.0	1377.2
	Duvall Police Department	4.6	1393.8
Snohomish	Monroe Police Department	3.1	1399.8
	Snohomish County Sheriff	2.6	1401.0
	Snohomish Police Department	2.1	1403.5
	Lake Stevens Police Department	1.2	1409.4
Skagit	Sedro-Woolley Police Department	2.1	1445.0
Whatcom	Everson Police Department	3.1	1478.6
	Sumas Police Department	0.1	1482.2

Source: FEMA, 2012.

Table 4.2.10-9 lists the major hospitals that would be near the WEP. In addition to these 8 hospitals, and there would be 24 additional hospitals within the larger cities along the pipeline route.

Table 4.2.10-9

Hospitals in Larger Cities Near the WEP

City	Largest Hospitals	Number of Beds	Distance from Pipeline to Hospitals (miles)	Number of Other Washington State Hospital Association Hospitals
Longview	Peace Health St. John's Medical Center	170	4.0	0
Olympia	Providence St. Peter Hospital	314	15.9	1
Tacoma	Tacoma General Hospital	391	10.8	6
Seattle	Swedish Medical Center	697	13.4	13
Bellevue	Overlake Hospital Medical Center	257	7.6	0
Everett	Providence Everett Medical Center	362	7.2	2
Mt. Vernon	Skagit Valley Hospital	137	5.0	2
Bellingham	St. Joseph Hospital	253	13.6	0

Source: Washington State Hospital Association, 2012.

Because the influx of nonlocal workforce would be small in any one area compared with the overall population, we conclude that construction would have a minor, temporary impact on emergency services. Project construction may have a temporary impact on local service activities such as permit issuance for vehicle load and width limits, police assistance with traffic flow during road crossings, and medical emergency facilities treatment for any project work-related injuries.

Northwest would work with the local fire departments and other emergency response services to coordinate activities for safe and effective response. Because of current safety regulations governing the construction design, monitoring, and operation of interstate natural gas pipelines, the potential for an accident involving the pipeline is very low. The pipeline would be safely installed and operated according to DOT regulations, and would not be a threat to public safety. Employees must pass operator qualification tests for core competency skills as dictated by DOT's Operator Qualification requirements. Employees would also participate in health and safety training. In addition, Northwest would develop an emergency response plan that includes procedures for minimizing the impacts of a pipeline emergency.

Northwest personnel currently operate the existing pipeline system and would operate the new pipeline. As the pipeline would parallel existing facilities, Northwest is currently engaged with all affected fire departments or other emergency responders, meets routinely, provides hands-on training, and performs mock emergencies to evaluate readiness and deficiencies and identify corrective behaviors. Coordination between Northwest and emergency responders regarding equipment and emergency responses has been ongoing throughout the history of the existing pipelines. Northwest personnel would continue to consult with local fire departments and emergency response agencies to determine whether additional equipment, training, and support are needed, and to provide those resources in the identified areas. Northwest provides these departments with the 24-hour emergency numbers and with verbal, written, and mapping descriptions of the pipeline system.

Additionally, Northwest participates in the Pipeline Association for Public Awareness, a nonprofit corporation that provides educational information concerning pipeline safety and emergency preparedness to residents and businesses located near pipelines, emergency responders and public officials in communities with pipelines, and excavators working near pipelines. The Pipeline Association for Public Awareness maintains an emergency responder capabilities and reporting tool, which allows local emergency response officials and pipeline operators to document and communicate the availability

of emergency response resources and capabilities that may be needed to respond to a local pipeline emergency.

As a result of the safety measures that would continue to be implemented, the pipeline would not have significant adverse impacts on emergency services. See section 4.2.13 for additional information related to pipeline safety.

Schools

The WEP would cross 24 school districts with over 300 public schools. Table 4.2.10-10 provides the number of schools and estimated enrollment for each school district in each county during the 2010–2011 and 2011–2012 school years.

During peak construction, up to 1,568 nonlocal personnel (including family members) may temporarily relocate to communities within the 8 counties traversed by the WEP. Assuming that 20 percent of the nonlocal personal would relocate to the area and bring 3 family members (2 children), up to 392 children could be enrolled in schools in communities near the project. The degree of impact on schools would vary from community to community, depending on the number of workers who elect to stay in each community, the duration of their stay, and the size of the community. However, given the small, temporary influx of workers and families, the likely variation in ages of school-aged children, as well as the number of schools (over 300) within districts crossed by the pipeline, we conclude that school enrollment would not be adversely affected. Construction-related impacts on nearby schools are discussed in section 4.2.9.3.

Table 4.2.10-10

School Districts Crossed by the WEP

County	School District	Number of Schools	Enrollment [a]
Cowlitz	Woodland School District	1 primary school 1 elementary school 1 intermediate school 1 middle school 2 high schools 1 academy	2,200
	Kalama School District	1 elementary school 1 middle school 1 high school	1,050
	Kelso School District	7 elementary schools 2 middle schools 2 high schools 1 academy 1 special education school 1 detention center	5,060
	Castle Rock School District	1 elementary school 1 middle school 1 high school	1,390
Lewis	Toledo School District	1 elementary school 1 middle school 1 high school 1 alternative school	855
	Winlock School District	1 elementary school 1 middle school 2 high schools	790
	Napavine School District	1 elementary school 1 junior/high school	780

Table 4.2.10-10

School Districts Crossed by the WEP

County	School District	Number of Schools	Enrollment [a]
	Chehalis School District	3 elementary schools 1 middle school 1 high school 1 academy 1 detention center	2,910
	Centralia School District	5 elementary schools 1 middle school 1 high school	3,500
Thurston	Tenino School District	2 elementary schools 1 middle school 1 high school	1,265
	Rainier School District	1 primary school 1 middle school 1 high school	900
Pierce	Bethel School District	7 elementary schools 3 junior high schools 1 secondary school 1 high school 1 academy	17,780
	Puyallup School District	21 elementary schools 7 junior high schools 3 high schools 1 alternative school	20,525
	Sumner School District #320	8 elementary schools 3 middle schools 2 high schools	8,230
	Dieringer School District	2 elementary schools 1 middle school	1,430
	Auburn School District [b]	14 elementary schools 4 middle schools 3 high schools 1 alternative school	14,600
King	Auburn School District [b]	14 elementary schools 4 middle schools 3 high schools 1 alternative school	14,600
	Kent School District	28 elementary schools 6 middle schools 4 high schools 2 academies	27,079
	Issaquah School District #411	15 elementary schools 5 middle schools 4 high schools	17,358
	Lake Washington School District	31 elementary schools 12 middle schools 8 high schools	25,408
Snohomish	Monroe School District	5 elementary schools 3 middle schools 3 high schools 1 academy 2 special education schools 1 education center	8,010
	Snohomish School District	10 elementary schools 3 middle schools 5 high schools	10,026

Table 4.2.10-10

School Districts Crossed by the WEP

County	School District	Number of Schools	Enrollment [a]
Skagit	Sedro-Woolley School District	1 preschool 7 elementary schools 1 middle schools 2 high schools	4,280
Whatcom	Mount Baker School District	1 preschool 3 elementary schools 1 junior high school 1 high school 1 academy	2,130
	Nooksack Valley School District	1 preschool 3 elementary schools 1 middle school 1 high school 1 academy	1,600

Source: U.S. Department of Education, 2013.

[a] Enrollment information based on Common Core of Data public school data 2010–2011 and 2011–2012 school years.

[b] Auburn School District encompasses a 62-mile area bridging King and Pierce Counties.

4.2.10.7 Transportation and Traffic

Roadways

The principal highways running generally north to south in the project area are I-5 and I-405. Appendix I8 lists the major, paved state and county roads and railroads that would be crossed by the WEP.

Along with materials storage, the contractor and pipe storage yards would provide a parking/carpooling area for Northwest and construction personnel. The number of additional vehicles on the state and county roads for each loop and compressor station would be disbursed based on the workers' origin and their various destinations. From the contractor and pipe storage yards, Northwest would use existing roads to access the construction right-of-way. Appendix I5 contains a list of existing access roads to be used during construction, along with explanations for their use; the access road locations are shown on the maps in appendix I1.

Temporary impacts on traffic during construction would result from the workforce commuting daily to the construction site. A maximum of 350 people would be working on any one spread at any given time and a maximum of 70 people would be working at a compressor station site. The majority of these individuals would travel to their respective staging areas or compressor stations from various locations prior to peak morning commuting hours and return in the evening after peak evening commuting hours. For each loop, about 280 workers would be transported on crew buses from the staging areas to the construction right-of-way and back again at the end of the day. The remaining individuals (in about 70 light duty trucks) would move from site to site on the construction right-of-way using local roads and highways on a daily basis. Light duty trucks would make two to three daily trips from the staging areas to various areas along the construction right-of-way as construction occurs at multiple locations.

About three to four pipe-stringing trucks would make two round trips per day from the staging area to the construction right-of-way for the duration of construction. Additionally, water trucks and dump trucks would make an average of six trips per day to deliver materials to the construction right-of-

way. The exact route to and from staging areas and the construction right-of-way would vary depending on the current location of construction activity.

Overall, the number and frequency of construction vehicle trips would be low on any particular roadway at any one time because staging areas and construction spreads would be distributed and construction would move sequentially along the construction right-of-way. Trips by vehicles visiting the right-of-way on a regular basis (e.g., crew bus and trucks) would be distributed along the length of the pipeline route as the pipe string is installed and construction activity progresses to a different part of the right-of-way.

Traffic at road crossings would be affected. Northwest has prepared a Traffic Management Plan to minimize impacts and would follow all applicable local, state, and federal traffic control measures. Traffic control measures such as flaggers, warning signs, lights, and barriers would be used during construction to ensure safety and minimize traffic congestion. Additionally, Northwest would implement these standard traffic control measures along all the routes where trucks would be turning on or off a main road. Northwest would also implement additional measures as required during the Washington State Department of Transportation and local permit processes.

Construction impacts on the existing road network would vary depending on the conditions and capacities of the roadways, transportation routes, and construction crossing methods at each road (typically installed using a boring technique or open cut). For open-cut crossings, detours would be established before roads are cut to minimize traffic delays. If a reasonable detour is not feasible, at least one traffic lane of the road would be left open, except for brief periods when road closure would be required. Roadways would be maintained in such a way as to allow access for emergency and private vehicles. Typically, construction interference at each road crossing would last less than 1 day.

The movement of construction equipment and materials to the work areas, as well as the daily commuting of workers, may have a slight impact on road surfaces. To maintain safe conditions and minimize this impact, construction workers would use only designated public roads and approved access roads on private lands for access to the right-of-way and compressor stations.

We received comments regarding the use of Saddleback Road during construction. Prior to any construction-related activities, Northwest would contact the Saddleback Neighborhood Road Maintenance Association to mutually agree on a resolution of their concerns. Northwest would negotiate a fee with the Association for the temporary road usage, utilizing established standards of the industry. Prior to construction, Northwest, at its expense and in collaboration with the Saddleback Neighborhood Road Maintenance Association, would employ the services of a third-party, independent road engineer/firm to evaluate the road's condition. Following construction, the same road engineer/firm would evaluate the condition of the road and develop plans to return it to a condition as good as or better than previously existed.

Northwest would conduct maintenance of the compressor stations periodically and would not affect traffic flow or patterns on any of the roadway systems associated with the WEP. There would be no new permanently assigned personnel at the compressor stations in addition to current personnel.

Rail

The pipeline route includes nine railroad crossings, which Northwest would cross via bore. Northwest would work with railroad owners during land acquisition to make sure all railroad crossings are permitted and designed in accordance with the required engineering specifications. Safety measures

specified in the crossing permits would be implemented to ensure the safety of personnel, property, rail operations, and the public.

4.2.10.8 Native American Treaty Fishing

We received comments from Native American tribes expressing concerns about impacts on treaty fishing rights from pipeline construction. Construction of the WEP may temporarily affect access to tribal usual and accustomed fishing places. Additionally, temporary impacts on fish habitat may affect fish productivity, which could reduce the number of fish available to tribal fisheries. However, these impacts would be localized and short term. The impacts on the fisheries associated with tribal treaty rights would be similar to those described in section 4.2.5.2 for fisheries in general.

4.2.10.9 Environmental Justice

Table 4.2.10-11 describes the ethnic and racial composition and income distribution of the eight counties crossed by the WEP. To assess the minority and low-income composition within pipeline area relative to that of its surroundings, census tract data were compared with county and state data (U.S. Census Bureau, 2010). The minority and low-income composition of census tracts adjacent to those that would be crossed by pipeline is provided in appendix M. The counties that would be traversed by the pipeline vary in population density, with population and overall ethnic diversity increasing near the Seattle-Bellevue-Everett area (Pierce, King, and Snohomish Counties).

Pierce and King Counties have African American populations (6.5 and 6.0 percent, respectively) greater than the state average of 3.9 percent. Census tracts 714.06 and 731.08 in Pierce County, and 521.05 in Snohomish County, have a higher percentage of African Americans (7.3, 8.0, and 5.6 percent, respectively) than the state average of 3.9 percent. Adjacent tracts 714.08, 714.09, 714.10, 714.11, 715.06, 729.06 in Pierce County, and 522.09 in Snohomish County, also have a higher percentage of African Americans than the state average.

Whatcom County has a Native American population (2.5 percent) greater than the state average of 1.8 percent. The population of American Indians and Alaska Natives is higher than state average (1.8 percent) in census tract 15.02 in Cowlitz County (5.8 percent), tract 9509 in Skagit County (4.0 percent), and adjacent tracts 311 and 312.02 in King County and 107.02 in Whatcom County.

King and Snohomish Counties have Asian populations (14.5 and 8.8 percent, respectively) greater than the state average of 7.7 percent. Census tracts 322.10, 322.11, 322.12, 322.13, 322.14, and 323.18 in King County (24.5, 22.6, 14.0, 33.6, 23.5, and 22.6, respectively) have higher Asian populations than the state average of 7.7 percent. Additionally, adjacent tracts 703.16 in Pierce County, 322.03, 322.15, and 323.16 in King County, and 519.26 and 521.07 in Snohomish County also have a higher proportion of Asians when compared to the state average. In this case, each crossed tract with a high Asian population does not have a noticeably higher Asian population when compared to that of surrounding tracts and adjacent tracts, many of which also have high Asian populations.

Pierce County has a population of Native Hawaiians and Other Pacific Islanders (1.3 percent) greater than the state average of 0.7 percent. Census tracts 731.08, 714.06, and 7.13.09 (2.8, 6.4, and 2.2 percent, respectively) and adjacent tracts 714.08, 714.11, and 715.06 in Pierce County have a noticeably higher population of Native Hawaiian and Pacific Islander residents than that of the state (0.7 percent).

Table 4.2.10-11

Demographics and Income Distribution of Census Tracts Crossed by the WEP

	Demographics (2010)							Income (2008–2012)	
Area	**Percent Caucasian**	**Percent African American**	**Percent American Indian and Alaska Native**	**Percent Asian**	**Percent Native Hawaiian and Other Pacific Islander**	**Percent Two or More Races**	**Percent Hispanic or Latino**	**Median Income**	**Percent Persons Below Poverty Level**
Washington State	71.6	3.9	1.8	7.7	0.7	4.3	11.7	$59,374	12.9
Cowlitz County	85.8	0.6	1.3	1.4	0.2	2.9	7.8	$46,568	17.9
Census Tract 20.02	91.6	0.5	2.2	0.6	0.0	3.8	1.5	$52,989	10.2
Census Tract 16	91.9	0.1	0.5	1.8	1.2	1.5	2.8	$57,560	7.8
Census Tract 12	84.8	0.0	0.2	0.5	0.0	5.0	9.5	$49,931	14.4
Census Tract 13	80.6	3.7	1.2	1.4	0.2	8.3	4.6	$33,589	23.2
Census Tract 17	95.0	0.0	0.2	0.0	0.0	3.5	1.2	$60,557	8.4
Census Tract 15.02	75.1	0.1	5.8	1.3	0.6	1.8	21.3	$59,913	25.6
Lewis County	86.0	0.5	1.3	0.9	0.1	2.5	8.7	$43,490	13.9
Census Tract 9713	85.4	0.5	1.9	0.2	0.0	6.2	9.5	$59,625	7.5
Census Tract 9711	93.4	0.7	0.7	0.6	0.0	1.7	4.5	$53,225	19.8
Census Tract 9717	87.1	0.6	0.2	0.2	0.0	4.9	8.9	$42,431	10.9
Census Tract 9714	83.1	1.6	0.3	0.0	0.0	7.7	7.6	$67,772	1.0
Census Tract 9716	87.5	2.2	0.9	0.5	0.0	2.9	6.9	$40,227	15.4
Census Tract 9708	86.5	0.8	0.9	2.2	0.0	0.3	9.5	$41,125	10.2
Thurston County	78.9	2.5	1.2	5.1	0.7	4.3	7.1	$63,224	11.1
Census Tract 126.20	88.5	0.1	0.9	2.1	0.2	5.7	3.6	$48,346	16.6
Census Tract 125.20	92.4	0.0	0.6	1.5	0.0	3.8	3.0	$59,911	12.6
Census Tract 125.30	91.8	1.2	2.8	0.8	0.0	2.2	2.8	$69,280	4.2
Pierce County	70.3	6.5	1.1	5.8	1.3	5.6	9.2	$59,105	11.9
Census Tract 733.02	88.3	0.2	0.3	1.1	0.0	5.1	5.6	$66,531	3.7
Census Tract 731.08	61.8	7.3	0.7	4.6	2.8	11.2	13.3	$68,542	8.6
Census Tract 704.01	91.4	2.7	0.0	1.8	0.0	0.5	3.6	$65,625	7.5
Census Tract 712.09	82.1	1.8	1.4	2.8	0.4	5.6	5.9	$92,399	2.9
Census Tract 712.10	85.3	0.0	0.3	3.8	0.0	4.2	6.5	$109,643	1.0
Census Tract 703.13	90.8	0.0	0.7	1.0	0.0	4.6	2.9	$90,882	4.2
Census Tract 714.06	62.2	8.0	0.3	8.4	6.4	6.9	8.4	$74,861	5.8
Census Tract 734.06	81.2	1.0	0.3	4.8	0.5	6	7.6	$62,425	3.0

Table 4.2.10-11

Demographics and Income Distribution of Census Tracts Crossed by the WEP

	Demographics (2010)							Income (2008–2012)	
Area	**Percent Caucasian**	**Percent African American**	**Percent American Indian and Alaska Native**	**Percent Asian**	**Percent Native Hawaiian and Other Pacific Islander**	**Percent Two or More Races**	**Percent Hispanic or Latino**	**Median Income**	**Percent Persons Below Poverty Level**
Census Tract 713.10	64.6	0.5	0.2	8.8	0.3	7.5	19.4	$86,053	6.8
Census Tract 713.09	72.9	2.5	0.8	4.9	2.2	7.9	8.3	$60,531	17.3
Census Tract 733.01	78.7	0.2	0.3	0.7	0.0	6.4	14.3	$44,638	17.7
Census Tract 712.07	70.7	3.7	0.9	3.9	0.5	14.0	11.2	$44,345	11.4
Census Tract 713.04	76.4	2.5	0.0	3.2	0.1	15.6	4.9	$62,354	8.9
Census Tract 712.08	77.8	1.7	1.3	7.4	0.0	7.6	4.1	$46,262	9.4
King County	64.8	6.0	0.7	14.5	0.7	4.1	8.9	$71,175	10.9
Census Tract 321.02	92.5	0.0	0.0	3.7	0.0	0.9	2.9	$102,827	5.5
Census Tract 322.10	64.6	1.4	0.3	24.5	0.0	5.5	4.0	$113,267	1.6
Census Tract 322.11	67.6	0.6	0.0	22.6	0.0	5.2	3.0	$102,955	3.0
Census Tract 320.05	78.9	2.3	1.7	4.2	0.2	4.4	10.3	$75,850	9.9
Census Tract 320.06	95.2	0.7	0.0	1.9	0.1	0.3	1.7	$85,565	2.6
Census Tract 316.01	90.2	1.7	0.0	3.2	0.0	2.5	3.1	$96,131	6.3
Census Tract 319.04	83.8	1.2	0.5	3.6	0.0	5.6	5.8	$101,016	3.1
Census Tract 322.13	82.8	0.5	0.0	14.0	0.0	1.1	0.8	$154,408	2.4
Census Tract 322.14	55.7	1.2	0.3	33.6	0.4	6.0	2.4	$152,845	1.3
Census Tract 322.12	60.0	4.5	0.2	23.5	0.2	7.0	4.7	$111,000	8.9
Census Tract 323.18	66	0.5	0.9	22.6	0.0	3.6	7.5	$140,707	1.3
Census Tract 312.04	90.1	2.1	1.8	1.1	0.0	2.2	2.7	$77,204	4.5
Census Tract 320.07	92.7	1.5	0.9	2.1	0.0	0.9	1.9	$92,083	9.1
Snohomish County	74.3	2.4	1.2	8.8	0.4	3.7	9.0	$68,338	9.8
Census Tract 526.07	86.9	0.4	0.2	2.2	0.3	2.4	7.6	$101,719	5.2
Census Tract 526.06	88.0	0.8	0.3	2.1	0.0	2.4	6.8	$72,941	8.8
Census Tract 521.08	96.5	0.7	0.0	0.0	0.0	0.0	2.4	$108,423	5.0
Census Tract 522.04	78.8	0.4	0.7	5.4	0.0	3.9	13.5	$82,517	3.7
Census Tract 521.05	79.3	5.6	0.0	0.0	0.0	3.2	8.3	$106,202	8.7
Census Tract 523.01	89.8	0.0	0.5	0.4	0.0	2.2	7.8	$91,875	8.2
Census Tract 523.02	94.1	0.2	0.6	1.5	0.0	2.6	0.9	$85,438	4.8

Table 4.2.10-11

Demographics and Income Distribution of Census Tracts Crossed by the WEP

	Demographics (2010)							Income (2008–2012)	
Area	**Percent Caucasian**	**Percent African American**	**Percent American Indian and Alaska Native**	**Percent Asian**	**Percent Native Hawaiian and Other Pacific Islander**	**Percent Two or More Races**	**Percent Hispanic or Latino**	**Median Income**	**Percent Persons Below Poverty Level**
Census Tract 521.12	86.3	0.4	1.0	5.4	0.0	4.1	2.8	$102,875	9.4
Census Tract 521.13	90.2	1.1	0.4	2.6	0.0	1.4	4.6	$110,341	1.3
Skagit County	76.7	0.5	1.7	1.7	0.2	2.1	16.9	$56,457	12.6
Census Tract 9512	92.1	0.0	0.4	0.0	0.0	0.2	7.3	$73,913	4.1
Census Tract 9513	92.4	0.0	0.9	2.0	0.0	0.3	4.4	$70,000	9.6
Census Tract 9527	91.6	0.2	0.2	0.6	0.0	0.8	6.6	$65,439	9.5
Census Tract 9509	86.3	1.9	4.0	0.8	0.0	5.0	3.5	$68,250	15.0
Whatcom County	81.9	0.9	2.5	3.5	0.2	3.0	7.8	$51,639	15.8
Census Tract 101	91.0	1.2	2.2	1.7	0.0	2.0	1.7	$44,989	17.3
Census Tract 102	82.6	0.0	0.8	1.9	0.0	1.5	14.5	$55,240	18.3

Sources: U.S. Census Bureau, 2010; 2008-2012.

Skagit County has a Hispanic population (16.9 percent) greater than the state average of 11.7 percent. Census tracts 15.02 in Cowlitz County (21.3 percent), tract 713.10 in Pierce County (19.4 percent), and adjacent tracts 522.08 in Snohomish County, and tracts 9516, 9523.02, and 9524.02 in Skagit County, have a noticeably higher population of Hispanic or Latino residents than the state average of 11.7 percent.

Five counties have incomes less than the state average of $59,374 and three greater than the state average. Lewis County has the lowest median household income ($43,490) and King County the highest ($71,175) (U.S. Census Bureau, 2008-2012). The three counties with a greater percentage of persons living below poverty level than the state average of 12.9 percent are Cowlitz County (17.9 percent), Lewis County (13.9 percent), and Whatcom County (15.8 percent). Several census tracts have a significantly higher percentage of residents below the poverty line than the Washington state average of 12.9 percent. These include census tracts 13 (23.2 percent) and 15.02 (25.6 percent) in Cowlitz County, tract 9711 (19.8 percent) in Lewis County, tracts 713.09 (17.3 percent) and 733.01 (17.7 percent) in Pierce County, and tracts 101 (17.3 percent) and 102 (18.3 percent) in Whatcom County. Adjacent census tracts showing higher proportions of residents below the poverty line include tract 3 (49.5 percent) and 18 (17.5 percent) in Cowlitz County, tracts 9701 (18.5 percent), 9702 (18.2 percent), and 9707 (27.4 percent) in Lewis County, tract 124.11 (19.8 percent) in Thurston County, tract 734.07 (18.6 percent) in Pierce County, tract 309.02 (22 percent) in King County, and tracts 524.02 (18.2 percent) and 526.04 (20.2 percent) in Snohomish County.

The locations of the pipeline facilities were chosen without preference for, or intentional impacts on, any particular social or economic segment or group. The pipeline facilities were sited to minimize impacts, as much as practicable, on human considerations, including minority and low-income residents, engineering constraints, and environmental resources. While there are some census tracts along the pipeline route that have greater minority and low-income populations than those of surrounding tracts, counties, and the state, the pipeline is a linear facility and also transverses many census tracts that have lower minority and low-income populations than that of surrounding areas. Additionally, the pipeline would be within an existing right-of-way and in many areas would replace an existing pipeline and therefore, no residences would be permanently displaced. Further, Northwest would implement construction and operational safety measures.

In densely populated residential areas, different techniques may be used with smaller crews to limit impacts on landowners. Specialized construction methods would be employed in areas where residential structures are within 50 feet of the construction work area. As further discussed in section 4.2.9.1, in residential areas Northwest would implement measures to ensure public safety and minimize temporary construction impacts such as noise, dust, property disturbance, and traffic. During construction, Northwest would implement standard traffic control measures, including signage and public notification materials, which would be in appropriate languages. Because of current safety regulations governing the construction design, monitoring, and operation of interstate natural gas pipelines, the potential for an accident involving the pipeline is very low. The pipeline would be safely installed and operated according to DOT regulations, and would not be a threat to public safety.

Northwest and FERC have conducted public involvement/outreach for the project, including a project mailing list, open houses, and public scoping meetings. Information was mailed out notifying property owners along the pipeline about the project and providing opportunities for comment. Twenty-two Native American groups identified as potentially having an interest in the project have received written notice, will receive further written and oral notifications, and will have the opportunity to comment on the project and potential impacts on historic properties and sensitive cultural resources (see section 4.2.11 for more information). Five public open houses have been held in communities along the

pipeline route so that interested parties could learn about the project and provide input on issues they would like to be considered. The FERC also held public scoping meetings in communities along the route to give stakeholders and the general public an additional opportunity to comment. The public involvement/outreach process did not identify community concerns regarding construction effects on minority and low-income populations. Northwest has indicated it would continue to provide opportunities for landowners and other stakeholders to meet and receive additional information about the project. These opportunities would include one-on-one meetings with land agents, community meetings, newsletters, brochures, fact sheets, and information through the project's toll-free number (888-892-8905), email (washingtonexpansion@williams.com), and website (www.washingtonexpansion.com). Communication and outreach efforts are discussed further in section 1.6.

The WEP pipeline is a linear facility that would be located within an existing pipeline right-of-way crossing areas of varied minority and low-income population compositions. The five compressor stations to be modified are also existing and in areas of varied minority and low-income population compositions. Therefore, we conclude that potential adverse impacts would not unduly or disproportionately affect environmental justice populations. The project would impact environmental justice individuals in the same manner as other individuals. Additionally, safety and other mitigation measures would be implemented and potential impacts that could be associated with the pipeline would be mitigated through settlements between Northwest and individual landowners. Therefore, construction and operation of the pipeline would not result in disproportionate, adverse human health or environmental effects on minority or low-income populations or individuals. The project is also expected to create economic benefits for local communities by generating additional tax revenue, employment opportunities, and local expenditures by workers. Contractors would be required to comply with applicable equal opportunity and nondiscrimination laws and policies. The criteria for positions would be based on qualifications without regard to age, race, creed, or sex, and would be in accordance with applicable federal, state, and local employment laws and policies.

4.2.11 Cultural Resources

Section 106 of the NHPA requires that FERC take into account the effects of its undertakings (including authorizations under Sections 3 and 7 of the NGA) on historic properties, and afford the ACHP an opportunity to comment. While Northwest may gather information and contact the SHPO and interested Indian tribes, in accordance with the regulations implementing Section 106 at 36 CFR 800.2(a)(3) and (c)(4), FERC remains responsible for all official findings of NRHP eligibility and project effects, and for government-to-government consultations with tribes.

The cooperating agencies (USACE, DOT, Coast Guard, DOE, EPA, and FWS) also have responsibilities for considering effects of their undertakings on historic properties under the NHPA. However, as lead federal agency for this project, FERC would address compliance with Section 106 jointly for all the cooperating agencies in this EIS, in accordance with Part 800.2(a)(2).

4.2.11.1 Consultations

The FERC staff consulted with the Washington SHPO, other agencies, and with Indian tribes regarding the project's potential impact on historic properties. Northwest also provided information about its project to the SHPO, other agencies, and Indian tribes, and requested comments on inventory and evaluation investigations.

Consultations with the Washington State Historic Preservation Office

We mailed our NOI for the Oregon LNG and the WEP projects, issued September 24, 2012, to the Washington SHPO. The Washington SHPO did not respond directly to FERC in response to our NOI.

Northwest also communicated with the Washington SHPO. On October 2, 2012, Northwest provided the Washington SHPO with a copy of the letter that it sent to the Indian tribes. On November 20, 2012, Northwest provided the Washington SHPO with a copy of its cultural resources research design. On March 27, 2013, Northwest met with Washington SHPO staff to discuss the project. Based on that meeting, on April 3, 2013, Northwest filed a request with FERC for "Delegation of Authority for Early Coordination with the Washington Department of Archaeology and Historic Preservation pursuant to Section 106 of the National Historic Preservation Act, Northwest Pipeline GP, Washington Expansion Project." FERC granted Northwest's request on April 19, 2013. On March 25, 2014, Northwest provided a revised research design to the Washington SHPO. In a letter to Northwest dated November 20, 2012, the SHPO agreed with the definition of the APE for archaeological resources, and requested additional data. In a letter to Northwest dated April 29, 2013, the SHPO agreed with the definition of the APE for historic standing structures.

On September 24, 2103, Northwest provided the Washington SHPO with a copy of a report titled *Northwest Pipeline GP Washington Expansion Project Cultural Resources Overview and Survey Report* (McClintock et al., 2013). On September 3, 2014, Northwest provided the Washington SHPO with a copy of its revised addendum report entitled *Addendum to Cultural Resources Overview and Survey Report—Survey of Highway 410 Reroute and Temporary Extra Workspace Areas and Easement* (McClintock and Wilt, 2014). The SHPO commented on that report in a letter to Northwest dated September 11, 2014.

Consultations with Other Federal Agencies

In response to our September 24, 2012 NOI, the NPS wrote a letter to FERC, dated November 7, 2012, raising concerns about potential impacts on the LCNHT and LCNHP. No portions of the WEP would impact either the LCNHT or the LCNHP. Consultations with federal agencies regarding cultural resources issues are described in section 4.1.11. Cooperating agencies were given an opportunity to review an administrative version of this EIS.

Consultations with Indian Tribes

The unique and distinctive political relationship between the United States and federally recognized Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements, and differentiates tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal responsibilities and obligations of the United States toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights. Indian tribes are defined in Part 800.16(m), as "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians."

FERC acknowledges that it has trust responsibilities to Indian tribes, and so, on July 23, 2003, we issued a "Policy Statement on Consultations with Indian Tribes in Commission Proceedings" in Order 635. That policy statement included the following key objectives:

- the Commission will endeavor to work with Indian tribes on a government-to-government basis, and will seek to address the effects of proposed projects on tribal rights and resources through consultation; and
- the Commission will ensure that tribal resources and interests are considered whenever the Commission's actions or decisions have the potential to adversely affect Indian tribes or Indian trust resources.

FERC staff identified Indian tribes that may attach religious and cultural significance to properties in the APE by conducting research through the Washington SHPO, the Washington Governor's Office of Indian Affairs, the BIA, and reviewing pertinent ethnographic literature. We initiated government-to-government consultations with Indian tribes by sending copies of our NOI to potentially interested Indian tribes. In addition, on January 16, 2013, we sent project-specific individual letters to tribal leaders for the following federally recognized Indian tribes: Chehalis Confederated Tribes, Cowlitz Indian Tribe, Confederated Tribes of Grand Ronde, Nez Perce Tribe, Nisqually Tribe, Shoalwater Bay Tribe, Confederated Tribes of Siletz Indians, Confederated Tribes of Umatilla, Confederated Tribes of Warm Springs, Yakama Nation, Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Puyallup Tribe, Samish Indian Nation, Sauk-Suiattle Tribe, Snoqualmie Tribe, Stillaguamish Tribe, Suquamish Indian Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, and Upper Skagit Indian Tribe. Table B3-2 in appendix B3 provides a summary of tribal consultations.

In an April 24, 2013 email to FERC staff, the Cowlitz Tribe suggested language that should be included in Northwest's Inadvertent Discovery Plan. The Puyallup Tribe, in an October 9, 2012 email to the FERC staff, requested additional information, including maps and cultural resources assessments. On October 8, 2012, the Samish Indian Nation requested copies of the cultural resources survey reports. In a February 20, 2013 email, the Samish Indian Nation indicated that further archaeological investigations of the APE should be conducted. The Stillaguamish Tribe of Indians, in a February 15, 2013 email to the FERC staff, also requested copies of cultural resources reports. In a February 22, 2013 email, the Stillaguamish Tribe indicated concerns for archaeological sites that may be located between MPs 1394 and 1400. In a February 13, 2013 letter to the Commission, the Swinomish Tribal Community indicated that it would participate in our Pre-filing process if staff time allowed.

In addition to the FERC consultation process, Northwest had its own communication program with Indian tribes. On September 28, 2012, Northwest sent letters to the tribes listed on table B3-2, informing them of the project and requesting comments. On September 24, 2013, Northwest sent copies of its cultural resources survey report (McClintock et al., 2013) to tribes in the project area. Copies of its revised addendum survey report (McClintock and Wilt, 2014) were sent to tribes on September 3, 2014. The Nisqually Indian Tribe, in a letter to Northwest dated September 8, 2014, stated that it had reviewed the addendum survey report and had no further concerns at this time, but would want to be informed if there are any inadvertent discoveries of archaeological resources or human remains. Also in response to its receipt of the addendum survey report, the Samish Nation indicated, in an email to Northwest dated September 5, 2014, that it was not interested in consulting on the project.

4.2.11.2 Results of Literature Reviews and Cultural Resources Surveys

A review of ethnographic literature indicates that the project area was once the homeland to three aboriginal linguistic groups, from south to north: Southwestern Coast Salish, Southern Coast Salish, and Central Coast Salish (Suttles, 1990). The Southwestern Coast Salish includes the Upper Chehalis and Cowlitz Tribes. Most of the Woodland and Chehalis Loops would be within the ancestral territories of those tribes. The Southern Coast Salish includes the Northern and Southern Lushootseed languages, encompassing the Duwamish, Kikialus, Lower Skagit, Muckleshoot, Nisqually, Puyallup, Samish, Sauk-Suiattle, S'Kllam, Snoqualmie, Squaxin, Stillaguamish, Suquamish, Swinomish, Tulalip, and Upper Skagit Tribes. Their ancestral territories covered the Sumner South, Sumner North A, Sumner North B, Snohomish, Mt. Vernon South, Mt. Vernon North A, and Mt. Vernon North B Loops. The Central Coast Salish includes the Lummi and Nooksack Tribes, whose ancestral territory covered the Sumas Loop.

Euro-American settlement of the project area began with the establishment of the fur trade post of Astoria in 1811, near the mouth of the Columbia River. In 1846, Great Britain ceded its claims below the 49th Parallel to the United States; with Washington Territory created in 1853. Washington became a state in 1889.

Northwest conducted site file searches and cultural resources surveys for the main components of its project: 10 noncontiguous loops extending a total of about 140 miles; 25 new MLVs and 10 pig launcher/receivers co-located with MLVs; modifications at 4 existing compressor stations; and 4 associated pipe and contractor yards. These facilities are further described in section 2.2.1. Northwest defined the APE for archaeological sites as a 200-foot-wide corridor centered on the pipeline. The APE for historic standing structures would only extend beyond the existing right-of-way for one parcel in the areas surrounding aboveground facilities. We and the SHPO accept those definitions of the APE.

Northwest conducted research at the Washington SHPO in 2012 to identify previously recorded cultural resources within 200 feet of the pipeline. Sixteen previously recorded sites are within the APE (table 4.2.11-1). All of the previously recorded sites in the APE were revisited and re-evaluated by Northwest in 2013 (McClintock et al., 2013). Eight of the previously recorded sites are recommended to be not eligible for the NRHP, requiring no further work. Four sites are unevaluated and require additional investigations. Four sites were evaluated as eligible for the NRHP, and Northwest should file a treatment plan for those historic properties.

Table 4.2.11-1

Previously Recorded Cultural Resources within the APE

Resource	Type	Description	NRHP Status
45LE563	Precontact	One piece of fire-cracked rock and one basalt flake	Recommended not eligible (2013)
Cowlitz Development Company Railroad	Historical	1923 to present	Recommended eligible (2006)
Chehalis Western / Wail to South Bay Rail Line	Historical	Railroad grade converted to trail	Recommended not eligible
45LE51	Precontact	Surface and subsurface debitage and tool scatter	Recommended eligible (2013)
45LE499	Precontact	Surface and subsurface fire-cracked rock, debitage, and tool scatter	Recommended eligible (2004)
45LE697	Precontact	Scraper	Unevaluated (2008)
45LE698	Historical archaeological	Glass and ceramic fragments, circa 1880 to 1950	Recommended not eligible (2013)

Table 4.2.11-1

Previously Recorded Cultural Resources within the APE

Resource	Type	Description	NRHP Status
45TN385	Historical archaeological	Railroad grade circa 1920s to 1930s	Recommended not eligible (2013)
Tacoma Eastern-Salsich Junction	Historical	Active rail line, dating to 1901	Recommended eligible (2004)
Ditch Number 4	Historical archaeological	Irrigation ditch constructed circa 1918 to 1953 on the southern edge of the Burlington Northern Santa Fe Railroad	Unevaluated (2013)
45SM371	Precontact	One early stage biface	Recommended not eligible (2004)
45SN22	Precontact	Single basalt blade	Unevaluated (1961)
45WH702	Historic	Circa 1900 domestic debris scatter	Unevaluated (2013)
45WH707	Historical archaeological	Abandoned grade for the Bellingham Bay and British Columbia Railroad, dating to 1901-1904	Recommended not eligible (2013)
45WH573	Historical archaeological	Early 20th century domestic debris scatter	Recommended not eligible (2004)
Saar Canal	Historical	Irrigation canal dating to about 1950	Recommended not eligible (2004)

A review of GLO historic maps identified 14 potential features recorded within 0.25 mile of the pipeline (table 4.2.11-2). None of the GLO features were relocated during surveys conducted by Northwest.

Table 4.2.11-2

Historic GLO Survey Plat Features Within 0.25 Mile of the Pipeline

Resource	Description	Date of Map
Structure on property of Widow and Heirs of Oliver Dufina	No information found for the Dufina family	1884 copy of 1864 map
Agricultural field	Part of the Moore homestead or claim. According to the surveyor's notes, Moore had a house and an "old barn"	1884 copy of 1855 map
Road from Olympia to Cowlitz Landing	Corresponded to the alignment of Jackson Highway	1884 copy of 1855 map
Unnamed road	No modern roads correspond to this alignment	1868
Country Road from Upper Puyallup to Steilacoom	No modern roads correspond to this alignment	1884 copy of 1874 map
Agricultural field of Anton Dumblar	No information found for Dumblar	1884 copy of 1874 map
Structure on property of A.B. Woolery	Early settler near Puyallup	1884 copy of 1865 map
Unnamed road	Corresponded to the Alignment of Sumner-Taps Highway East	1884 copy of 1865 map
Unnamed trail	No modern roads correspond to this alignment	1884 copy of 1881 map
Trail from the Mouth of the Cedar River	Roughly corresponds to the alignment of the Issaquah-Fall City Road	1884 copy of 1864 map
Road to Snohomish City	No modern roads correspond to this alignment	1884 copy of 1871 map
Cady's Road	Conforms to the alignment of U.S. Highway 2	1884 copy of 1866 map
Unnamed trail	No modern roads correspond to this alignment, but it appears to have connected several early homesteads in the area	1885
William "Noran"	Home and field of William Moran, an early settler	1885

Of the 140 miles of combined looping, Northwest believes that 64 miles were adequately covered by previous archaeological surveys. For the WEP, Northwest inventoried 73.5 miles of pipeline in 2012. The survey covered a 200-foot-wide corridor. In 37 areas identified as having a high potential for buried materials, a total of 271 shovel probes were excavated. Five cultural resources sites were newly documented as a result of the 2012 surveys. These sites are listed in table 4.2.11-3. Three of these sites, the Meeker Southern Railway grade, a historic debris scatter, and a Seattle, Lake Shore and Eastern Railroad were evaluated as not eligible for the NRHP; and no further work was recommended. Two sites were unevaluated. Northwest believes that site WEP-C-02 (historic railroad) can be avoided. Archaeological testing was recommended at prehistoric site 45CW228.

Table 4.2.11-3

Cultural Resources Identified During 2012 Northwest Surveys of the APE for the WEP

Site Number	Resource Type	NRHP Evaluation	Northwest Recommendation
WEP-B-02	Historic railway	Not eligible	No further work
45TN448	Historic scatter	Not eligible	No further work
WEP-C-02	Historic railway	Unevaluated	Avoidance
45CW228	Precontact lithics	Unevaluated	Phase II testing
45KL451	Historic railway	Not eligible	No further work

Northwest completed supplemental archaeological surveys in 2013 and 2014, to address design changes to the pipeline route at MP 1349.3 near State Highway 410 in Pierce County, and at 91 ATWS. A total of 15 shovel tests were excavated along the Highway 410 Reroute, and shovel tests were also excavated at 77 of the ATWS. The surveys found that two previously recorded archaeological sites (45LE51 and 45LE499) were located at two ATWS. Northwest recommended further investigations at those locations to assess potential project effects on those sites (McClintock and Wilt, 2014).

4.2.11.3 Unanticipated Discovery Plan

Northwest's application to FERC included a *Plan and Procedures for the Unanticipated Discovery of Cultural Resources and Human Remains* (Discovery Plan). A first draft of the Discovery Plan was submitted to the Washington SHPO and tribes for review on September 24, 2013. As of October 2014, no comments had been received on the Discovery Plan. Northwest has not yet documented that the latest version of its Discovery Plan was reviewed and approved by the Washington SHPO. Therefore, **we recommend that:**

- **Prior to construction, Northwest should file with the Secretary copies of comments from the Washington SHPO and interested Indian tribes on the Discovery Plan. If the SHPO or tribes do not find the plan acceptable, Northwest should file a revised Discovery Plan that addresses their concerns, for review and written approval by the Director of OEP.**

4.2.11.4 Compliance with the NHPA

We have not yet completed the process of complying with the NHPA. Under the ACHP's regulations for implementing Section 106 of the NHPA at 36 CFR 800, FERC, as the lead federal agency, on behalf of the cooperating agencies, consults with the SHPOs and Indian tribes, identifies historic properties in the APE, and makes determinations of project effects. If any historic properties would be adversely affected, a treatment plan would need to be prepared, approved by the consulting parties, and implemented in accordance with an agreement document to resolve adverse effects.

The FERC staff consulted with Indian tribes to identify cultural or religious properties of importance to tribes that may be affected by the project. No Native American sacred, ceremonial, cultural, or religious sites, or burials were identified in the APE by Northwest, tribes, the BIA, the SHPO, the Washington Governor's Office of Indian Affairs, or the NPS.

To date, no comments have been received from the Washington SHPO or the contacted tribes regarding the findings of the original *Washington Expansion Project Cultural Resources Overview and Survey Repor*t (McClintock et al., 2013) and Discovery Plan. We cannot make official determinations of eligibility for cultural resources identified in the APE until after the SHPO and tribes comment. The Washington SHPO did review Northwest's revised addendum survey report (McClintock and Wilt, 2014) and stated that no historic properties would be affected at the Highway 410 Reroute and 91 ATWS.

Cultural resources surveys for the entire proposed pipeline route and associated ancillary facilities have not been completed as landowner permission has not been obtained for all parcels. Northwest also has not conducted cultural resources surveys for the contractor and pipe storage yards. Table 4.2.11-4 lists areas along the loops that still require archaeological surveys. Nor has Northwest provided site-specific avoidance plans, testing plans or reports for the sites which are unevaluated, or treatment plans for any historic properties that cannot be avoided.

Table 4.2.11-4

Areas That Still Require Archaeological Surveys

Loop	Number of Parcels Not Yet Surveyed
Woodlawn	16
Chehalis	1
Sumner South	17
Sumner North A	5
Sumner North B	13
Snohomish	4
Mt. Vernon South	0
Mt. Vernon North A	0
Mt. Vernon North B	0
Sumas	0

To ensure that the Commission's responsibilities under the NHPA are met, **we recommend that:**

- **Northwest should <u>not begin construction</u> of facilities and/or use of staging, storage, or temporary work areas <u>until</u>:**
  - **a. Northwest files with the Secretary:**
    - **(1) remaining cultural resources survey reports;**
    - **(2) site evaluation reports, and avoidance or treatment plans, as required; and**
    - **(3) comments on the reports, studies, and plans from the Washington SHPO and appropriate interested Indian tribes;**
  - **b. the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and**
  - **c. FERC staff reviews and the Director of OEP approves the cultural resources reports, studies and plans, and notifies Northwest in writing that treatment**

measures (including archaeological data recovery, if necessary) may be implemented and/or construction may proceed.

All material filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION – NOT FOR PUBLIC RELEASE."

4.2.12 Air Quality and Noise

4.2.12.1 Air Quality

Existing Environment

Regional Climate

The Cascade Mountain Range divides the state of Washington into two major climatic regions: Western Washington and Eastern Washington. Each region comprises several climate districts (NOAA, 1985).

The WEP would be in the Western Washington climatic region, where summers are cool and comparatively dry and winters are mild, wet, and cloudy. The strongest winds are generally from the south or southwest and occur during the late fall and winter. In the interior valleys, wind velocities can be expected to reach 40 to 50 mph each winter and 75 to 90 mph once every 50 years.

The Western Washington climatic region is composed of five climate districts. The pipeline loops and compressor station modifications would be in the Puget Sound-Lowlands and East Olympic-Cascade Foothills climate districts.

Puget Sound-Lowlands

This climate district includes a narrow strip of land along the west side of Puget Sound, southward from the Strait of Juan de Fuca to the vicinity of Centralia and Chehalis, and a somewhat wider strip along the east side of the Sound that extends northward to the Canadian border. Variations in the temperature, length of the growing season, fog, rainfall, and snowfall are due to such factors as the distance from Puget Sound, the rolling terrain, and air from over the ocean reaching this area through the Strait of Juan de Fuca and the Chehalis River valley. Occasionally, in the winter, cold air from the interior of Canada flows southward through the Fraser River canyon and over the northern Puget Sound lowlands.

Annual precipitation ranges from 32 to 35 inches between the Canadian border and Seattle, and then gradually increases to 45 inches in the vicinity of Centralia. Winter snowfall ranges from 10 to 20 inches. Both rainfall and snowfall increase with a slight increase in elevation and distance from the Sound.

The average January maximum temperature ranges from 41 to 45 °F and minimum temperatures from 28 to 32 °F. During July, the average maximum temperature ranges from 73 °F near the Canadian border to 78 °F in the vicinity of Olympia, and the average minimum temperature is near 50 °F. The Sumner South Loop, Sumner North A Loop, Sumner North B Loop, Sumner Compressor Station modifications, Snohomish Loop, Snohomish Compressor Station modifications, Mt. Vernon South Loop, Mt. Vernon North A Loop, Mt. Vernon North B Loop, Mt. Vernon Compressor Station modifications,

Sumas Loop, and Sumas Compressor Station modifications would be within the Puget Sound-Lowlands climate district.

East Olympic-Cascade Foothills

This climate district includes foothills along the eastern slope of the Coast Range, foothills along the western slope of the Cascade Mountains, and the valley separating these ridges from the vicinity of Chehalis to the Columbia River. The easterly movement of moist air from over the ocean produces downslope winds in foothills along the eastern slope of the Coast Range and upslope winds in the foothills along the western slope of the Cascade Mountains. Precipitation is heavier along the windward slopes than in the valley or along the leeward slopes. The average annual precipitation ranges from 40 inches in the lower valleys near the Columbia River to 90 inches above 1,000 feet and along the western slopes of the Cascade Mountains. Annual snowfall increases from less than 10 inches in the lower valleys to 50 inches in elevations above 500 feet.

In January, the average maximum temperature ranges from 38 to 45 °F, and the average minimum temperature from 25 to 32 °F. In July, the average maximum temperature ranges from 75 to 80 °F and the average minimum temperature is near 50 °F. The Woodland Loop, Chehalis Loop, and Chehalis Compressor Station modifications would be within the East Olympic-Cascade Foothills climate region.

Air Quality Control Regions

AQCRs were established by the EPA and local agencies, in accordance with Section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through state implementation plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR.

Sections of the WEP in Cowlitz and Lewis Counties would be within the Portland Interstate AQCR. Sections of the WEP in Thurston, Skagit, and Whatcom Counties would be within the Olympic-Northwest Interstate AQCR.

Existing Air Quality

The pipeline would be routed through Cowlitz, Lewis, Thurston, Pierce, King, Snohomish, Skagit, and Whatcom Counties in Washington. The five existing compressor stations that would be modified as part of the WEP are in Lewis, Pierce, Snohomish, Skagit, and Whatcom Counties. Cowlitz, Lewis, Skagit, and Whatcom Counties are currently in attainment with all NAAQS.

Maintenance areas are those geographic areas that were classified as nonattainment but are now consistently meeting the NAAQS. Maintenance areas have been redesignated by EPA from nonattainment to attainment with a maintenance plan. Through monitoring and modeling, these areas have demonstrated that they have sufficient controls in place to meet and maintain NAAQS.

The portion of the pipeline routed through Pierce, King, and Snohomish Counties would be within CO and O_3 maintenance areas. The Sumner Compressor Station, located in Pierce County, is within a PM_{10}, CO, and O_3 maintenance area. The Snohomish Compressor Station, located in Snohomish County, is in a CO and O_3 maintenance area.

A portion of Pierce County is classified as nonattainment for $PM_{2.5}$. The Sumner South Loop portion of the pipeline routed through Pierce County would be within this $PM_{2.5}$ nonattainment area; however, the Sumner Compressor Station is outside of the $PM_{2.5}$ nonattainment area.

Existing Compressor Station Emissions

The five existing compressor stations (Chehalis, Sumner, Snohomish, Mt. Vernon, and Sumas) currently emit pollutants as part of their normal operation. Table 4.2.12-1 presents the PTE emissions of criteria pollutants, HAPs, and GHGs for each existing compressor station. These inventories include emissions from compressors, as well as support equipment such as boilers, generators, and line heaters.

Table 4.2.12-1

Summary of Potential-to-Emit from Existing Compressor Stations

	PTE Emissions (tpy)							
	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC	HAP	CO_2e
Chehalis Compressor Station	18.4	18.4	219	185	3.2	49.7	18.6	110,356
Sumner Compressor Station	5.6	5.6	98	95	2.9	1.8	0.9	95,000
Snohomish Compressor Station	5.6	5.6	98	95	2.9	1.8	0.9	95,000
Mt. Vernon Compressor Station	15.4	15.3	753	220	2.4	57.2	26.4	124,087
Sumas Compressor Station	20.0	19.9	1,207	361	4.9	80.9	49.8	229,375

Ambient Air Quality Standards

Emissions from all phases of construction and operation of the WEP would be subject to applicable state and federal air regulations. Most air quality regulatory programs address emissions from stationary sources of air pollution; these programs would primarily affect operations at the compressor stations. Air quality regulations affecting the pipeline and compressor station construction are primarily concerned with reducing emissions associated with construction equipment and fugitive dust. Air pollutant emission sources are regulated at the federal level by the CAA, as amended, and at the state level by the WAC in Washington.

National Ambient Air Quality Standards

The EPA has established NAAQS for seven criteria pollutants: SO_2, CO, NO_2, ozone, PM_{10}, $PM_{2.5}$, and lead. The NAAQS were set at levels by the EPA to protect human health (primary standards) and human welfare (secondary standards). The NAAQS and relevant estimated background concentrations for the project area are listed in table 4.2.12-2.

Washington Ambient Air Quality Standards

For most criteria pollutants, WAAQS are the same as federal NAAQS; however, Washington has set standards for SO_2 that include different averaging periods, and a more stringent 1-hour standard. The national and Washington state ambient air quality standards are described in section 4.1.12.1.

Table 4.2.12-2

National and State Ambient Air Quality Standards and Background Levels

Air Pollutant	Averaging Period	Background Level [a]	NAAQS Primary Standard [b]	NAAQS Secondary Standard [b]	Washington State Standard [c]
SO_2	Annual	N/A	N/A	N/A	0.02 ppm
	24-hour	N/A	N/A	N/A	0.10 ppm
	3-hour	0.01 ppm [d]	N/A	0.5 ppm [e]	N/A
	1-hour	N/A	0.075 ppm [f]	N/A	0.40 ppm [e]
					0.25 ppm [g]
	5-minutes	N/A	N/A	N/A	0.80 ppm
Lead	Rolling 3-month average	0.03 µg/m^3 [h]	0.15 µg/m^3 [i]	0.15 µg/m^3 [i]	N/A
		0.01 µg/m^3 [h]			
CO	1-hour	1.0 ppm [d]	35 ppm [e]	N/A	35 ppm [e]
	8-hour	2.4 ppm [d]	9 ppm [e]	N/A	9 ppm [e]
NO_2	Annual	N/A	0.053 ppm [e]	0.053 ppm [e]	0.05 ppm [e]
	1-hour	0.023 ppm	0.100 ppm [j]	N/A	N/A
Ozone	8-hour	0.069 ppm	0.075 ppm [k]	0.075 ppm [k]	N/A
	1-hour (Daily Maximum)				0.12 ppm [l]
PM_{10}	24-hour	23 µg/m^3 [d]	150 µg/m^3 [m]	150 µg/m^3 [m]	150 µg/m^3 [m]
$PM_{2.5}$	24-hour	14 µg/m^3 [n]	35 µg/m^3 [o]	35 µg/m^3 [o]	N/A
		31 µg/m^3 [n]			
		36 µg/m^3 [n]			
	Annual	5.8 µg/m^3 [p]	15 µg/m^3 [q]	15 µg/ m^3 [q]	N/A
		7.5 µg/m^3 [p]			
		7.6 µg/m^3 [p]			

µg/m^3 = micrograms per cubic meter

[a] Background information is from http://www.epa.gov/airdata/ accessed August 17 and 18, 2012, and March 10, 2014.

[b] Source: http://www.epa.gov/air/criteria.html.

[c] Source: http://www.ecy.wa.gov/programs/air/sips/WA_Stds_August2011.pdf

[d] Background information is from Seattle, Washington.

[e] Not to be exceeded more than once per year.

[f] Compliance based on 3-hour average of 99th percentile of the daily maximum 1-hour average at each monitor within an area.

[g] Not to be exceeded more than twice in a consecutive 7-day period.

[h] The 3-month average statistic currently is not available for the state of Washington. The annual first maximum is the value displayed for Auburn and Snohomish, Washington, respectively.

[i] Not to be exceeded.

[j] Compliance based on a 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area.

[k] Compliance based on a 3-year average of fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area.

[l] Not to be exceeded more than 1 day in a calendar year.

[m] Not to be exceeded more than once per year, on average, over 3 years.

[n] The background concentrations are for Seattle Marysville, and Tacoma, Washington, respectively.

[o] Compliance based on a 3-year average of 98th percentile of 24-hour concentrations at each population-oriented monitor within an area.

[p] Compliance based on 3-year average of weighted annual mean PM2.5 concentrations at community-oriented monitors. The background concentrations are for King County Pierce County, and Snohomish County, Washington, respectively.

[q] Compliance based on a 3-year average of weighted annual mean $PM_{2.5}$ concentrations at community-oriented monitors.

Regulatory Requirements for Air Quality

Federal Air Quality Requirements

New Source Performance Standards

40 CFR 60 establishes NSPS for specific emission sources.

40 CFR 60, Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, establishes emission standards and compliance schedules for the control of emissions from stationary combustion turbines where construction, modification, or reconstruction commences after February 18, 2005. 40 CFR 60, Subpart KKKK, would be applicable to the Chehalis Compressor Station, Sumner Compressor Station, Snohomish Compressor Station, Mt. Vernon Compressor Station, and Sumas Compressor Station because the heat input for each of the new turbines at each compressor station at peak load would be greater than 10.7 gigajoules per hour (10 MMBtu/hr) and construction of the turbines would commence after February 18, 2005.

40 CFR 60, Subpart GG, Standards of Performance for Stationary Gas Turbines, establishes NOx and SO_2 emission standards for the control of emissions from stationary combustion turbines where construction, modification, or reconstruction commences after October 3, 1977. Per 60.4305(b), stationary combustion turbines regulated under 40 CFR 60 Subpart KKKK are exempt from the requirements of 40 CFR 60 Subpart GG. 40 CFR 60, Subpart GG would not be applicable to the WEP because per 60.4305(b), stationary combustion turbines regulated under 40 CFR 60 Subpart KKKK are exempt from the requirements of 40 CFR 60 Subpart GG.

40 CFR 60, Subpart KKK, Standards of Performance for Equipment Leaks of Volatile Organic Compounds from Onshore Natural Gas Processing Plants, is applicable to affected facilities in onshore natural gas processing plants where construction, reconstruction, or modification commences after January 20, 1984. 40 CFR 60, Subpart KKK, would not be applicable to the WEP because, per 60.630(e), compressor stations that are not located at a natural gas processing plant site are exempt.

40 CFR 60, Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, requires applicable stationary spark ignition internal combustion engines to meet emission standards, as well as fuel, monitoring, and maintenance requirements depending on the model year, the date of manufacture, and the date when the unit was modified or reconstructed. 40 CFR 60, Subpart JJJJ, would be applicable to the 500-hp, natural gas emergency generators that would be installed at each of the five compressor stations for emergency operation.

The pipeline would not include any sources regulated under 40 CFR 60.

Prevention of Significant Deterioration

New sources that meet the definition of a major stationary source are subject to review under the PSD program that is administered by WA Ecology. The emission threshold for a major stationary source varies under PSD according to the source type. As incorporated by reference to 40 CFR 52.21 in WAC 173-400-720, a source is considered a major source under PSD if it emits or has the potential to emit (PTE) 250 tpy or more of any New Source Review (NSR) pollutant, or 100 tpy for specified source categories. None of the WEP facilities meet any of the specified source categories. Therefore, the PSD pollutant threshold for NSR pollutants for each component of the WEP is 250 tpy.

A source is also subject to the PSD program if a modification of an existing major source increases emissions of a federally regulated NSR pollutant to above PSD SERs, as stated in 40 CFR 52.21 (b)(23) and (40).

The Chehalis Compressor Station is not currently a PSD source. As shown in table 4.2.12-3, the WEP modifications would not result in an exceedance of PSD thresholds. Therefore, the Chehalis Compressor Station would not be subject to PSD permitting requirements and only an NOC would be required.

The Sumner Compressor Station is not currently a major stationary source for PSD. As shown in table 4.2.12-3, the WEP modifications would not result in an exceedance of PSD thresholds. Therefore, the Sumner Compressor Station would not be subject to PSD permitting requirements and only an NOC would be required.

The Snohomish Compressor Station is not currently a major PSD source. As shown in table 4.2.12-3, the WEP modifications would not result in an exceedance of the PSD threshold. Therefore, the Snohomish Compressor Station would not be subject to PSD permitting requirements and only an NOC would be required.

Table 4.2.12-3

Compressor Station PSD Applicability (tpy)

Source	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC
Chehalis Compressor Station						
PTE from new equipment	19.11	19.70	4.57	4.78	4.78	2.35
PSD threshold	250	250	250	250	250	250
Above PSD threshold	No	No	No	No	No	No
Sumner Compressor Station						
PTE from new equipment	83.30	84.83	20.81	22.22	22.22	9.81
PSD threshold	250	250	250	250	250	250
Above PSD threshold	No	No	No	No	No	No
Snohomish Compressor Station						
PTE from new equipment	35.52	36.34	8.68	9.21	9.21	4.26
PSD threshold	250	250	250	250	250	250
Above PSD threshold	No	No	No	No	No	No

The Mt. Vernon Compressor Station is an existing major stationary source for PSD; therefore, any modification resulting in a significant emissions increase and a significant net emissions increase of a regulated pollutant greater than its SER would qualify as a major modification. Emission increases from the proposed Mt. Vernon Compressor Station modifications would be below the SERs. Therefore, the Mt. Vernon Compressor Station would not subject to PSD permitting requirements and only an NOC would be required.

The Sumas Compressor Station is an existing major stationary source for PSD; therefore, any modification resulting in a significant emissions increase and a significant net emissions increase of a regulated pollutant greater than its SER would qualify as a major modification. As a result, the WEP modifications associated with the Sumas Compressor Station would be subject to PSD review under WAC 173-400-700 for that pollutant. Table 4.2.12-4 summarizes the emissions increase as a result of the WEP modifications to the Sumas Compressor Station.

Table 4.2.12-4

Summary of Emissions Increase (tpy)

Source	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC
Mt. Vernon Compressor Station						
PTE from new equipment	35.90	36.73	8.81	9.29	9.29	4.31
SER	40	100	40	15	10	40
Above SER	No	No	No	No	Yes	No
Sumas Compressor Station						
PTE from new equipment	92.70	94.36	23.13	24.67	24.67	10.91
SER	40	100	40	15	10	40
Above SER	Yes	No	No	Yes	Yes	No

The pipeline would not trigger review under the PSD program.

Title V Operating Permits

Title V of the CAA requires states to establish an air operating permit program. The requirements of Title V are outlined in 40 CFR Part 70 and the permits required by these regulations are often referred to as Part 70 permits. The EPA has delegated authority to issue Part 70 permits to the WA Ecology.

If a facility's PTE exceeds the criteria pollutant or HAP thresholds, the facility is considered a Title V major source. Under Part 70, the major source threshold for an air emission source in Washington is 100 tpy for any criteria pollutant, 10 tpy for any individual HAP, or 25 tpy for the aggregate of all HAPs.

The Chehalis Compressor Station currently operates under an AOP and would continue to require an AOP. Within 1 year of turbine, boiler, and emergency generator startup, Northwest would apply to have the new turbine, boiler, and emergency generator engine added to the Chehalis Compressor Station AOP.

The Sumner Compressor Station currently does not operate under an AOP. Criteria and HAP PTE emissions after the WEP equipment modifications would continue to be below AOP thresholds and the facility would not be required to obtain an AOP.

The Snohomish Compressor Station currently does not operate under an AOP. However, because the NOx and CO PTE from the existing equipment and the new equipment to be operated as part of the WEP would exceed 100 tpy, an AOP would be required. An AOP application would be filed within 12 months of initial startup of the modifications.

The Mt. Vernon Compressor Station currently operates under an AOP and would continue to require an AOP. Within 1 year of turbine, boiler, and emergency generator startup, Northwest would apply to have the new turbines, boiler, and emergency generator engine added to the Mt. Vernon Compressor Station AOP.

The Sumas Compressor Station currently operates under an AOP and would continue to require an AOP. Within 1 year of turbine, boiler, and emergency generator startup, Northwest would apply to have the new turbines, boiler, and emergency generator engine added to the Sumas Compressor Station AOP.

Predicted emissions from the pipeline would not trigger the requirement for a Title V operating permit.

National Emission Standards for Hazardous Air Pollutants

The NESHAPs are codified in 40 CFR Parts 61 and 63. The NESHAPs rules were developed to address certain individual HAPs and HAP emissions from a variety of source categories.

The source category NESHAPs (40 CFR Part 63) typically apply to facilities that are classified as major sources of HAPs and operate affected equipment as listed in each standard. However, several of these source category NESHAPs also apply to affected equipment at area sources of HAPs. A facility is a major source of HAPs if it emits any individual HAP in excess of 10 tons per year or a combination of HAPs in excess of 25 tons per year. A facility is an area source of HAPs if it emits HAPs below major source thresholds. The Chehalis, Mt. Vernon, and Sumas Compressor Stations are major sources of HAPs and would remain major sources after the WEP modifications. The Sumner and Snohomish compressor stations are area sources of HAPs and would remain area sources of HAPs following the proposed modifications.

40 CFR 63, Subpart DDDDD, National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters, establishes emission limits and work practice standards for HAPs emitted from industrial, commercial, and institutional boilers and process heaters at major sources of HAPs. The Chehalis, Mt. Vernon, and Sumas Compressor Stations are classified as major sources of HAPs and would remain so after the WEP modifications. The Sumner and Snohomish, Compressor Stations are area sources, not major sources, and would remain so after the WEP modifications. Because this subpart is applicable only to major sources of HAPs, 40 CFR 63 Subpart DDDDD would only be applicable to the Chehalis, Mt. Vernon, and Sumas Compressor Stations.

40 CFR 63, Subpart JJJJJJ, National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources, establishes emission limits and work practice standards for HAPs emitted from industrial, commercial, and institutional boilers and process heaters at area sources of HAPs. 40 CFR 63, Subpart JJJJJJ, would not be applicable to the Sumner and Snohomish Compressor Stations because, even though they are area sources of HAPs and would remain so after the WEP modifications, they are not applicable to gas-fired boilers. The Chehalis, Mt. Vernon, and Sumas Compressor Stations are not area sources of HAPs; therefore, 40 CFR 63 Subpart JJJJJJ would not be applicable to these compressor stations.

40 CFR 63, Subpart YYYY, National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines, establishes national emission limitations and operating limitations for HAP emissions from stationary combustion turbines located at major sources of HAP emissions. It also establishes requirements to demonstrate initial and continuous compliance with the emission and operating limitations. 40 CFR 63 Subpart YYYY is applicable to all combustion turbines constructed or reconstructed after January 14, 2003, at major sources of HAPs. In August 2004, EPA finalized an action to stay the effectiveness of the NESHAPs for certain new sources. Lean premix gas-fired stationary combustion turbines must comply with the initial notification requirements but need not comply with any other requirement of the subpart until EPA takes final action to require compliance and publishes a document in the Federal Register. 40 CFR 63 Subpart YYYY would be applicable to the Chehalis, Mt. Vernon, and Sumas Compressor Stations, as these are all major sources of HAPs and construction of the new turbines would commence after January 14, 2003. However, only initial notification is required until EPA takes final action on this rule. The Sumner and Snohomish Compressor Stations are not currently a major source of HAPs and the modifications proposed would not cause them to become major sources. Therefore, 40 CFR 63 Subpart YYYY would not be applicable to these two compressor stations.

40 CFR 63, Subpart HH, National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities, would not be applicable to the WEP because the proposed system modifications include only the expansion of the pipeline and the addition of new compressors and associated equipment, boilers, and emergency generators. In addition, the existing compressor stations do not meet the definition of a natural gas processing plant. As such, the proposed modifications to the compressor stations would not include any affected sources, as defined by this subpart.

40 CFR 63, Subpart HHH, National Emission Standards for Hazardous Air Pollutants from Natural Gas Transmission and Storage Facilities, would not be applicable to the WEP because the proposed modifications would not include glycol dehydration units, which are the affected source covered by this subpart.

40 CFR 63, Subpart ZZZZ, National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines, sets forth the EPA-adopted NESHAPs for reciprocating internal combustion engines. These standards apply to reciprocating internal combustion engines at both major sources and area sources of HAPs. The 500-hp, natural-gas-fired, emergency use generator engines must meet the requirements of 40 CFR 60 Subpart JJJJ. No further requirements apply to the new emergency generator engines under 40 CFR 63 Subpart ZZZZ.

The pipeline would not be a major source of HAPs and would not include equipment regulated under the NESHAPs rules. Therefore, 40 CFR 61 and 63 would not be applicable to the pipeline.

Federal Class I Area Protection

In 1977, the U.S. Congress designated certain lands as Mandatory Federal Class I (Class I) areas. Class I areas were designated because the air quality was considered a special feature of the area (e.g., national parks or wilderness areas). These Class I areas, and any other areas that have been redesignated Class I areas since 1977, are given special protection under the PSD program. The PSD program establishes air pollution increment increases that are allowed by new or modified air pollution sources. If the new stationary source is required to comply with PSD program requirements and is near a Class I area, the source is required to determine its impacts at the nearby Class I area(s). The source is also required to notify the appropriate federal land manager(s) for the nearby Class I area(s).

An air quality assessment was conducted for possible AQRV impacts on Class I areas within 100 km of the five WEP compressor stations. AQRVs include impacts on visual range and acid deposition.

Federal Class I area air quality guidance (FLAG, 2010) allows an emissions divided by distance (Q/D) factor of 10 to be used as a screening threshold for AQRV impacts. For the WEP screening analysis, all Class I areas within 100 km (62 miles) of the WEP sites (including sites less than 50 km (31 miles) from a source) were identified. Based on this survey, eight Class I areas were identified as being within 100 km of one or more of the compressor stations.

All AQRVs were included in the screening analysis by calculating the pollutant emissions as the total annual emissions of SO_2, NOx, PM_{10}, and H_2SO_4 in tpy, based on 24-hour maximum allowable emissions. For this screening analysis, only the emissions from the new combustion turbine compressor engine(s) were considered. The annual emissions of SO_2, NOx, PM_{10}, and H_2SO_4, calculated using the 24-hour maximum allowable emissions for the proposed combustion turbines at each site are divided by the distance (in km) from the Class I area. The maximum Q/D for the WEP would be less than the FLAG guidance Q/D ratio of 10, as shown in table 4.2.12-5. This screening indicates Class 1 areas and the AQRVs would not be adversely impacted by the WEP.

Table 4.2.12-5

Screening for Class I Areas within 100 Kilometers of the WEP Compressor Stations

Compressor Station	Class I Areas	Distance to the WEP Compressor Station (km)	Facility Total Tons Per Year (Q) (new turbine(s) only)	Class I AQRV Q/D (tons per year based on 24-hour max)
Chehalis	Mt. Rainier National Park	76.7	26.7	0.3
	Goat Rocks Wilderness	97.4	26.7	0.3
	Adams Wilderness	101.7	26.7	0.3
Sumner	Olympic National Park	89.0	127.3	1.4
	Alpine Lakes Wilderness	52.6	127.3	2.4
	Mt. Rainier National Park	34.1	127.3	3.7
	Goat Rocks Wilderness	80.2	127.3	1.6
Snohomish	North Cascades National Park	101.2	52.4	0.5
	Glacier Peak Wilderness	64.7	52.4	0.8
	Olympic National Park	79.6	52.4	0.7
	Alpine Lakes Wilderness	36.8	52.4	1.4
	Mt. Rainier National Park	88.4	52.4	0.6
Mt. Vernon	Pasayten Wilderness	98.3	53.0	0.5
	North Cascades National Park	56.9	53.0	0.9
	Glacier Peak Wilderness	59.5	53.0	0.9
	Olympic National Park	90.3	53.0	0.6
	Alpine Lakes Wilderness	97.0	53.0	0.5
Sumas	Pasayten Wilderness	88.5	142.0	1.6
	North Cascades National Park	45.9	142.0	3.1
	Glacier Peak Wilderness Area	87.0	142.0	1.6

General Conformity

A conformity analysis must be conducted if a federal action would generate emissions that would exceed the conformity threshold levels (*de minimis* levels) of the pollutant(s) for which an area is designated as a nonattainment area or maintenance area.

For the proposed pipeline construction, the Chehalis, Sumner South, Sumner North A, and Sumner North B Loops would be in a PM_{10} maintenance area. The Sumner North B and Snohomish Loops would be in CO and O_3 maintenance areas. The Sumner South Loop portion of the pipeline routed through Pierce County would be in a $PM_{2.5}$ nonattainment area. All other pipeline loops would be in attainment areas.

For the proposed compressor station modifications, the Sumner Compressor Station would be within PM_{10}, CO, and O_3 maintenance areas. The Snohomish Compressor Station would be in CO and O_3 maintenance areas. The Chehalis, Mt. Vernon, and Sumas Compressor Stations would be in attainment areas.

The Chehalis, Sumner South, Sumner North A, and Sumner North B Loops would be in a PM_{10} maintenance area. Table 4.2.12-6 summarizes the estimated emissions from construction or modification of the Chehalis, Sumner South, Sumner North A, and Sumner North B Loops. The results show that emissions would be below the conformity applicability threshold, and therefore a conformity analysis would not be required.

Table 4.2.12-6

Conformity Applicability for Construction of Chehalis, Sumner South, Sumner North A, and Sumner North B Loops (tpy)

Source	Chehalis Loop	Sumner South Loop	Sumner North A Loop	Sumner North B Loop
PM_{10} Construction PTE	19.31	5.52	5.38	6.09
PM_{10} Applicability Threshold	100	100	100	100
Conformity Analysis Required?	No	No	No	No

tpy = tons per year
PTE = potential to emit

The Sumner North B and Snohomish Loops would be in CO and O_3 maintenance areas. NOx and VOC emissions are regulated as ozone precursors. As shown in table 4.2.12-7, the estimated emissions from construction or modification of the Sumner North B and Snohomish Loops would be below the conformity applicability threshold and therefore a conformity analysis is not required.

Table 4.2.12-7

Conformity Applicability for Construction of Sumner North B and Snohomish Loops (tpy)

Source	NOx	VOC	CO
Sumner North B Loop	2.86	0.85	15.21
Applicability Threshold Level	100	100	100
Conformity Analysis Required?	No	No	No
Snohomish Loop Construction	2.72	0.82	13.91
Applicability Threshold	100	100	100
Conformity Analysis Required?	No	No	No

The Sumner South Loop portion of the pipeline routed through Pierce County would be in a $PM_{2.5}$ nonattainment area. NOx and SO_2 emissions are regulated as $PM_{2.5}$ precursors. As shown in table 4.2.12-8, the estimated emissions from construction or modification of the Sumner South Loop would be below the conformity applicability threshold and therefore a conformity analysis is not required.

Table 4.2.12-8

Conformity Applicability for Sumner South Loop Construction (tpy)

Source	$PM_{2.5}$	NOx	SO_2
Sumner South Loop	5.00	2.69	0.02
Applicability Threshold	100	100	100
Conformity Analysis Required?	No	No	No

All other pipeline loops are in attainment areas; therefore, the General Conformity Rule is not applicable and a conformity analysis is not required. Also, the Chehalis, Mt. Vernon, and Sumas Compressor Stations are in attainment areas. Therefore, the General Conformity Rule is not applicable and a conformity analysis is not required.

The Sumner Compressor Station is within a PM_{10}, CO, and O_3 maintenance area. NOx and VOC emissions are regulated as ozone precursors. As shown in table 4.2.12-9, the estimated emissions from construction or modifications at the compressor station would be below the conformity applicability threshold; therefore, a conformity analysis is not required. In addition, because the General Conformity Rule exempts actions subject to NSR, emissions associated with the operation of the proposed modifications at the Sumner Compressor Station are not applicable to the General Conformity Rule and no conformity determination is required.

Table 4.2.12-9

Conformity Applicability for Sumner Compressor Station Construction(tpy)

Source	PM_{10}	NOx	VOC	CO
Sumner Compressor Station	8.35	0.83	0.15	4.14
Applicability Threshold	100	100	100	100
Conformity Analysis Required?	No	No	No	No

The Snohomish Compressor Station is in a CO and O_3 maintenance area. NOx and VOC emissions are regulated as ozone precursors. As shown in table 4.2.12-10, the estimated emissions from construction or modifications at the compressor station would be below the conformity applicability threshold and therefore a conformity analysis is not required. Again, the General Conformity Rule exempts actions subject to NSR; therefore, emissions associated with the operation of the proposed modifications at the Snohomish Compressor Station would not be subject to the rule.

Table 4.2.12-10

Conformity Applicability for Snohomish Compressor Station Construction (tpy)

Source	NOx	VOC	CO
Snohomish Compressor Station	1.05	0.21	6.14
Applicability Threshold	100	100	100
Conformity Analysis Required?	No	No	No

Chemical Accident Prevention

The chemical accident prevention provisions, codified in 40 CFR Part 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulation, the facility must prepare and submit an RMP. If a facility does not have a listed substance on site, or the quantity of a listed substance is below the applicability threshold, the facility would not have to prepare an RMP. In the latter case, the facility still must comply with requirements of the general duty provisions in Section 112(r)(1) of the 1990 Clean Air Act Amendments (CAAA) if there is any regulated substance or other extremely hazardous substance on site. The general duty provision is as follows:

> *The owners and operators of stationary sources producing, processing, handling and storing such substances have a general duty… to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.*

Stationary sources are defined in 40 CFR Part 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities belonging to the same industrial group, located on

one or more contiguous properties, under the control of the same person (or persons under common control), and from which an accidental release may occur. However, the federal definition also states that the term "stationary source" would not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term "transportation" includes transportation subject to oversight or regulation under 49 CFR Parts 192, 193 or 195 or a state natural gas or hazardous liquid program for which the state has in effect a certification to DOT under 49 USC 60105.

With the exception of natural gas constituents (such as methane, ethane, and propane), no regulated substance would be handled or stored in quantities greater than the applicability threshold. In addition, natural gas pipelines are not covered by the RMP provisions if they are regulated by the DOT or an equivalent state natural gas program certified by DOT in accordance with 49 CFR 6010.5. An RMP would not be required for the pipeline or the compressor stations. Northwest would maintain awareness of hazard issues and would meet the requirements of the general duty provision.

Greenhouse Gas Reporting

On November 8, 2010, the EPA finalized reporting requirements for the petroleum and natural gas industry under 40 CFR Part 98 Subpart W. This subpart was then amended on December 23, 2011. Subpart W requires petroleum and natural gas facilities that emit 25,000 metric tons or more of CO_2e per year to report annual emissions of specified GHGs from various processes within the facility. EPA GHG reporting requirements would be applicable to the Chehalis, Sumner, Snohomish, Mt. Vernon, and Sumas compressor stations. The pipeline would not meet the definition of a GHG source. Therefore, the federal and state of Washington GHG reporting requirements would not be applicable to fugitive emissions from the pipeline.

Washington Air Quality Requirements

In addition to EPA requirements, air quality in Washington is also regulated by WA Ecology and local clean air agencies. WA Ecology implements and enforces air quality regulations in counties without an air pollution control agency. The clean air agencies that would be responsible for implementing and enforcing air quality regulations for the various WEP facilities are described below.

- Southwest Clean Air Agency (SWCAA) would be responsible for the Woodland Loop, a portion of the Chehalis Loop that would cross through Thurston County, and the Chehalis Compressor Station.
- Olympic Region Clean Air Agency (ORCAA) would be responsible for a portion of the Chehalis Loop.
- Puget Sound Clean Air Agency (PSCAA) would be responsible for the portion of the Chehalis Loop that would cross through Lewis County, the Sumner South Loop, the Sumner North A Loop, the Sumner North B Loop, the Sumner Compressor Station, the Snohomish Loop, and the Snohomish Compressor Station.
- Northwest Clean Air Agency (NWCAA) would be responsible for the Mt. Vernon South Loop, Mt. Vernon North A Loop, Mt. Vernon North B Loop, Mt. Vernon Compressor Station, Sumas Loop, and Sumas Compressor Station.

Local clean air agencies may implement and enforce most state and federal regulations. All local agencies have agency-specific regulations that may be more restrictive than the state or federal regulations.

Washington Construction Permits

NSR is required for the construction of a new stationary source or modification of a stationary source to confirm compliance with applicable ambient air quality standards and emission standards, as well as to confirm that appropriate air pollution control technologies are employed. The program under which a new source or modification is reviewed depends on the type and quantity of the potential air emissions associated with the new source or modification.

New sources that meet the definition of a "major stationary source" are subject to review under the PSD program that is administered by WA Ecology. The emission threshold for a "major stationary source" varies under PSD according to the type of source. Under WAC 173-400-720, a source is considered a major source under PSD if it emits or has the PTE 250 tpy or more of any NSR pollutant, or 100 tpy for specified source categories. None of the WEP facilities would include the specified source categories. Therefore, the PSD pollutant threshold for NSR pollutants for each component of the WEP would be 250 tpy. A source is also subject to the PSD program if a modification of an existing major source increases emissions of a federally regulated NSR pollutant to above PSD SERs, as stated in 40 CFR 52.21 (b)(23) and (40).

Before actual construction of a new or modified source can begin, Northwest would obtain approval from the permitting agency confirming that the NSR process is completed and a preconstruction permit or permit to construct is obtained. For sources and modifications that are applicable to the PSD program, a PSD permit would be obtained from WA Ecology for those pollutants subject to PSD review. For all other pollutants and modifications, a Notice of Construction (NOC) must be filed and an Order of Approval obtained from the applicable clean air agency.

During construction, the pipeline and compressor station modification construction activities would be regulated by WAC 173-400-040, which addresses fugitive dust, visible emissions, odor, and concealment. WAC 173-400-040(9) requires that reasonable precautions be used to prevent particulate matter emissions from becoming airborne, including (but not limited to) the use of water or chemicals for dust suppression.

In addition, the construction and operation of the pipeline and existing compressor stations must also comply with the following applicable local clean air agency regulations that address fugitive dust, nuisances (including odors), and particle fallout.

For the project facilities that would be within the SWCAA jurisdictional area, the following regulations would apply.

- SWCAA 400-040 (1-8), which addresses visible (opacity) emissions, fallout, fugitive emissions, odors, emissions detrimental to persons or property, SO2, concealment and masking, and fugitive dust sources.
- SWCAA 400-050 (1), which provides the PM emission standards for combustion units.
- SWCAA 400-072(4)(c), which provides emission standards for emergency generator engines with rated capacities less than 1,000 hp.

For the portion of the Chehalis Loop that would cross through Thurston County within the ORCAA jurisdictional area, the following regulations would apply.

- ORCAA Rule 7.5, which addresses concealment and masking of air contaminants.
- ORCAA Rule 7.6, which addresses detriments to person or property standards concerning air contaminants and water vapor.
- ORCAA Rule 8.2, which provides the general standards for maximum visual emissions.
- ORCAA Rule 8.3, which addresses the general maximum PM standards, including fugitive particulate material.
- ORCAA Rule 8.5, which provides the required odor control measures.

For the project facilities that would be within the PSCAA jurisdictional area, the following regulations would apply.

- PSCAA Regulation 1, Section 9.03, which addresses the visual standard.
- PSCAA Regulation 1, Section 9.07, which provides the SO_2 emission standard for fuel-burning equipment.
- PSCAA Regulation 1, Section 9.09, which addresses the PM standard for fuel-burning equipment burning any fuel other than wood.
- PSCAA Regulation 1, Section 9.11, which addresses detriments to person or property standards and odors.
- PSCAA Regulation 1, Section 9.13, which addresses concealment and masking of air contaminants.
- PSCAA Regulation 1, Section 9.15, which prohibits fugitive dust and requires preventive measures.
- PSCAA Regulation 1, Section 9.20, which requires that machinery and equipment be maintained in good working order.

For the project facilities that would be within the NWCAA jurisdictional area, the following regulations would apply.

- NWCAA Section 451, which provides visual (opacity) standards and requirements.
- NWCAA Section 455, which summarizes the PM standards from gaseous and distillate fuel-burning equipment.
- NWCAA Sections 460 and 462, which address the heat/weight standard for sulfur compound emissions for sources with an aggregate heat input capacity greater than 500 MMBtu/hr.
- NWCAA Section 462, which provides sulfur compound emission standards.
- NWCAA Section 520, which limits sulfur compounds in fuel.
- NWCAA Section 530, which outlines general nuisance requirements and prohibits air emissions from creating a nuisance.
- NWCAA Section 535, which addresses odor and odor control measures.

- NWCAA Section 540, which addresses concealment and masking of air contaminants.
- NWCAA Section 550, which requires the use of reasonable precautions to prevent PM emissions from becoming airborne and the requirement for reasonably available control technology be implemented to prevent the release of fugitive PM to the ambient air.
- NWCAA Section 580.11, which requires owners and/or operators of stationary emission sources of VOCs to register the source(s) with NWCAA.

The construction activities associated with the pipeline and the modifications to the existing compressor stations would employ reasonable measures for dust control in compliance with applicable requirements of WA Ecology and local clean air agencies.

Greenhouse Gas Reporting

Per WAC 173-441, any source that emits 10,000 metric tons of CO_2e per calendar year is required to perform GHG reporting. Once a source is subject to the GHG reporting requirements, the source must submit an annual GHG report, even if the source would not meet applicability requirements in WAC 173-441-030(1) or (2) in a future year. State of Washington GHG reporting requirements would be applicable to the Chehalis, Sumner, Snohomish, Mt. Vernon, and Sumas Compressor Stations.

Title V Operating Permit Applicability

In addition to obtaining a construction permit, Title V of the federal Clean Air Act, the Operating Permit program, as described in 40 CFR Part 70, requires certain major sources of air emissions to apply for an operating permit within 12 months of becoming subject to the regulation. These operating permits are referred to in Washington as Chapter 401 Permits, Title V Permits, or Air Operating Permits (AOPs). AOPs combine into one document all operational and procedural requirements, applicable regulations, emission standards, and monitoring, record-keeping, and reporting requirements. Washington's operating permit program regulations are covered in WAC 173-401 and require a source to have an AOP if it has the PTE any of the following:

- more than 100 tpy of any criteria pollutant (lower thresholds apply in nonattainment areas);
- more than 10 tpy of any HAP, as listed in 112(b) of the federal Clean Air Act; or
- more than 25 tpy of a combination of any HAPs.

These levels differ from the major source levels for PSD. A source may also be required to have an AOP if it is subject to the following federal air quality requirements:

- Title IV Acid Rain Program;
- NSPS; or
- NESHAPs.

The applicable local clean air agency would process AOP applications for sources in its jurisdictions. Newly major sources must submit an application within 12 months of becoming subject to the regulation.

Construction Air Quality Impacts and Mitigation

Construction Emissions

The WEP would generate air emissions from temporary construction activities. The construction of the pipeline is anticipated to start in the third quarter of 2016 to meet an in-service target of fourth quarter 2018.

Initiating compression modifications at the five existing compressor stations is anticipated to start in the second quarter of 2017. All work, including both pipeline and compression, would be completed in the fourth quarter of 2018. Estimated duration of construction activities at each station is about 9 months. Construction activities would include:

- site preparation, including clearing, grading, trenching, excavation of footings and foundations, and backfilling operations;
- foundation work;
- installation of pipeline/major equipment; and
- right-of-way restoration.

During construction, there would be short-term affects to air quality. To prevent wildfires along the pipeline corridor, downed trees, slash, or woody debris would not be burned; therefore, no emissions from burning would be generated. Construction emissions related to the installation of the pipeline and modifications to the existing compressor stations would result from the following activities:

- emissions from fuel-burning construction equipment and vehicles;
- fugitive dust emissions from site preparation, grading, trenching, and backfilling;
- fugitive dust emissions from travel of vehicles/equipment on paved and unpaved roads; and
- fugitive dust emissions from wind erosion of areas disturbed during construction activities.

Regulated pollutant emissions associated with construction would include criteria pollutants (NOx, CO, SO_2, VOCs, PM_{10}, and $PM_{2.5}$), HAPs, and GHGs. Table 4.2.12-11 presents a summary of estimated construction emissions associated with pipeline and compressor station modifications.

Table 4.2.12-11

Summary of Estimated Construction Emissions from the WEP Pipeline Modifications

	Emissions (tons)							
	NOx	**CO**	**SO_2**	**VOCs**	**PM_{10}**	**$PM_{2.5}$**	**HAP**	**CO_2e**
Pipeline Loop Modifications								
Woodland Loop	10.05	52.12	0.06	2.30	37.90	8.77	0.13	3,577
Chehalis Loop	3.62	17.36	0.01	0.98	19.31	6.45	0.05	1,292
Sumner South Loop	2.69	13.80	0.02	0.82	5.52	5.00	0.03	1,039
Sumner North A Loop	2.68	13.75	0.02	0.82	5.38	4.99	0.03	1,036
Sumner North B Loop	2.86	15.21	0.02	0.85	6.09	5.06	0.03	1,133
Snohomish Loop	2.72	13.91	0.02	0.82	7.27	5.17	0.03	1,048
Mt. Vernon South Loop	2.53	12.36	0.01	0.78	5.69	5.01	0.03	946
Mt. Vernon North A Loop	2.53	12.38	0.01	0.78	5.88	5.03	0.03	946
Mt. Vernon North B Loop	2.68	13.75	0.02	0.82	5.75	5.02	0.03	1,037
Sumas Loop	2.68	13.76	0.02	0.82	5.77	5.02	0.03	1,037
Total	**35.04**	**178.40**	**0.21**	**9.79**	**104.56**	**55.52**	**0.42**	**13,091**
Compressor Station Modifications								
Chehalis Compressor Station	0.72	3.14	<0.01	0.12	7.59	0.46	<0.01	267
Sumner Compressor Station	0.83	4.14	<0.01	0.15	8.35	0.54	0.01	332
Snohomish Compressor Station	1.05	6.14	0.01	0.21	8.36	0.55	0.01	462
Mt. Vernon Compressor Station	0.74	3.17	<0.01	0.12	10.61	0.76	<0.01	271
Sumas Compressor Station	0.94	5.14	0.01	0.18	7.97	0.51	0.01	397
Total	**4.28**	**21.73**	**0.02**	**0.78**	**42.88**	**2.82**	**0.03**	**1,729**

Road vehicle emissions include construction worker commuter traffic and heavy-duty delivery trucks.

Construction equipment includes construction and installation of equipment. HAP emission factors for construction equipment are not available.

Fugitive emissions include dust generated during site clearing, excavation, trenching, and backfilling, as well as VOCs from asphalt construction.

Total construction emissions from combined pipeline and compressor station construction activities are presented in table 4.2.12-12.

Table 4.2.12-12

Summary of Total Estimated Construction Emissions

	Emissions (tons)							
	NOx	**CO**	**SO_2**	**VOCs**	**PM_{10}**	**$PM_{2.5}$**	**HAP**	**CO_2e**
Pipeline Loop Construction	35.04	178.40	0.21	9.79	104.56	55.52	0.42	13,091
Compressor Station Construction	4.28	21.73	0.02	0.78	42.88	2.82	0.03	1,729
Total	**39.32**	**200.13**	**0.23**	**10.57**	**174.44**	**58.34**	**0.45**	**14,820**

Construction Emissions Mitigation

Because of their relatively short-term nature, construction emissions would not have a long-term effect on ambient air quality. Northwest would require its contractors to employ standard dust control measures during construction to reduce generation of fugitive dust due to surface disturbances. Dust control measures may include the following:

- reduction of speeds on unpaved roads to 15 mph or less in the construction area;

- use of sweepers or water trucks to remove "track-out" at any point of public street access;
- stabilization of soil storage piles by tarps, fencing, or other erosion control measures; and
- limiting fugitive dust emissions on the WEP right-of-way through a watering regimen.

Operational Air Quality Impacts and Mitigation

During operation of the pipeline and the five modified compressor stations, emissions of criteria pollutants, GHGs, HAPs, and Washington-regulated toxic air pollutants (TAP) would occur.

Along the pipeline route, leaks and venting could occur at compressor stations and potentially from small leaks at flanges and valves. Emissions expected during operation of the pipeline would be relatively minor. Maintenance activity emissions would be managed in accordance with air quality regulations. Fugitive emissions estimated for pipeline operations were calculated using the Tier 2 methodology outlined in *Greenhouse Gas Emission Estimation Guidelines for Natural Gas Transmission and Storage – Volume I GHG Emission Estimation Methodologies and Procedures* (Interstate Natural Gas Association of America [INGAA], 2005). Five compressor stations and the pipeline length of about 140 miles were used in the estimate. In addition, fugitive VOC emissions were estimated using the Tier 2 INGAA methodology assuming a 1 percent by volume VOC concentration in transmission natural gas. Table 4.2.12-13 presents an estimate of annual pipeline emissions from fugitive leaks and venting emissions.

Table 4.2.12-13

Estimated WEP Pipeline Fugitive and Venting Emissions

	Emissions (tpy)			
	CH_4	**CO_2**	**CO_2e**	**VOCs**
Compressor station – blowdown and venting	559	32.9	14,008	18.7
Pipeline blowdown	121	7.1	3,032	4.0
Compressor station – fugitives	3,149	182	78,907	105.1
Total pipeline transmission – fugitives	1.6	0.6	40.6	0.3
Pipeline – transmission	1.6	—	40.0	0.05
Pipeline – transmission (CO_2 from CH_4 oxidation)	—	0.5	0.5	—
Pipeline – transmission (CO_2 from pipeline leaks)	—	0.1	0.1	0.2
Total	**3,831**	**223**	**95,988**	**128**

Modifications to the existing Chehalis Compressor Station would include the installation and operation of a new Taurus 60 turbine, rated at 7,684 hp. In addition, one 3.5-MMBtu/hr, natural gas boiler and one 500-hp, natural-gas-fired emergency generator would be installed. Emissions of these new units would be added to the existing emissions for the Chehalis Compressor Station summarized in table 4.2.12-14. Table 4.2.12-14 presents the total emissions that would result from the expanded compressor station after the WEP modifications are complete.

Table 4.2.12-14

Estimated Total Potential Emissions from Operation of the Compressor Stations and Percentage Change over Existing Emissions

	Emissions (tpy)							
Compressor Station	**PM_{10}**	**$PM_{2.5}$**	**NOx**	**CO**	**SO_2**	**VOC**	**HAP**	**CO_2e**
Expanded Chehalis								
New total emissions	23.18	23.18	238	205	7.8	52.1	19.2	148,256
Change over existing emissions (%)	26	26	9	11	143	5	3	34
Modified Sumner								
New total emissions	22.22	22.22	83.30	84.83	20.81	9.81	2.40	173,000
Change over existing emissions (%)	297	297	-15	-11	618	445	167	82
Modified Snohomish								
New total emissions	14.81	14.815	133.52	131.34	11.58	6.06	1.92	167,500
Change over existing emissions (%)	164	164	36	38	299	237	113	76
Modified Mt. Vernon								
New total emissions	24.69	24.69	788.9	256.73	11.21	61.51	27.43	197,387
Change over existing emissions (%)	60	61	5	17	367	8	4	59
Modified Sumas								
New total emissions	44.65	44.556	1,200	355.09	27.85	54.84	29.85	385,411
Change over existing emissions (%)	123	124	0	-2	468	-32	-40	68

Northwest submitted air dispersion modeling results in October 2013 supplying additional analysis for each compressor station modification in comparison to NAAQS. Table 4.2.12-15 presents the preliminary assessment of potential ambient air quality impacts that were produced using the AERSCREEN dispersion model (v11126) for compressor station proposed modifications. These results are considered preliminary because available compressor station designs are in the preliminary stages and general assumptions were used for certain variables such as stack height and building configurations.

Table 4.2.12-15

Air Dispersion Modeling Results

Pollutant	**Averaging Period**	**Chehalis Modeled Ambient Concentration (µg/m3)**	**Sumner Modeled Ambient Concentration (µg/m^3)**	**Snohomish Modeled Ambient Concentration (µg/m^3)**	**Mt. Vernon Modeled Ambient Concentration (µg/m^3)**	**Sumas Modeled Ambient Concentration (µg/m^3)**	**NAAQS/ WAAQS (µg/m^3)**
SO2	1-hour	13	42	14	13	36	196/65
	3-hour	13	42	14	13	36	1,300
NO2	1-hour	50	158	20	94	135	188
	Annual	5	16	2	9	13	100/94
PM2.5	24-hour	9	29	9	9	23	35
	Annual	1	5	2	2	4	15
PM10	24-hour	9	29	9	9	23	150
CO	1-hour	56	178	57	57	152	40,000
	8-hour	50	160	51	51	137	10,000

Operational Air Quality Mitigation

Per the requirements of WAC 173-400-113, WAC 173-400-720, and SWCAA 400-110(2)(c), a best available control technology (BACT) analysis would be performed to determine the appropriate control technologies to be implemented to reduce regulated pollutants from each of the new proposed equipment. This BACT analysis would be submitted for approval by the SWCAA as part of the NOC application. In addition, impact analyses for TAPs and criteria pollutants, and toxic best available control technology (tBACT) analysis would be performed and submitted, in accordance with WAC 173-460-070 and WAC 173-460-060. The identified controls would be installed to reduce emissions for the new compressor, natural gas boiler, and emergency generator. The applicable BACT could result in lower emissions for the Chehalis Compressor Station than those summarized in table 4.2.12-14.

Modifications to the existing Sumner Compressor Station include the removal of the two existing turbines (Mars 90s, each rated at 13,220 hp) and the installation and operation of two new turbines (Titan 130s, each rated at 20,483 hp). In addition, one 3.5-MMBtu/hr, natural gas boiler and one 500-hp, natural gas emergency generator would be installed and operated. Table 4.2.12-14 presents the total emissions that would result from the removal of older equipment and the addition of new units at the compressor station after the WEP modifications are complete.

In accordance with the requirements of WAC 173-400-113 and WAC 173-400-720, as well as PSCAA Regulation 1 Section 6.01, a BACT analysis would be performed to determine the appropriate control technologies to be employed to reduce regulated pollutants from each new emission unit. This BACT analysis would be submitted for PSCAA approval as part of the NOC application. In addition, a TAP impact analysis and tBACT analysis would be performed and submitted in accordance with WAC 173-460-060 and WAC 173-460-070. The identified controls would be installed to reduce emissions for the new turbine, natural gas boiler, and emergency generator engine. The required, applicable BACT could result in lower emissions for the Sumner Compressor Station than those summarized in table 4.2.12-14.

Modifications to the existing Snohomish Compressor Station include the installation and operation of one new Mars 100 turbine, rated at 14,996 hp. In addition, one 3.5-MMBtu/hr, natural gas boiler and one 500-hp, natural gas emergency generator would be installed. Emissions of this new unit would be added to the existing emissions for the Snohomish Compressor Station summarized in table 4.2.12-1. Table 4.2.12-14 presents the total emissions that would result from the expanded compressor station after the WEP modifications are complete.

In accordance with the requirements of WAC 173-400-113, as well as those of PSCAA Regulation I, Section 6.01, a BACT analysis would be performed to determine the appropriate control technologies to be employed to reduce regulated pollutants from each new emission unit. This BACT analysis would be submitted for PSCAA approval as part of the NOC. In addition, TAP impact analysis and tBACT analysis would be performed and submitted in accordance with WAC 173-460-060 and WAC 173-460-070. The identified controls would be installed to reduce emissions for the new turbine, natural gas boiler, and emergency generator engine. The required, applicable BACT could result in lower emissions for the Snohomish Compressor Station than those summarized in table 4.2.12-14.

Modifications to the Mt. Vernon Compressor Station would include the installation and operation of one new Mars 100 turbine, rated at 14,996 hp. In addition, one 3.5-MMBtu/hr, natural-gas-fired boiler and one 500-hp, natural-gas-fired emergency generator would be installed. Emissions of this new unit would be added to the existing emissions for the Mt. Vernon Compressor Station summarized in table 4.2.12-1. Table 4.2.12-14 presents the total emissions that would result from the expanded compressor station after the WEP modifications are complete.

In accordance with the requirements of WAC 173-400-113 and WAC 173-400-720, as well as those of NWCAA 300.7, a BACT analysis would be performed to determine the appropriate control technologies to be employed to reduce regulated pollutants from each new emission unit. This BACT analysis would be submitted for NWCAA for approval as part of the NOC application. In addition, TAP impact analysis and tBACT analysis would be performed and submitted in accordance with WAC 173-460-060 and WAC 173-460-070. The identified controls would be installed to reduce emissions for the new turbine, natural gas boiler, and emergency generator engine. The required, applicable BACT could result in lower emissions for the Mt. Vernon Compressor Station than those summarized in table 4.2.12-14.

Modifications to the Sumas Compressor Station would include the removal of the four existing Ingersoll Rand 2,000-hp units and the installation and operation of two new turbines (one Titan 250 rated at 29,982 hp and one Mars 100 rated at 14,996 hp). In addition, one 3.5-MMBtu/hr, natural-gas-fired boiler and one 500-hp, natural-gas-fired emergency generator would be installed. Table 4.2.12-14 presents the total emissions that would result from the removal of older equipment and the addition of new units at the compressor station after the WEP modifications are complete.

In accordance with the requirements of WAC 173-400-113 and WAC 173-400-720, as well as those of NWCAA 300.7, a BACT analysis would be performed to determine the appropriate control technologies to be employed in order to reduce regulated pollutants from each new emission unit. This BACT analysis would be submitted for NWCAA approval as part of the NOC for pollutants not subject to PSD review and to WA Ecology for pollutants subject to PSD review. In addition, TAP impact analysis and tBACT analysis would be performed and submitted in accordance with WAC 173-460-70 and WAC 173-460-60. The identified controls would be installed and operated to reduce emissions for the new turbines, natural gas boiler, and emergency generator engine. The required, applicable BACT could result in lower emissions for the Sumas Compressor Station than those summarized in table 4.2.12-14.

Air Quality Conclusions

The WEP would generate air emissions from temporary construction activities. Because of their relatively short-term nature, construction emissions would not have a long-term effect on ambient air quality. Northwest would require its contractors to employ standard dust control measures during construction to reduce fugitive dust due to surface disturbances.

During operation of the pipeline and the five modified compressor stations, emissions of criteria pollutants, GHGs, HAPs, and Washington-regulated TAPs would occur. Along the pipeline route, leaks and venting could occur at compressor stations and potentially from small leaks at flanges and valves. Emissions expected during operation of the pipeline would be relatively minor.

Operation of the five compressor stations would require Northwest to comply with applicable federal and state air quality regulations, where applicable, including PSD, Title V, National Emission Standards for Hazardous Air Pollutants, Chemical Accident Prevention rules, and GHG reporting. The WEP would not result in impacts at Federal Class I Areas.

As identified above, Northwest's air quality impact modeling analysis demonstrate that the air quality impact of the compressor stations would be below the NAAQS. Therefore, given the temporary nature of construction emissions, and the impact levels below the NAAQS, we conclude that the WEP would not result in significant local or regional air quality impacts.

4.2.12.2 Noise

Noise quality can be affected during construction and operation of the project and the magnitude and frequency of noise can vary considerably during the day, week, or the seasons, based on changing weather conditions, vegetative cover, and nonproject sources of noise. Two measures that associate the time-varying quality of noise to its effect on people are the 24-hour equivalent sound level (L_{eq}) and day-night averaged sound level (L_{dn}). The L_{eq} is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the L_{eq} plus 10 decibels on the A-weighted scale (dBA), added to account for people's greater sensitivity to nighttime sound (between the hours of 10 p.m. and 7 a.m.). The A-weighted scale is used as human hearing is less sensitive to low and high frequencies than mid-range frequencies. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 9 dBA is perceived as a doubling of noise.

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. FERC has adopted this criterion for new compression and associated facilities, and it is used here to evaluate the potential noise impact from operation of each of the proposed compressor stations. An L_{dn} of 55 dBA is equivalent to a continuous noise level L_{eq} of 48.6 dBA for facilities that operate at a constant level of noise.

Regulatory Requirements for Noise

Federal Noise Regulations

Federal noise regulations are discussed in section 4.1.12.2.

Washington Noise Regulations

Washington state noise regulations are discussed in section 4.1.12.2.

Local Noise Regulations

The pipeline and modified compressor stations are located in several local jurisdictions within Washington, including counties and cities. Relevant local noise regulations are summarized in table 4.2.12-16.

Table 4.2.12-16

Local Noise Regulations

City or County	Applicable Activities	Summary of Noise Regulations
Cowlitz County	Pipeline construction	Cowlitz County Code Chapter 18.10, Land Use Ordinance, states every development shall comply with Chapter 173-60 WAC, Maximum Environmental Noise Levels. Chapter 10.25, Nuisance Noises, exempts sounds created by construction between 7:00 a.m. and 10:00 p.m. from restrictions on noise generation.
City of Woodland	Pipeline construction	City of Woodland Municipal Code Chapter 17 sets forth noise performance standards applicable to commercial and industrial development. No construction noise limits are specified.
Lewis County	Compressor station construction and operation; pipeline construction	Lewis County Code Chapter 17, Land Use and Development Regulations, states that no development shall exceed the maximum environmental noise level established by Chapter 173-60 WAC.
Thurston County	Pipeline construction	Thurston County Code Chapter 10.36, Public Disturbance Noise, states that sounds originating from temporary construction sites as a result of construction activities between 7 a.m. and 10 p.m. are exempt from provisions of Chapter 10.36.
Pierce County	Compressor station construction and operation; pipeline construction	Pierce County Code Chapter 8.76, Noise Pollution Control, states that no person shall cause or permit noise exceeding the maximum permissible noise levels (equivalent to Chapter 173-60 WAC) to intrude into the property of another person. Construction activity exempt between 7 a.m. and 10 p.m.
City of Puyallup	Pipeline construction	City of Puyallup Municipal Code Chapter 6.16, Noise Control, exempts noise emanating from temporary construction sites from the provisions of the chapter except between the hours of 10:00 p.m. and 7:00 a.m.
City of Sumner	Pipeline construction	City of Sumner Municipal Code Chapter 8.14, Noise Control, states that no person shall cause or permit noise exceeding the maximum permissible noise levels (equivalent to the levels specified under Chapter 173-60 WAC) to intrude into the property of another person. Construction activity between 7:00 a.m. and 6:00 p.m. on weekdays, and 10:00 a.m. to 6:00 p.m. on Saturdays, Sundays, and legal holidays shall be allowed to operate at the noise level necessary to complete construction.
King County	Pipeline construction	King County Code Chapter 12.88 establishes maximum permissible noise levels for construction site, including time-of-day restrictions.
City of Covington	Pipeline construction	City of Covington Municipal Code Chapter 8.20, Noise Control, defines public disturbance noise as, among others, originating from any construction activity between 8:00 p.m. and 7:00 a.m. on weekdays and 6:00 p.m. and 9:00 a.m. on Saturdays, Sundays, or federal holidays
City of Sammamish	Pipeline construction	City of Sammamish Municipal Code Chapter 16.05, Construction Code, limits construction noise to (exceptions may be granted): 7:00 a.m. to 8:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. Saturdays and holidays.
Snohomish County	Compressor station construction and operation; pipeline construction	Snohomish County Code Chapter 10.01, Noise Control, sets maximum permissible sound levels and time-of-day limits according to the type of the sound source and the type of the receiving property. Sounds created by construction equipment (including special construction vehicles) at temporary construction sites, during daytime hours, are exempt from these levels.
Skagit County	compressor station construction and operation; pipeline construction	Skagit County Code Chapter 9.50, Noise Control, states that it is unlawful to exceed the noise levels permitted by WAC 173-60, Maximum Environmental Noise Levels. Provisions do not apply to sounds exempted under WAC 173-60.
Whatcom County	Compressor station construction and operation; pipeline construction	Whatcom County Code Chapter 20.80.620, Noise, states that every development shall comply with WAC 173-60, Maximum Environmental Noise Levels.

Existing Noise Levels

Northwest has collected ambient noise data showing existing noise levels at NSAs in the vicinity of the five compressor stations and at the proposed HDD crossing locations for the Cowlitz, Newaukum, Puyallup, Snohomish, and South Fork Nooksack Rivers.

Existing Compressor Station Noise Levels

Table 4.2.12-17 presents a summary of ambient noise levels measured at the compressor stations. The measurements were taken at the Chehalis, Snohomish, and Mt. Vernon Compressor Stations in April 2014. Ambient noise levels were measured at the Sumner Compressor Station in 2003 and at the Sumas Compressor Station in 2004. NSA locations are shown in figure 4.2.12-1 through figure 4.2.12-5. Two of the three NSAs shown in figure 4.2.12-5 have been removed from residential use since the noise levels were measured in 2004, and therefore, only results for one NSA are included in table 4.2.12-17.

Table 4.2.12-17

Measured Noise Levels at NSAs Closest to the Compressor Stations

Site	Distance to NSA (feet)	Bearing from Compressor Station to NSA	L_{eq} Noise Levels (dBA)	L_{dn} Noise Levels (dBA)
Chehalis Compressor Station				
NSA 1	1,370	East	51.3 [a]	57.7 [a]
NSA 6	1,390	West	55.6 [a]	62.0 [a]
Sumner Compressor Station				
NSA 1	630	North	45.3	--
NSA 2	790	East	48.1	--
NSA 3	770	East	47.1	--
NSA 4	790	East	47.7	--
NSA 5	590	South	46.1	--
NSA 6	520	South	45.8	--
NSA 7	460	South	47.2	--
NSA 9	390	South	47.6	--
NSA 11	590	South	43.4	--
Snohomish Compressor Station				
NSA 1	860	North	47.0	53.4
NSA 2	340	East	47.0	53.4
NSA 3	720	South	35.5	41.9
NSA 8	1,150	West	40.0	46.4
Mt. Vernon Compressor Station				
NSA 2	1,500	South	44.2	50.6
NSA 3 [b]	1,290	East	47.0	53.4
NSA 4	1,890	North	37.4	43.8
NSA 5 [b]	1,330	East	46.1	52.5
Sumas Compressor Station				
NSA 3	310	Southeast	47.2	--

[a] Due to the noise associated with I-5, these noise levels at the NSAs exceed FERC limits. The predominant source of noise was related to non-compressor station noises (e.g., I-5).

[b] Measurements were taken with all units at full load and all cooling fans operating, resulting in a higher than normal compression ratio. The high compression ratio caused the Plant B recycle valve to open, producing high noise levels in the recycle piping, which caused noise levels to be above the allowable federal limits at NSA 3 and NSA 5. The measurements were retaken while the recycle valve was manually closed and those measurements are presented here.

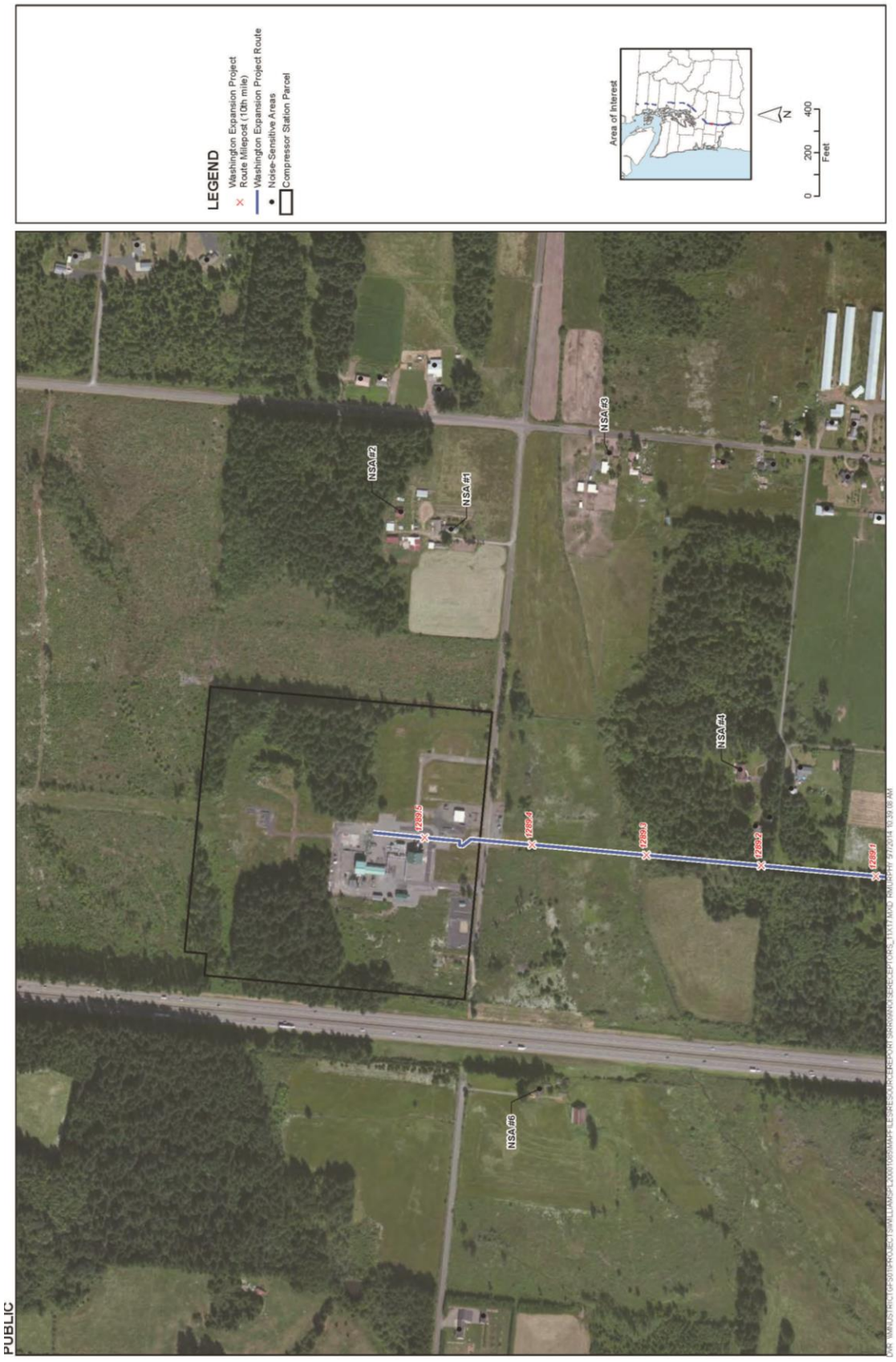


Figure 4.2.12-1: Noise-Sensitive Areas Near the Chehalis Compressor Station

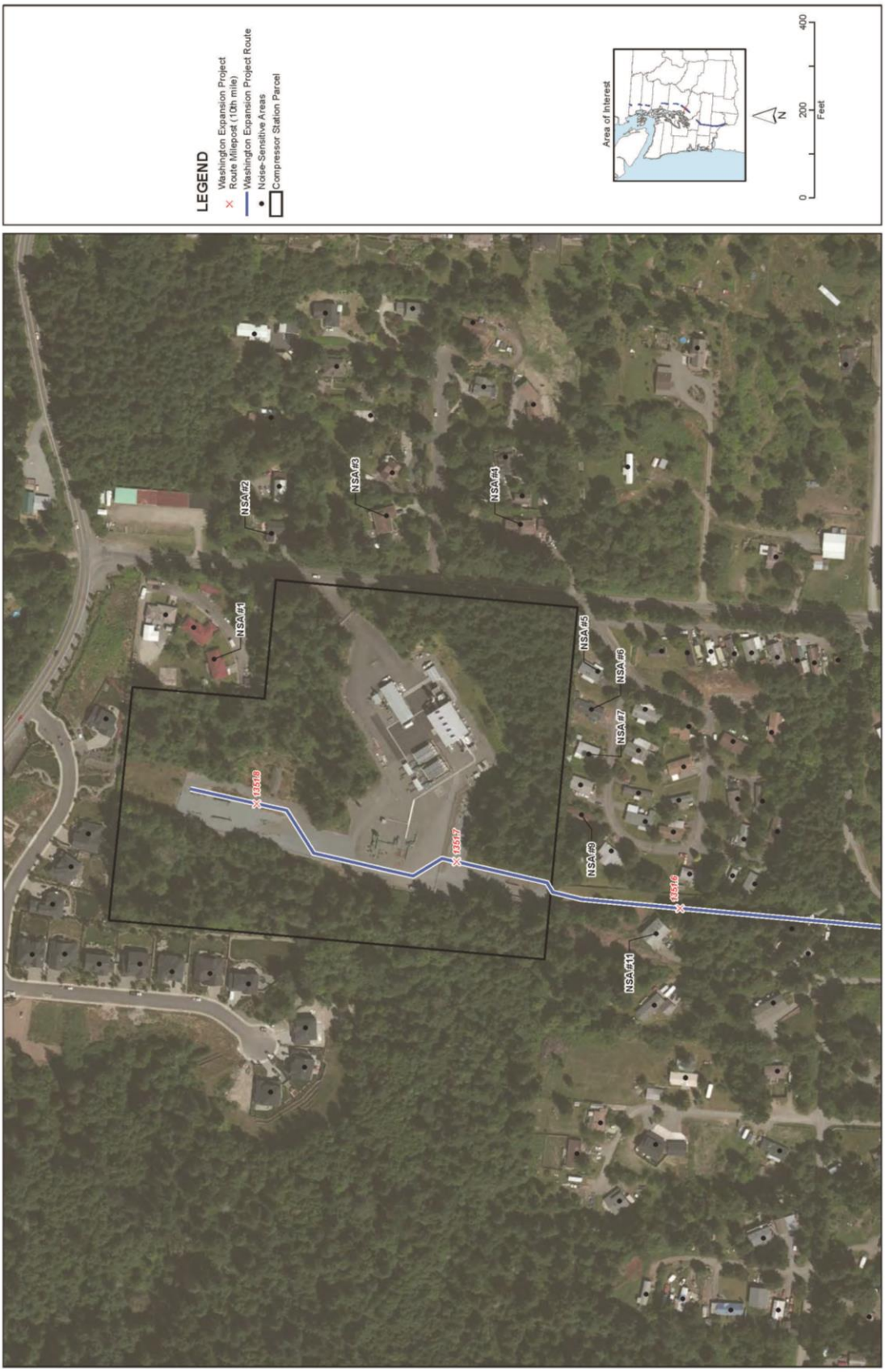


Figure 4.2.12-2: Noise-Sensitive Areas Near the Sumner Compressor Station



Figure 4.2.12-3: Noise-Sensitive Areas Near the Snohomish Compressor Station



Figure 4.2.12-4: Noise-Sensitive Areas Near the Mt. Vernon Compressor Station



Figure 4.2.12-5: Noise-Sensitive Areas Near the Sumas Compressor Station

HDD Location Noise Levels

Northwest measured background noise levels at NSAs in the vicinity of the proposed HDD crossings in June 2014. The measured noise levels are presented in table 4.2.12-18. NSA locations are shown in figure 4.2.12-6 through figure 4.2.12-10.

Table 4.2.12-18

Measured Noise Levels in the Vicinity of Proposed HDD Crossings

Site	Le_q Noise Levels (dBA)	Notes
Cowlitz River		dominant noise source was distant traffic on I-5 about 1/2 mile west
NSA 2	36.5	
NSA 3	39.5	
Newaukum River		loudest noise sources were from distant traffic on I-5 about 1 mile west, and a train more than 2 miles west
NSA 1	44.8	
NSA 2	44.7	
Puyallup River		loudest noise sources were from traffic on Highway 410 to the north, and distant traffic on Highway 512 to the west
NSA 1	43.0	
NSA 2	54.8	
NSA 3	45.4	
Snohomish River		loudest noise was from traffic on Highway 522 about 1,300 feet south
NSA 1	48.7	
NSA 2	56.7	
NSA 3	48.7	
South Fork Nooksack River		the most noticeable noise originated from farm equipment at NSA 2; other minor noise included distant traffic and birds
NSA 1	36.6	
NSA 2	45.2	
NSA 3	34.8	

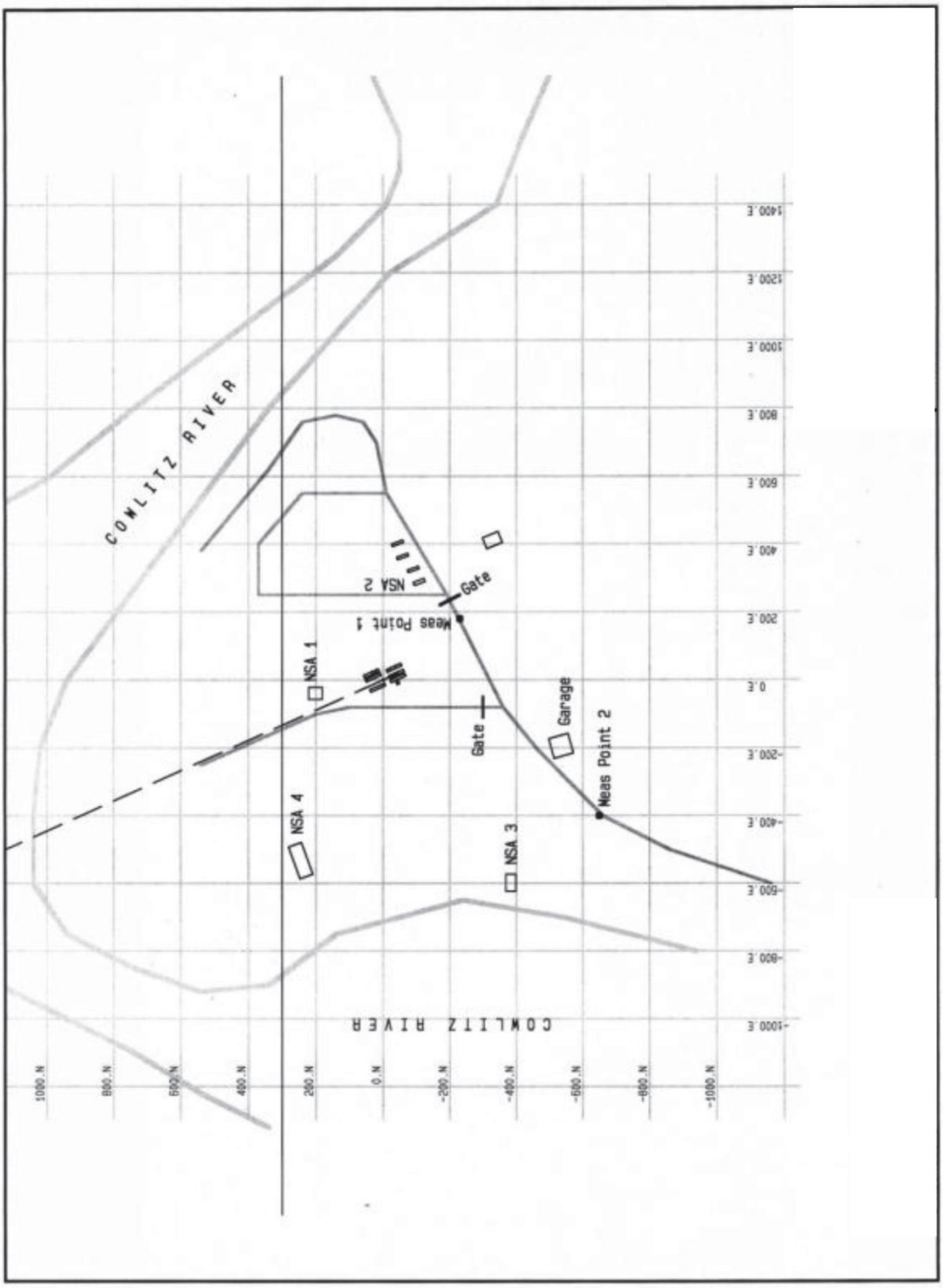


Figure 4.2.12-6: Cowlitz River HDD Crossing Noise Survey Area Plot

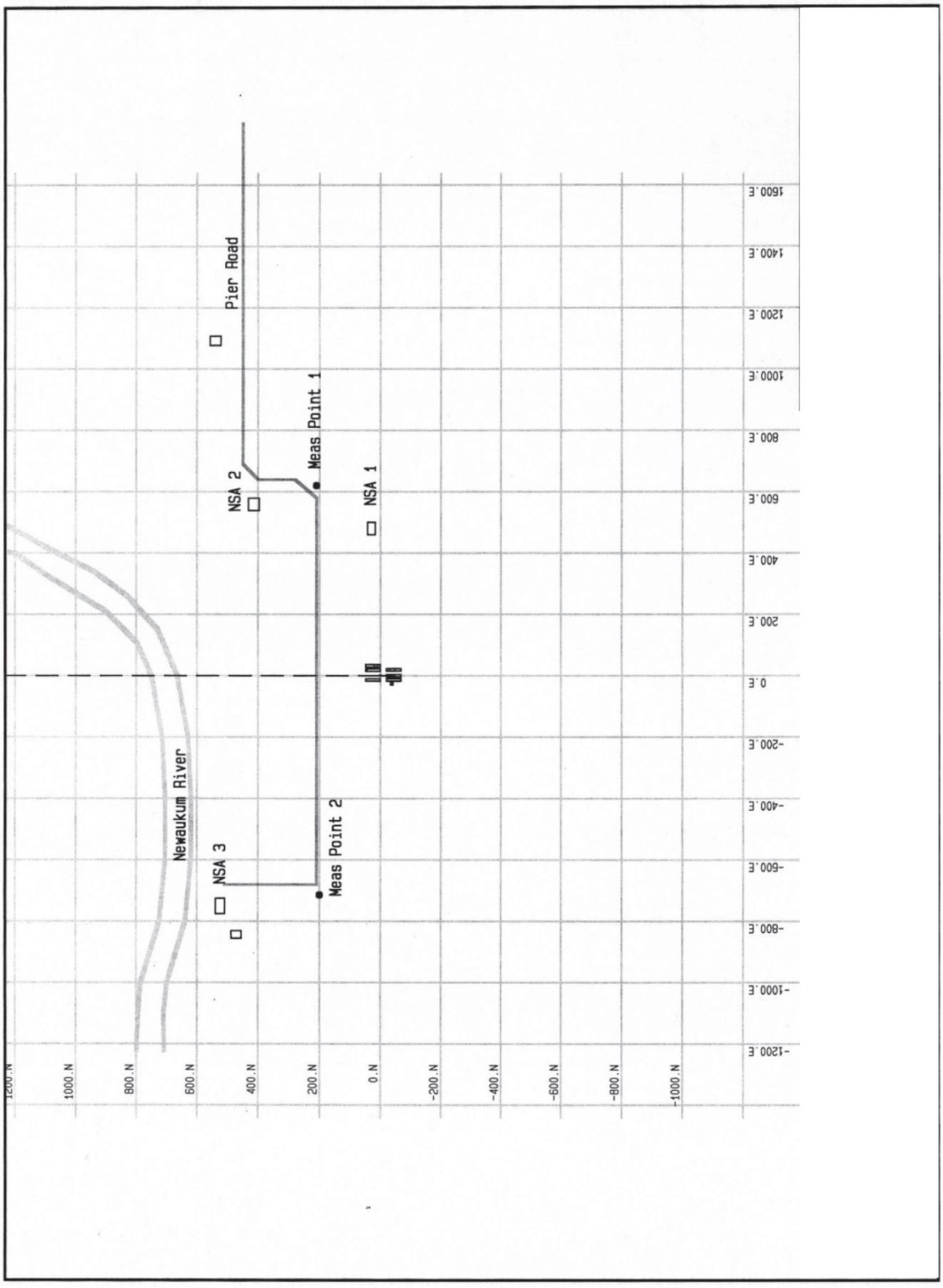


Figure 4.2.12-7: Newaukum River HDD Noise Survey Area Plot

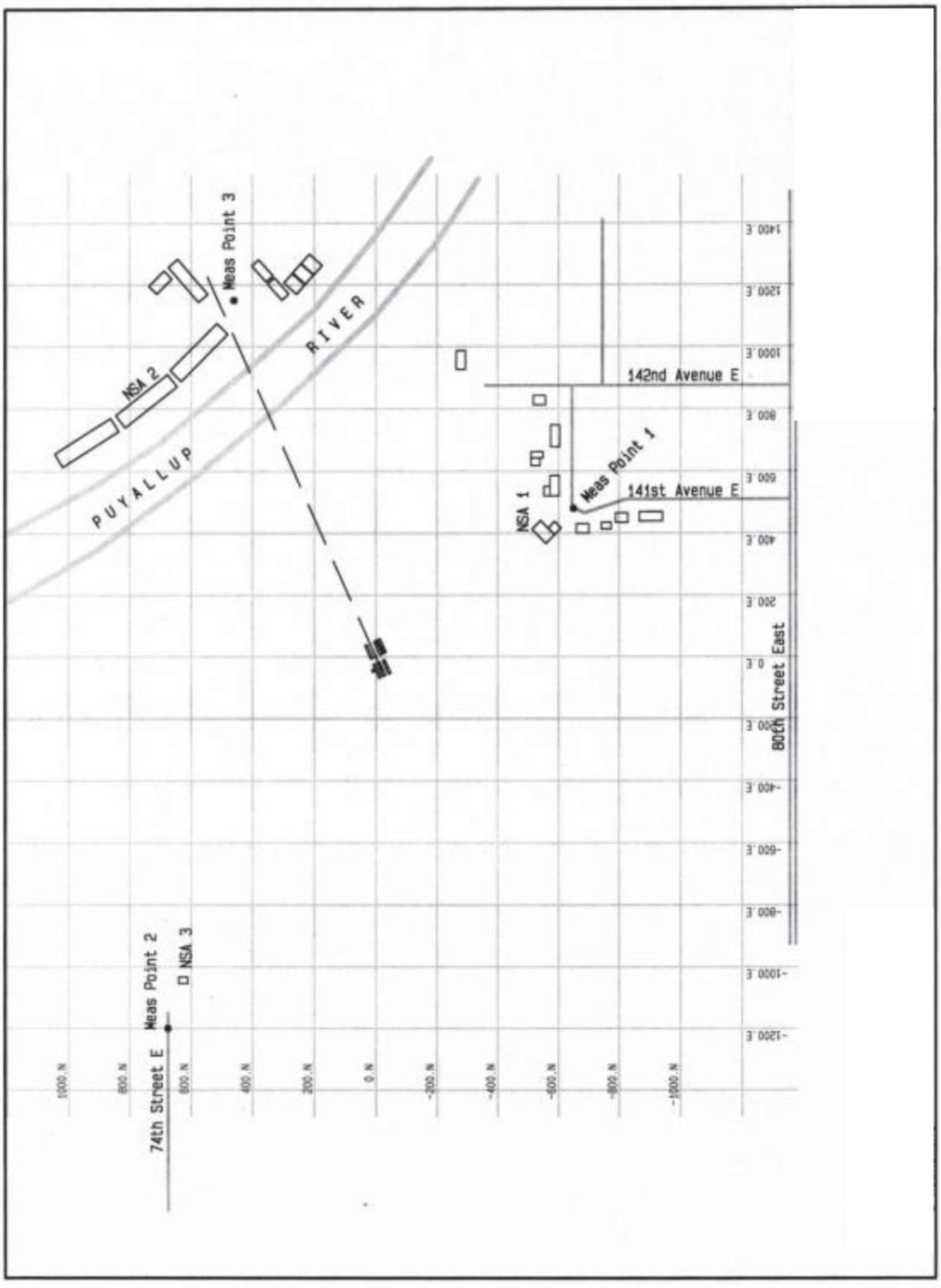


Figure 4.2.12-8: Puyallup River HDD Noise Survey Area Plot

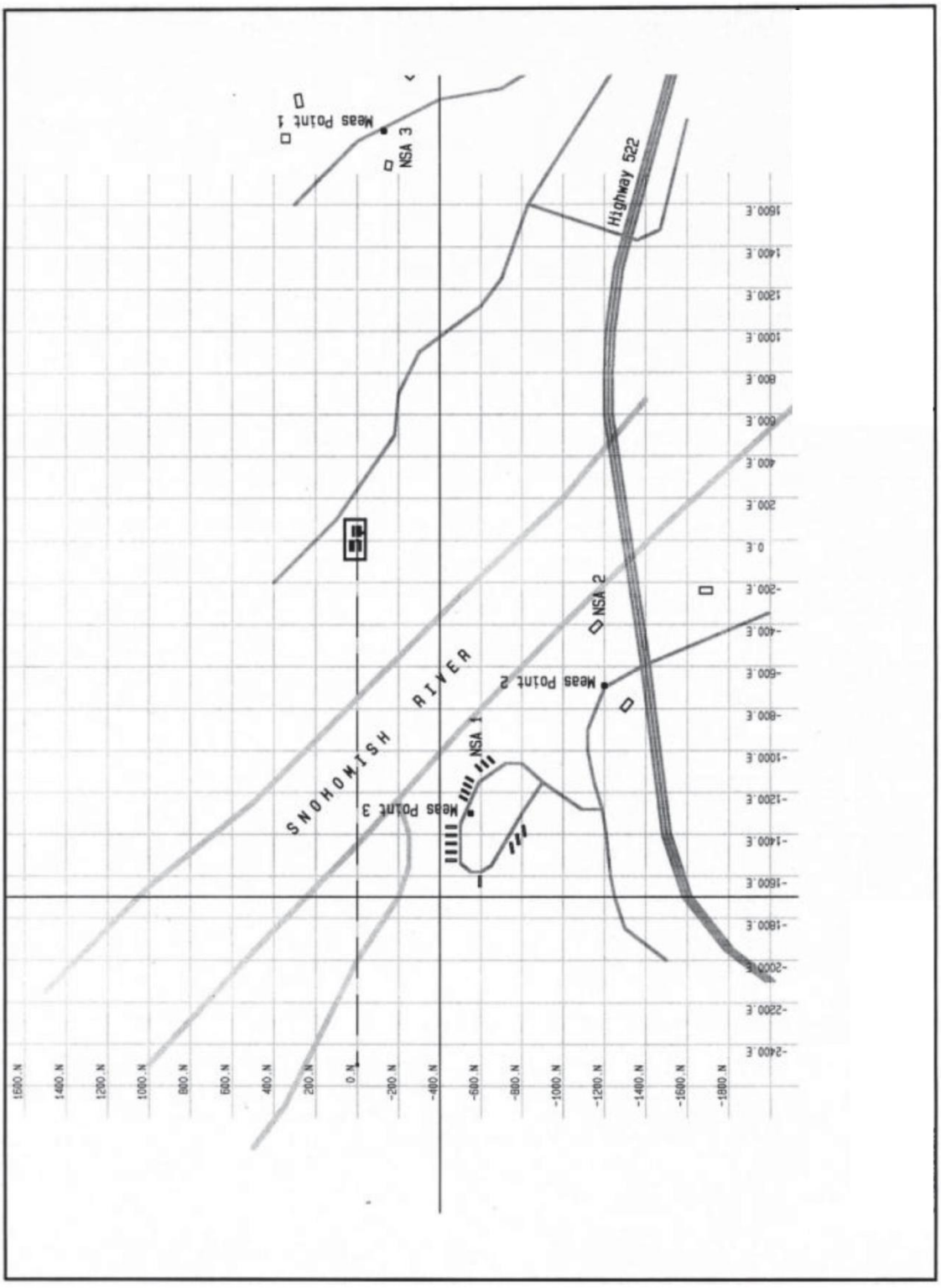


Figure 4.2.12-9: Snohomish River HDD Crossing Noise Survey Area Plot

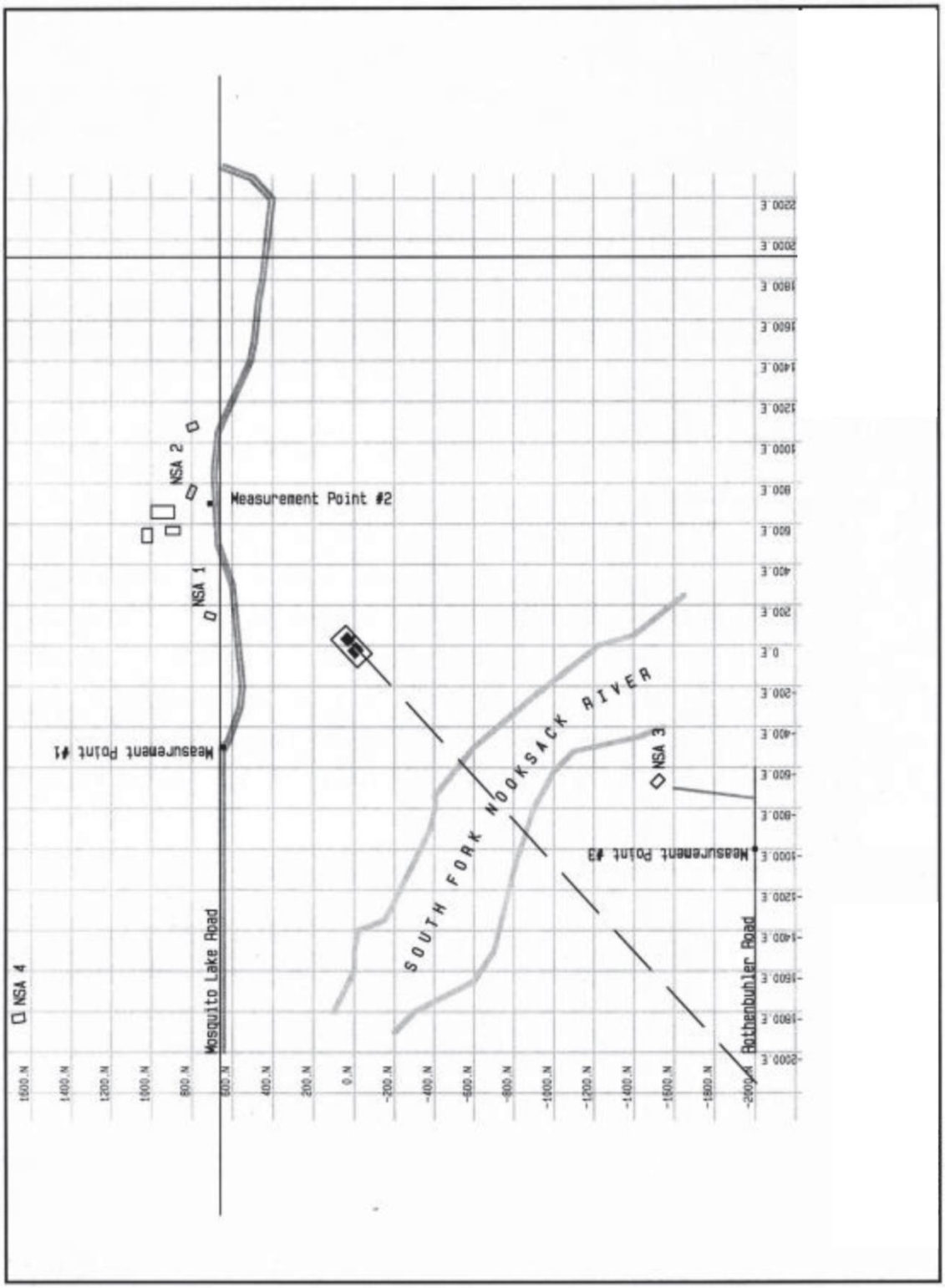


Figure 4.2.12-10: South Fork Nooksack HDD River Crossing Noise Survey Area Plot

Noise Impacts and Mitigation

Temporary noise impacts would result from pipeline and compressor station construction. Long-term noise increases would result from operation expansion of the compressor stations. These potential increases were compared with the standards for permissible noise at the NSAs.

Construction

Temporary noise generated by normal pipeline and compressor station construction activities would be similar to that described in section 4.1.12.2.

HDD equipment, and entry and exit point noise levels from HDD equipment would be the same as described in section 4.1.12.2. HDD crossings are planned at the Cowlitz, Newaukum, Puyallup, Snohomish, and South Fork Nooksack Rivers.

The Puyallup and Snohomish River crossings may be completed by the direct pipe method instead of HDD. The direct pipe method is typically quieter than the HDD method. At present, Northwest plans on limiting HDD activities to daytime hours.

At the Cowlitz River HDD crossing, a noise analysis was conducted to predict unmitigated noise levels at the nearest NSA as well as noise levels under two mitigation scenarios.

1. Installation of barrier walls with a Sound Transmission Class 35 noise reduction rating (STC-35) or better and having good sound absorption properties on the equipment side of the wall.
2. Installation of barrier walls (as described above) plus installation of two tents over the equipment to reduce the noise levels.

The nearest NSA is a residence about 180 feet to the north of the HDD location. Table 4.2.12-19 presents a summary of the predicted unmitigated HDD noise levels at the nearest NSAs, as well as noise levels under each of the mitigation scenarios. The table lists the predicted HDD L_{eq} noise levels at the NSA building structures and their property boundaries. The L_{dn} noise levels at the NSA buildings are shown for comparison with FERC L_{dn} limit of 55 dBA. The L_{eq} noise levels at the NSA property boundaries are shown for comparison with the Washington State daytime limit of 60 dBA and nighttime limit of 50 dBA.

Table 4.2.12-19

Predicted HDD Noise Levels in the Vicinity of the Cowlitz River Crossing

L_{dn} Noise Level for Comparison with FERC Noise Standards				
NSA	**FERC L_{dn} Standard**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with 20-foot Barrier and Acoustic Tents**
NSA 1	55	84.3	62.5	50.9
NSA 2	55	81.5	58.4	46.9
NSA 3	55	72.3	50.2	39.7
NSA 4	55	74.2	52.2	42.3
L_{eq} Noise Level for Comparison with WAC Noise Standards				
NSA	**WAC L_{eq} Standard (Day/Night)**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with 20-foot Barrier and Acoustic Tents**
Property Boundary 1	60/50	78.2	56.6	48.4
Property Boundary 2	60/50	75.9	52.8	41.1
Property Boundary 3	60/50	68.0	45.7	35.2
Property Boundary 4	60/50	69.3	47.2	37.2

The results of the analysis show that unmitigated noise levels and noise levels with only a 20-foot-high noise barrier would exceed the applicable noise standards at the nearest NSA. However, noise levels at the nearest NSA meet the applicable standards when both the barrier wall and acoustical tent mitigation are used together.

At the Newaukum River HDD crossing, a similar noise analysis was conducted to predict unmitigated noise levels at the nearest NSA as well as noise levels under the same two mitigation measures; except that each measure was evaluated independently rather than cumulatively as was done for the Cowlitz River crossing HDD. The nearest NSA is a residence about 430 feet to the east of the HDD location. Table 4.2.12-20 presents a summary of the predicted unmitigated HDD noise levels at the nearest NSAs, as well as noise levels under each of the separate mitigation scenarios. The table lists the predicted HDD L_{eq} noise levels at the NSA building structures and their property boundaries for comparison with FERC L_{dn} noise standards, and the Washington State daytime and nighttime L_{eq} standards.

Table 4.2.12-20

Predicted HDD Noise Levels in the Vicinity of the Newaukum River Crossing

L_{dn} Noise Level for Comparison with FERC Noise Standards				
NSA	**FERC L_{dn} Standard**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
NSA 1	55	70.2	58.8	51.1
NSA 2	55	61.5	55.8	50.6
NSA 3	55	60.6	54.6	47.7
L_{eq} Noise Level for Comparison with WAC Noise Standards				
NSA	**WAC L_{eq} Standard (Day/Night)**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
Property Boundary 1	60/50	72.3	54.4	49.7
Property Boundary 2	60/50	69.1	51.3	46.0
Property Boundary 3	60/50	64.7	49.2	42.8

The results of the analysis show that unmitigated noise levels and noise levels with a 20-foot-high noise barrier would exceed the applicable noise standards at the nearest NSA. However, noise levels at the nearest NSA meet the applicable standards when acoustical tent mitigation is used.

At the Puyallup River HDD crossing, a similar noise analysis was conducted to predict unmitigated noise levels at the nearest NSA as well as noise levels under the same two independent mitigation measures evaluated for the Newaukum River crossing HDD. The nearest NSA is a residence about 650 feet to the southeast of the HDD location. Table 4.2.12-21 presents a summary of the predicted unmitigated HDD noise levels at the nearest NSAs, as well as noise levels under each of the separate mitigation scenarios. The table lists the predicted HDD L_{eq} noise levels at the NSA building structures and their property boundaries for comparison with FERC L_{dn} noise standards, and the Washington State daytime and nighttime L_{eq} standards.

Table 4.2.12-21

Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed Puyallup River HDD Crossing

L_{dn} Noise Level for Comparison with FERC Noise Standards				
NSA	**FERC L_{dn} Standard**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
NSA 1	55	73.0	55.2	50.8
NSA 2	55	67.6	53.9	46.1
NSA 3	55	66.7	52.4	45.1
L_{eq} Noise Level for Comparison with WAC Noise Standards				
NSA	**WAC L_{eq} Standard (Day/Night)**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
Property Boundary 1	60/50	67.8	49.9	45.5
Property Boundary 2	60/50	61.5	47.8	40.0
Property Boundary 3	60/50	60.6	46.3	38.9

The results of the analysis show that unmitigated noise levels and noise levels with a 20-foot-high noise barrier would exceed the applicable noise standards at the nearest NSA. However, noise levels at the nearest NSA meet the applicable standards when acoustical tent mitigation is used.

At the Snohomish River HDD crossing, a similar noise analysis was conducted to predict unmitigated noise levels at the nearest NSA as well as noise levels under the same two independent mitigation measures evaluated for other HDD crossings. The nearest NSA at the Snohomish drilling site is a trailer park about 1,250 feet southwest of the HDD location. Table 4.2.12-22 presents a summary of the predicted unmitigated HDD noise levels at the nearest NSAs, as well as noise levels under each of the separate mitigation scenarios. The table lists the predicted HDD L_{eq} noise levels at the NSA building structures and their property boundaries for comparison with FERC L_{dn} noise standards, and the Washington State daytime and nighttime L_{eq} standards.

Table 4.2.12-22

Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed Snohomish River HDD Crossing

L_{dn} Noise Level for Comparison with FERC Noise Standards				
NSA	**FERC L_{dn} Standard**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
NSA 1	55	66.3	53.0	54.6
NSA 2	55	66.5	51.5	54.6
NSA 3	55	49.1	47.9	41.2
L_{eq} Noise Level for Comparison with WAC Noise Standards				
NSA	**WAC L_{eq} Standard (Day/Night)**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
Property Boundary 1	60/50	60.5	47.1	48.7
Property Boundary 2	60/50	60.8	45.7	48.8
Property Boundary 3	60/50	43.9	42.6	36.3

The results of the analysis show that unmitigated noise levels would exceed the applicable noise standards at the nearest NSA. However, noise levels at the nearest NSA meet the applicable standards when either the 20-foot-high barrier or acoustical tent mitigation is used.

At the South Fork Nooksack River HDD crossing, a similar noise analysis was conducted to predict unmitigated noise levels at the nearest NSA as well as noise levels under the same two

independent mitigation measures evaluated for the Newaukum River crossing HDD. The nearest NSA is a residence about 700 feet to the north of the HDD location along Mosquito Lake Road. Table 4.2.12-23 presents a summary of the predicted unmitigated HDD noise levels at the nearest NSAs, as well as noise levels under each of the separate mitigation scenarios. The table lists the predicted HDD L_{eq} noise levels at the NSA building structures and their property boundaries for comparison with FERC L_{dn} noise standards, and the Washington State daytime and nighttime L_{eq} standards.

Table 4.2.12-23

Predicted Mitigated and Unmitigated HDD Noise Levels in the Vicinity of the Proposed South Fork Nooksack River HDD Crossing

L_{dn} Noise Level for Comparison with FERC Noise Standards				
NSA	**FERC L_{dn} Standard**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
NSA 1	55	72.7	56.2	50.3
NSA 2	55	68.2	53.1	46.3
NSA 3	55	63.5	50.6	42.5
NSA 4	55	59.4	42.8	38.8
Leq Noise Level for Comparison with WAC Noise Standards				
NSA	**WAC L_{eq} Standard (Day/Night)**	**Unmitigated L_{dn}**	**L_{dn} with 20-foot Barrier**	**L_{dn} with Acoustic Tents**
Property Boundary 1	60/50	67.6	51.1	45.1
Property Boundary 2	60/50	62.5	47.3	40.6
Property Boundary 3	60/50	57.8	44.8	36.7
Property Boundary 4	60/50	53.3	36.7	32.7

The results of the analysis show that unmitigated noise levels and noise levels with a 20-foot-high noise barrier would exceed the applicable noise standards at the nearest NSA. However, noise levels at the nearest NSA would meet the applicable standards when acoustical tent mitigation is used; therefore, **we recommend that**:

- **Prior to construction of any HDD or direct pipe method crossings, Northwest should file with the Secretary, for the review and written approval by the Director of OEP, a noise mitigation plan to reduce the projected noise level attributable to the proposed drilling operations at NSAs *with predicted noise levels above 55 dBA L_{dn}*. During drilling operations, Northwest should implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSAs.**

No specific locations requiring blasting have been identified and blasting is not anticipated. In the event blasting is required, it would be conducted during the daylight hours consistent with WAC 173-60-050 and would be performed according to a Blasting Plan prepared for the project.

Northwest would employ a combination of noise mitigation methods, including equipment noise controls and administrative measures, to effectively minimize effects of construction activity at NSAs near the WEP. Northwest would establish a means for owners of nearby residences and other properties to report any significant undesirable noise conditions associated with construction of the WEP. Throughout construction of the WEP, Northwest would document, investigate, evaluate, and attempt to resolve noise complaints related to the WEP. This same process would be used during project operation. Northwest or its authorized agent would do the following:

- document and respond to each noise complaint;
- attempt to contact the person(s) making the noise complaint within 24 hours;
- conduct an investigation to attempt to determine the source of noise related to the complaint; and
- if the noise complaint is legitimate, take all feasible measures to reduce the noise at its source.

Northwest would restrict timing of noisy construction or demolition work (that causes off-site annoyance as evidenced by the filing of a legitimate noise complaint) to 7 a.m. to 7 p.m. Monday through Saturday. Haul trucks and other engine-powered equipment would be equipped with adequate mufflers. Haul trucks would be operated in accordance with posted speed limits. Truck engine exhaust brake use would be limited to emergencies. Further, semipermanent stationary equipment (such as generators and lights) may be available in "quiet" packages and would be stationed as far from sensitive areas as possible.

Specifically for HDD operations at the river crossings identified, Northwest would implement appropriate mitigation measures to achieve compliance during HDD installation operations. The installation contractor may select equipment with different sound characteristics than those assumed for the purposes of the noise analysis presented above; therefore, more or less mitigation may be required to attain acceptable noise levels. Northwest would ultimately implement those measures that are necessary to achieve the required results at the time of construction.

Operation

The pipeline would not be a meaningful source of noise during normal operation. There would be some associated operational noise related to pipeline maintenance activities at pig launcher/receiver and valve sites. These facilities would not substantially contribute to the WEP's operational noise levels and would only generate noise during scheduled maintenance activities such as blowdowns and pig runs. Only two pig launcher/receivers would be less than 300 feet from NSAs. The pig launcher/receiver at MP 1291.3 along the Sumner North A Loop would be 130 feet from the nearest NSA, and the launcher/receiver at MP 1435.7 along the Mt. Vernon South Loop would be 225 feet from the nearest NSA.

The primary source of operational noise for the WEP would be the modified compressor stations. Preliminary vendor-specific noise information is currently available for some, but not all, of the equipment expected to be the dominant noise sources. One of the most substantial noise sources associated with compressor stations is the noise resulting from the gas-turbine-driven compressors. This noise results from three main components: combustion air intake, exhaust, and turbine/compressor-radiated mechanical noise. Precast concrete buildings or other acoustically rated structures have been successfully installed around gas compressors located near NSAs, and appropriate measures would be included in the design of the compressor stations to comply with the regulatory limits. For this evaluation, the compressor stations included acoustically rated wall, ceiling, and door assemblies in addition to silenced building ventilation. The noise from the combustion air inlet and the exhaust was

reduced through the application of silencers. The noise from the turbines/compressors was reduced through the application of enclosures that reduced the near- field sound pressure level to 85 dBA.

Air coolers downstream of compressors are another important source of noise; however, there are several mechanisms to mitigate air cooler noise, such as low-noise fans, barriers, or silencers. One air cooler was included in the analysis for each compressor station. Aboveground piping and valving were not included in the evaluation because no information was available at this preliminary stage. These noise sources can be acoustically lagged (materials applied to the surface to reduce noise) or enclosed.

An evaluation of operational noise from the new equipment at each compressor station at the nearest identified NSAs was conducted using the CADNA/A noise model. CADNA/A is a sophisticated software program that enables complete noise modeling of complex industrial plants. The sound propagation factors used in the model have been adopted from ISO 9613. Atmospheric absorption for conditions of 10 °C and 70 percent relative humidity (conditions that favor propagation) was computed in accordance with ISO 9613-1, *Calculation of the Absorption of Sound by the Atmosphere.*

Noise impacts from the WEP operation would be required to meet the most restrictive limits established by jurisdictional agencies. The state of Washington limit of 60 dBA L_{eq} in the daytime and 50 dBA L_{eq} at night is equivalent to an L_{dn} of 60 dBA. The FERC limit of 55 dBA L_{dn}, which is equivalent to a continuous noise level of 49 dBA, is more restrictive and would be the governing limit for those areas where a more restrictive county, local, or station-specific regulation does not exist.

FERC regulations also limit increases in perceptible vibration at any NSA. An unexpected and unanticipated imbalance in the equipment could contribute to ground vibration levels in the vicinity of the equipment. Northwest would ensure that the equipment installed is well balanced and designed to produce very low vibration levels throughout its life. Furthermore, vibration monitoring systems installed in the equipment are designed to ensure that the equipment remains balanced. If an imbalance occurs, the event would be detected and the equipment would automatically shut down.

Northwest does not anticipate perceptible increases in vibration at the existing compressor stations. New turbines would be installed in acoustically rated buildings or enclosures that are designed to mitigate equipment vibrations from being transmitted off site. At the Sumas Compressor Station, Northwest would remove four of the six existing compressors, which would minimize potential for vibration.

The noise evaluation that was conducted based on this information demonstrates that compliance with the noise limits at each compressor station is feasible with the level of noise control included in the evaluation. The final design may differ from the design on which this preliminary evaluation is based, but post-construction testing would be conducted to demonstrate compliance with the applicable limits. If necessary, Northwest would develop additional site-specific approaches during final design such as increased acoustical ratings for wall, ceiling, and door assemblies, silencer building ventilation as well as combustion air inlet and exhausts. Results of the noise evaluation for the five modified compressor stations are discussed below.

The Chehalis Compressor Station is in Lewis County, which does not have noise regulations more restrictive than the state of Washington limit. Therefore, the noise levels from the station must meet both the federal and state requirements at nearby residences and state requirements at the station property boundaries. The federal requirement is an L_{dn} of 55 dBA at any NSA. For a 24-hour steady noise source, an L_{eq} of 49 dBA is equal to an L_{dn} of 55 dBA. The Washington requirement is 50 dBA at any residential property boundary (Class C to Class A at night) or 70 dBA at any agricultural property boundary (Class C to Class C, day or night). The Chehalis Compressor Station is located in an agricultural EDNA Class C area, with nearby residences being localized Class A areas.

The highest estimated L_{eq} at any of the NSA from the new compressor equipment is predicted to be 58 dBA. However, the predominant source of noise at the NSAs was related to noncompressor station noise (I-5 is a substantial existing source of noise in the vicinity of the NSAs identified near this compressor station). The total of existing equipment noise plus noise predicted from the new equipment at any of the NSAs is expected to comply with the controlling limit of 49 dBA.

The Sumner Compressor Station is in Pierce County, which does not have noise regulations more restrictive than the state of Washington limit. Therefore, the noise levels from the station must meet both the federal and state requirements at nearby residences; however, in this case, FERC requirement of an L_{dn} of 55 dBA (equivalent to an L_{eq} of 49 dBA) would be more restrictive. The highest L_{eq} at any of the NSAs is predicted to be 45 dBA. The total of existing equipment noise plus noise predicted from the new equipment at any of the NSAs complies with the controlling limit of 49 dBA.

The Snohomish Compressor Station is in Snohomish County. Snohomish County's regulations differ from WAC 173-60 in that the maximum permissible sound levels are set according to the district of the sound source and the district of the receiving property. The maximum permissible noise levels set for industrial sources at residential districts at night is 50 dBA (equivalent to the state of Washington limit). FERC's requirement is an L_{dn} of 55 dBA (equivalent to an L_{eq} of 49 dBA) at any NSA. FERC's requirements would be more restrictive than the state and local regulations. The highest estimated L_{eq} at any of the NSAs is predicted to be 44 dBA. The total of existing equipment noise plus noise predicted from the new equipment at any of the NSAs complies with the controlling limit of 49 dBA.

The Mt. Vernon Compressor Station is in Skagit County, which does not have noise regulations more restrictive than the state of Washington limit. Therefore, the noise levels from the station must meet both the federal and state requirements at nearby residences and state requirements at the station property boundaries. The highest estimated L_{eq} at any of the NSAs is predicted to be 37 dBA. The total of existing noise equipment noise level (47.0 dBA) plus noise predicted from the new equipment complies with the controlling limit of 49 dBA.

The Sumas Compressor Station is in Whatcom County, which does not have noise regulations more restrictive than the state of Washington limit. The compressor station is located in an agricultural EDNA Class C area, with nearby residences treated as Class A within the Class C areas. The station property boundaries abut agricultural land. The Washington requirement is 50 dBA at any residential property boundary (Class C to Class A at night) or 70 dBA at any agricultural property boundary (Class C to Class C day or night). The Sumas Compressor Station property boundaries currently abut agricultural areas and, therefore, have a 70 dBA noise limit.

The FERC order (Docket Nos. CP02-4-000 and CP02-4-001) for the Evergreen Project constructed in 2003 imposed site-specific limits on NSAs for the Sumas Compressor Station. These limits were based on noise levels at the NSAs measured during a noise survey conducted in 2003. However, two of the NSAs presented in that report have been removed from residential use since 2003. The remaining NSA was subject to an L_{eq} noise limit of 51.8 dBA. This FERC limit would be less restrictive than the state limit of 50 dBA, which would therefore be the controlling limit.

The highest estimated noise level at the remaining NSA is predicted to be 43 dBA. The existing equipment is estimated to be 47.2 dBA. The total would be 49 dBA, which is less than the controlling limit of 50 dBA.

To ensure that the closest residents to the compressor stations would not experience significant noise impacts, **we recommend that:**

- **<u>No later than 60 days</u> after placing the modified compressor stations in service, Northwest should file a noise survey with the Secretary. If a full load condition noise survey is not possible, Northwest should provide an interim survey at the**

maximum possible horsepower load and provide the full load survey within 6 months. If the noise attributable to the operation of all of the equipment at the compressor stations under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSA, Northwest should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Northwest should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.

Conclusions

During construction, Northwest would employ a combination of noise mitigation methods, including equipment noise controls and administrative measures, to effectively minimize effects of construction activity at NSAs near the WEP.

Specifically for HDD operations at the river crossings identified, Northwest would implement appropriate mitigation measures to achieve compliance during HDD installation operations. The installation contractor may select equipment with different sound characteristics than those assumed for the purposes of the noise analysis presented above; however Northwest would ultimately implement those measures that are necessary to achieve the required results at the time of construction.

During operation, the pipeline would not be a meaningful source of noise during normal operation. The primary source of operational noise for the WEP would be the modified compressor stations. Noise impacts from the WEP operation would be required to meet the most restrictive limits established by jurisdictional agencies. The state of Washington limit of 60 dBA L_{eq} in the daytime and 50 dBA L_{eq} at night is equivalent to an L_{dn} of 60 dBA. The FERC limit of 55 dBA L_{dn}, which is equivalent to a continuous noise level of 49 dBA, is more restrictive and would be the governing limit for those areas where a more restrictive county, local, or station-specific regulation does not exist. Northwest would implement mitigation measures at each site to ensure that the applicable standards are met at the nearest NSA.

Perceptible increases in vibration at the compressor stations would not be expected from the project. Northwest would be requested to ensure that there would be no perceptible increase in vibration from the modification to the compressor stations. New turbines would be installed in acoustically rated buildings or enclosures that are designed to mitigate equipment vibrations from being transmitted off site.

With Northwest's proposed mitigation measures and our recommendations, we conclude that the project would not result in significant noise or vibration impacts at the nearest NSAs.

4.2.13 Reliability and Safety

Section 4.1.13.10 describes PHMSA's pipeline safety program, natural gas pipeline safety standards, pipeline accident data, and general impacts on public safety. The following sections discuss aspects of pipeline reliability and safety specific to the WEP.

4.2.13.1 Safety Standards

In Washington, by signed agreement with the OPS, the state inspects interstate gas and hazardous liquid pipeline operators. This work is performed by the Washington Utilities and Transportation Commission.

The pipeline and aboveground facilities associated with the Washington Expansion Project would be designed, constructed, operated, and maintained in accordance with or to exceed the DOT Minimum Federal Safety Standards in 49 CFR 192, as described in section 4.1.13.10.

Preliminary class locations for the project have been determined based on the relationship of the pipeline centerline to other nearby structures and manmade features. The WEP would consist of 76.9 miles of Class 1, 34.7 miles of Class 2, and 29.0 miles of Class 3 pipe. See section 4.1.13.10 for class location definitions.

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Northwest would reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required to comply with the DOT requirements for the new class location.

We received several comments about the potential effects of a pipeline rupture and natural gas ignition. As described in section 4.1.13.10, DOT has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. The DOT regulations specify the requirements for the integrity management plan in 49 CFR 192.911

Once a pipeline operator has determined the HCAs along its pipeline, it must apply the elements of its integrity management plan to those segments of the pipeline within HCAs. The HCAs have been determined based on the relationship of the pipeline centerline to other nearby structures and identified sites. Of the 140 miles of proposed pipeline route, Northwest has identified about 26.5 miles that would be classified as an HCA. The pipeline integrity management rule for HCAs requires inspection of the pipeline HCAs every 7 years. Northwest has developed an integrity management plan in accordance with DOT regulations. In addition, Northwest would participate in the "Call Before You Dig" programs and other related pre-excavation notification organizations in Washington.

The DOT prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Each pipeline operator is required to establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of Northwest's plan would include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

We received a comment that a pipeline emergency response plan should be available for review prior to installation of the pipeline. As described above, DOT regulations prescribe the minimum standards for operating and maintaining pipeline facilities, including the requirement for each pipeline operator to establish an emergency response plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Northwest has an emergency response plan for its existing pipeline that it would update prior to construction. Northwest would provide the appropriate training to local

emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle operational pipeline emergencies.

The WEP would parallel Northwest's existing facilities and Northwest currently meets routinely with affected fire departments and other emergency responders along its existing pipeline route. Northwest would continue to perform mock emergencies with the emergency response agencies to evaluate readiness and deficiencies and identify corrective behaviors. Northwest personnel would continue to consult with local fire departments and emergency response agencies to determine whether additional equipment, training, and support are needed, and to provide those resources in the identified areas. In the event of an emergency, Northwest personnel would work in tandem with emergency responders.

Northwest would continue to provide local hands-on training to local fire districts that covers:

- how to identify pipeline rights-of-way;
- the principles of natural gas;
- knowing the difference between natural gas and mercaptan;
- how to identify hazards to pipeline corridors;
- how to detect leaks;
- how to respond to emergencies at aboveground facilities; and
- photos and locations of all Northwest facilities within the fire district.

Northwest would continue to provide to each local fire station/district its Emergency Response Plan that includes a listing of key personnel and contact information, a written summary of the hands-on training, and maps of all pipelines and facilities within the district.

4.2.13.2 Pipeline Accident Data

Pipeline accident data for recent years is provided and discussed in section 4.1.13.10.

4.2.13.3 Impact on Public Safety

General impacts of natural gas pipelines on public safety are addressed in section 4.1.13.10. We received comments specifically addressing the safety and reliability of the Northwest Pipeline. These comments mentioned previous natural gas accidents in the area and on Northwest's pipeline system and the risk of fire or explosion in heavily wooded areas during both construction and operation of the WEP. Other comments focused on the response to a pipeline emergency and requested review of emergency response plans and evacuation plans prior to approval of the WEP.

The PHMSA database of significant incidents occurring on natural gas transmission and distribution pipeline systems has recorded 22 incidents in Washington between 2003 and October 1, 2014. These incidents, described in section 4.1.13.10, were caused by failures of materials, welds, or equipment; excavation damage; corrosion; natural forces; other outside forces; or incorrect operation (PHMSA, 2014).

As described in section 4.1.13.10, the available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1994 to 2013, there were an average of 62 significant incidents, 10 injuries and 2 fatalities per year. The number of significant incidents over the more than 303,000 miles of natural gas transmission lines indicates the risk is low for an incident at any given location. The operation of the WEP would represent a slight increase in risk to the nearby public.

4.3 CUMULATIVE EFFECTS

Cumulative effects may result when the environmental effects associated with a proposed project are added to impacts associated with past, present, or reasonably foreseeable future projects. Although the individual impact of each separate project might not be significant, the additive or synergistic effects of multiple projects could be significant.

This cumulative impacts analysis uses an approach consistent with the methodology set forth in relevant guidance (CEQ, 1997 and 2005; EPA, 1999), and focuses on potential impacts from the proposed projects on resource areas or issues where their incremental contribution would be potentially significant when added to the potential impacts of other actions. To avoid unnecessary discussions of insignificant impacts and projects and to adequately address and accomplish the purposes of this analysis, an action must first meet the following three criteria to be included in the cumulative analysis:

- affect a resource potentially affected by the proposed project;
- cause this impact within all, or part of, the geographic project area; and
- cause an impact within all, or part of, the time span for the potential impact from the proposed project.

Table 4.3-1 lists present and reasonably foreseeable future actions that may, when added to the effects of past actions and the effects of construction and operation of the Oregon LNG Project and the WEP, have a cumulative effect on environmental resources. These actions were identified using information provided by Oregon LNG, Northwest, internet research, comments, and communications with federal, state, and local agencies.

The projects listed are generally located along the Oregon LNG Project from Warrenton, Oregon, to Woodland, Washington, and the WEP from Woodland north to the Canadian border. The cumulative effect study area surrounding the terminal was extended to include the lower Columbia River and the northwest corner of Clatsop County, Oregon. Present and reasonably foreseeable future actions specific to Clatsop County are listed at the end of table 4.3-1, while actions affecting the entire study area are listed first.

The assessment (or geographic) area of the potential cumulative effects includes the area directly affected by project construction in addition to the area of effect the projects would have on a resource. The assessment area varies by resource. Effects on geology and soil resources would likely not extend beyond the projects' construction boundaries. Therefore, the area of potential cumulative effects would be limited for those resources. Effects on air quality are likely to extend beyond the projects' boundaries. Effects on water quality would have a geographic area of potential effect that would extend to watershed boundaries. The socioeconomic geographic area of potential effect would include the counties where the projects would be constructed and operated.

For the purposes of this analysis, the temporal extent of other actions would start in the recent past and extend out for the expected physical operational service life of the proposed projects (50 years). "Reasonably foreseeable actions" are proposed actions or developments that have applied for a permit from local, state, or federal authorities or which are publicly known.

Where the analysis indicated a potential for cumulative effects, information has been quantified if feasible; however, quantitative details about future actions and their potential effects are conceptual, indeterminate, and can only be described qualitatively. Economic conditions, the availability of

financing, the issuance of permits, and an action's construction schedule can all affect how a project is quantified. In addition, due to location, different actions may contribute cumulative effects only for certain resources. For this reason, the analysis does not address every potential effect for every action listed in table 4.3-1.

Table 4.3-1

Past, Present, and Reasonably Foreseeable Future Actions

Action	Description	Timeframe			Primary Relevant Resources
		Past	Present	Future	
Agricultural Development	Past and ongoing agricultural practices including crops, animal grazing, and associated management practices.	x	x	x	Vegetation, wildlife, wetlands
Forest/Timber Management and Lumber Industry Operations	Past and ongoing forest practices, harvest, and mill operations by public/commercial/private entities. Projection of 12,500 acres harvested and replanted in the next 5 years within the Tillamook State Forest alone. [a]	x	x	x	Vegetation, wildlife, wetlands, soils, socioeconomics
Residential/Commercial/Industrial Development	Past and ongoing housing and commercial and industrial business construction.	x	x	x	Vegetation, wildlife, wetlands, soils, socioeconomics, land use
Mining Activities	Past and ongoing mineral resource excavating including coal, gems, bauxite, and aggregate.	x	x	x	Geology, aquatic resources, vegetation, socioeconomics
Transportation Corridors	Past construction and ongoing maintenance of federal and state highways, and local public and private transportation systems. I-5 and Highway 26 are major corridors in the project area. Other highways would also be crossed by the project.	x	x	x	Vegetation, wildlife, aquatic resources, wetlands, socioeconomics, land use
Federal Columbia River Power System	System of hydropower projects on the Columbia River and lower Snake River. Past construction of 14 dams along the mainstem Columbia River. The closest of the hydropower projects to the proposed terminal is the Bonneville Dam.	x	x	x	Aquatic resources, socioeconomics
Utility Corridors	Construction and upgrade of electrical transmission and distribution lines, substations, pipelines, and ancillary facilities, such as the proposed BPA I-5 Corridor Reinforcement Project between Castle Rock, WA and Troutdale, OR.	x	x	x	Vegetation, wildlife, aquatic resources, wetlands, socioeconomics, land use
Mist Underground Gas Storage Facility and South Mist Extension	Existing underground natural gas storage facility near Mist, OR. At a future date, the South Mist Extension may be connected to the Oregon LNG pipeline near MP 63.5.	x	x	x	Vegetation, wildlife, wetlands, soils, land use

Table 4.3-1

Past, Present, and Reasonably Foreseeable Future Actions

Action	Description	Timeframe			Primary Relevant Resources
		Past	Present	Future	
Salmon Recovery Strategy	Long-term strategy to recover threatened and endangered fish in the NW Region through increased water flow, habitat improvements, increased estuary productivity, hatchery reforms, and management of selected fisheries.	x	x	x	Aquatic resources
Mount St. Helens Sediment Management Plan	Ongoing plan being revised to manage sediment buildup in the lower 20 miles of the Cowlitz River	x	x	x	Water resources, aquatic resources
NW Innovation Works Kalama Manufacturing & Marine Export Facility.	Construction and operation of a natural gas-to-methanol production plant and storage facility on 90 acres in the Port of Kalama. A new deep draft marine terminal on the Columbia River would be built by the Port of Kalama. Natural gas would be delivered via a proposed lateral pipeline (see below). [b]			x	Water resources, aquatic resources, soils, vegetation, socioeconomics, marine transportation
Kalama Lateral Project	Construction and operation of a 3.1-mile-long, 24-inch-diameter natural gas pipeline to service a proposed methanol plant (above). The lateral would interconnect with the existing Northwest Pipeline near MP 1254.			x	Vegetation, aquatic resources, water resources, wetlands, soils
Ambre Energy/ Arch Coal, Inc. Millennium Bulk Terminal	An operating bulk materials port on the Columbia River in Longview, Cowlitz County, Washington. The adjacent former Reynolds aluminum smelter site is currently being redeveloped into an import-export facility. The new terminal facilities would include a rail yard to house trains arriving from western U.S. coal mines, and two new docks to create a port capable of receiving, stockpiling, blending and loading coal for export. At full build-out, two vessels per day would depart for offshore markets.		x	x	Marine transportation, water resources, aquatic resources, air quality
Compensatory Mitigation	Oregon LNG would mitigate off-site for temporary or permanent impacts on fish, wetlands, and wildlife habitat. Potential sites include: 120 acres at the mouth of Youngs River (Hess property); and 45 acres of floodplain adjacent to the Nehalem River (Carmichael property). Removal of fish passage barriers and acquisition of forest lands in the Coast Range.			x	Vegetation, wildlife, aquatic resources, water resources, wetlands

Table 4.3-1

Past, Present, and Reasonably Foreseeable Future Actions

Action	Description	Timeframe			Primary Relevant Resources
		Past	Present	Future	
Actions within Clatsop County (Terminal Area)					
Pacific Ridge Estates	Phase 2 (under construction) and 3 (planned) of a residential subdivision 2.4 miles west of the terminal site within Warrenton.		x	x	Land use
Gramson Estates	Planned residential subdivision 1.6 miles southwest of the terminal site within Warrenton.			x	Land use
Warrenton Downtown and Marina Renewal	Planning documents have mapped out a guide for the revitalization of downtown and marina districts with the goal of completion by 2040.			x	Land use, recreation, socioeconomics, water resources, aquatic resources
Mouth of the Columbia River Dredging	Ongoing maintenance of the federal navigation channel by the USACE at the mouth of the Columbia River. Dredging disposal at shallow water site, deepwater site, and near the north jetty.	x	x	x	Marine transportation, aquatic resources, water resources
Skipanon River Channel Dredging	Periodic maintenance dredging by the USACE in the Skipanon River between the Columbia River and marina.	x	x	x	Marine transportation, aquatic resources, water resources
General Columbia River Cargo Shipping	Past and ongoing commercial ship and recreational boat traffic along the Columbia River. Between 2001 and 2011, an average of 217 ships per month crossed the Columbia Bar.	x	x	x	Marine transportation, aquatic resources, water resources
Columbia River Commercial and Recreational Fishing	The lower Columbia River supports a number of commercial and recreational fisheries, including salmon, steelhead, sturgeon, eulachon, bottom fish, shellfish, and Dungeness crab.	x	x	x	Marine transportation, aquatic resources, water resources
Columbia River Recreational Boating	Past and ongoing recreational boating along the lower Columbia River includes, but is not limited to, kayaking, sailing, personal watercraft, canoeing, and waterskiing.	x	x	x	Marine transportation, aquatic resources, water resources
Columbia River Cruise Ships	Seasonal cruise ship traffic between the mouth of the Columbia River and the Port of Astoria.	x	x	x	Marine transportation, aquatic resources, water resources
Columbia and Lower Willamette Navigation Project Dredging	Ongoing maintenance dredging of the Columbia River by the USACE between RMs 3.0 and 106.5, and to RM 11.0 in the Willamette River. Dredging disposal at upland disposal sites, beach nourishment, and ocean disposal sites.	x	x	x	Marine transportation, aquatic resources, vegetation, wildlife, water resources

Table 4.3-1

Past, Present, and Reasonably Foreseeable Future Actions

Action	Description	Timeframe			Primary Relevant Resources
		Past	Present	Future	
Columbia Tidal Energy Hydroelectric Project	A hydroelectric project containing a series of seven underwater clusters of tidal energy conversion devices connected by underwater transmission cables to electrical infrastructure. Four are on the Washington shore of the Columbia River in Pacific and Wahkiakum Counties and three are on the Oregon shore in Clatsop County. Project is under development.			x	Marine transportation, aquatic resources
Nonjurisdictional Facilities					
Electrical Facilities to support the terminal	• Upgrade the existing 230-kV Driscoll-Clatsop transmission line to double circuit 230-kV. • Upgrades at the Driscoll, Clatsop, and Warrenton Substations. • Upgrade the existing 115-kV Clatsop-Warrenton transmission line to double circuit 230-kV/115-KV. • New 230-kV transmission line from the Warrenton Substation to the terminal.			x	Vegetation, visual resources
Electrical facilities to support the new compressor station for the Oregon LNG Project	New substation and transmission line connecting to BPA power line.			x	Vegetation, visual resources
Water and wastewater pipelines to support the terminal	• New 10-inch-diameterpotable water pipeline to connect to existing 18-inch Warrenton water main. • New 16-inch-diameter wastewater pipeline to existing Warrenton POTW outfall and diffuser; adjustments to diffuser. • New Warrenton POTW effluent pump station			x	Land use

[a] Skinner, 2015

[b] Port of Kalama, 2014

This table is not intended to provide an all-inclusive listing of actions; however, it does list those actions that are likely to contribute to the cumulative impacts within the vicinity of the Oregon LNG Project and the WEP.

CEQ regulations require agencies to consider environmental effects of proposed actions, including direct and indirect effects, if these effects are reasonably foreseeable. As discussed in section 1.4, we do not consider effects from production associated with additional shale gas development as "reasonably foreseeable." FERC also does not evaluate end user cumulative impacts of the LNG exports as it is not possible to know who those end users would be, or for FERC to realistically be able to characterize those impacts (especially in foreign countries, where environmental constraints would be different from the U.S. permitting process). Thus determining the end users and associated impacts is not reasonably foreseeable.

4.3.1 Cumulative Effects on Resources

Existing environmental conditions in the vicinity of the Oregon LNG Project and the WEP reflect the extensive changes brought about by long-term human occupancy and use. For example, native vegetative communities in the area of the projects have been substantially altered from their pre-Euro-American settlement condition by timber harvest, agricultural practices, introduction of nonnative species, and commercial/industrial and residential developments, while fisheries have been affected by commercial harvest and physical alteration of rivers and streams. The effects of past and present activities on resource conditions are evident in the descriptions of the affected environment for each of the resources, which can be found in sections 4.1 and 4.2. The following sections discuss the potential cumulative effects of the past, present, and future actions.

4.3.1.1 Geologic Resources

Cumulative effects on near surface geology and mineral resources would be limited primarily to the combined impacts of other actions within the area of effect and previous construction activities along the same route as the proposed pipelines. The terminal would require rock imported during construction, but use of rock for the Oregon LNG Project and any of the future actions would come from permitted quarries, this resource is abundant in the area, and it is not anticipated that the cumulative effects of rock removal would be adverse.

Records indicate that 18 quarries/mineral resource areas and 1 oil/gas well would be within about 0.25 mile of the Oregon LNG pipeline and 39 quarries/mineral resource areas would be within 0.25 mile of the WEP (see sections 4.1.1.2 and 4.2.1.2). Pipeline construction for Oregon LNG and the WEP would not be expected to adversely impact any mining operations. Impacts on mining operations and mineral resources as a result of the other actions considered have not been identified. However, we conclude it unlikely that the Oregon LNG Project and the WEP along with the actions in table 4.3-1 would result in significant cumulative impacts on mineral resources.

The actions in table 4.3-1 would not cumulatively contribute to the incidence or severity of geologic hazards with the possible exception of landslides. If ground and vegetation disturbance from more than one action occur at the same time and within immediate proximity in an area prone to landslides, a landslide could be triggered more easily than if the actions were separated in time and space. We conclude that Oregon LNG's and Northwest's proposed measures for minimizing landslides risks along with our recommendations would also serve to mitigate this cumulative impact.

Shoreline erosion is caused by waves from river currents, wind, and ship traffic. LNG marine carriers would increase the number of vessels on the Columbia River by about 10 ships per month (round trip). Ship traffic on the Columbia River has decreased since the 1990s; however, the size of the vessels has increased. It is not reasonable to predict the exact number of vessel trips resulting from future actions listed in table 4.3-1; however, the number and size of those vessels may well be larger than those in the past. This in turn, could cause increased shoreline erosion over time.

4.3.1.2 Soils and Sediments

The majority of soils in the areas considered for this analysis have been disturbed by past actions such as fill placement, timber harvesting, agricultural practices, road construction, pipelines, and commercial/industrial and residential development. Future soil disturbing activities would contribute to cumulative erosion and sedimentation.

Oregon LNG proposes to minimize erosion and sedimentation impacts through implementation of the measures specified in its Plan and Procedures and SWPPP (see appendix F1), and Agricultural Impact Mitigation Plan (see appendix F2). Northwest proposes to minimize erosion and sedimentation impacts through implementation of the measures specified in its Plan, Procedures, and ECRP (see appendix J1). For future actions, the State of Oregon and Washington as well as many local jurisdictions (who would need to issue development permits) would have requirements in place to minimize erosion and sedimentation impacts.

Cumulative impacts for soils designated as Prime, Unique, or other Important Farmland, referred to collectively as Important Farmland in this document, would occur as a result of the actions considered in this analysis. The Oregon LNG pipeline would cross Important Farmland for 25.1 miles of its length and the WEP would cross the same classification of land for 117.2 miles, for a total of 142.3 miles. There has been a long-term trend of converting Important Farmland to other uses within the cumulative impacts study area. It should also be noted that many areas designated as Important Farmland are not zoned for agricultural use. Cropland designated as Important Farmland may still be used as cropland after pipeline construction. The same is true for land crossed by future proposed power lines.

We conclude that the cumulative effect on soil resources would be temporary and minor.

4.3.1.3 Water Resources

The Oregon LNG Project would cross four major watersheds in Oregon: Lower Columbia, Nehalem, Lower Columbia-Clatskanie, and Lower Willamette (see section 4.1.3.2). The WEP and the Oregon LNG pipeline would cross a total of fifteen major watersheds in Washington: Lewis, Lower Columbia-Clatskanie, Cowlitz, Upper Chehalis, Deschutes, Puget Sound, Puyallup, Duwamish, Lake Washington, Skykomish, Snohomish, Lower Skagit, Strait of Georgia, Nooksack, and Fraser (see sections 4.1.3.2 and 4.2.3.2). All of these watersheds have been cumulatively affected by the past actions of urbanization, timber harvesting, and agriculture. These actions are likely to continue into the foreseeable future. Timber harvesting began in the 1860s leading to loss of historic forest types with the conversion of timber land to agriculture and urban development. This has resulted in historic riparian areas being replaced with alder and invasive species such as canary grass and blackberries, affecting stream temperatures and overall surface water health (NMFS and FWS, 2006). Soil disturbance caused by past activities has accelerated sediment delivery to streams and introduced contaminants that lower water quality.

The Oregon LNG pipeline would cross 184 waterbodies and the WEP would cross 271, for a total of 455 waterbodies, including 424 crossed by open-cut methods. Construction of waterbody crossings may cause a localized increase in turbidity in waterbodies, but these impacts would be temporary and quickly diminish after the crossing is completed and the right-of-way is restored and revegetated. Clearing of riparian vegetation at waterbody crossings can result in localized increased water temperatures from loss of shading. As discussed in section 4.1.5.2, HDD would be used at many of the larger waterbody crossings, and at other crossings, measures would be implemented to minimize removal of riparian vegetation and restore riparian vegetation that has been removed. Northwest would minimize riparian clearing by using existing right-of-way for most non-HDD crossings. Oregon LNG and Northwest evaluated the risk of pipeline exposure due to vertical scour or channel migration and would bury the pipelines below expected scour depth. Periodic monitoring during operation would detect indications of scour and allow for corrective action. Therefore, we conclude that the overall cumulative effect on waterbodies would not be significant.

It is reasonable to assume that actions listed in table 4.3-1, such as timber and agricultural activities and urban development, would occur within the watersheds listed above during the construction and operation of the pipelines and terminal. Most of these actions are expected to be private and do not have long public notification lead times to enable them to be captured specifically in this document. Oregon and Washington have active erosion control programs that, if followed, define measures to be taken that would reduce impacts to surface waters by these future actions. With appropriate mitigation measures in place as previously defined, impacts from ground disturbance associated with the proposed projects would not contribute significant cumulative impacts on surface water.

Impacts from dredging at the Oregon LNG terminal would add to impacts from other dredging actions listed in table 4.3-1. Since the 1870s the Columbia River has been periodically dredged to accommodate larger ships (USACE, 2014). The shallow water placement sites are limited to use by one dredge at a time because of safety restrictions. Due to the temporary nature of dredging and the physical and temporal separation of the proposed action and other reasonably foreseeable actions, their combined cumulative impact on water quality would not be significant. Other dredging actions would require permits that would typically include conditions to mitigate for impacts.

Groundwater would not be used during the construction or operation of either Oregon LNG Project or the WEP. During pipeline construction, shallow groundwater could experience a temporary and localized disturbance from changes in overland flow and recharge caused by clearing, trenching, and grading. Near-surface soil compaction caused by heavy construction vehicles could temporarily reduce the soil's ability to absorb water but would be mitigated through decompaction methods such as soil disking. Water wells in close proximity to the construction right-of-way would be monitored for impacts (see sections 4.1.3.1 and 4.2.3.1). We conclude that impacts on groundwater from the WEP and the Oregon LNG Project would be localized and temporary and would not contribute significantly to cumulative impacts.

4.3.1.4 Wetlands

Since Euro-American settlement, thousands of acres of wetlands in the Pacific Northwest have been lost to agriculture and development. The act of lowering the water level in Lake Washington in 1916 alone drained thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish, and the Sammamish River corridor (NMFS and FWS, 2006). Modern day development also affects wetlands, but current wetland-related laws and regulations; which require avoidance, minimization, and compensation for impacts on wetlands; have resulted in a "no net loss" approach that has greatly reduced the cumulative impacts on wetlands (BPA, 2012). Future actions that receive permits to affect wetlands would be required to follow the "no net loss" approach, and therefore if wetland impacts could not be avoided, compensation would be expected.

The Oregon LNG Project and the WEP would contribute cumulative impacts on wetlands along with a number of the actions included in table 4.3-1. As described in sections 4.1.4 and 4.2.4, permanent wetland impacts would equal about 89.4 acres (30.7 acres in Washington and 56.7 acres in Oregon). Both Oregon LNG and Northwest would minimize direct wetlands impacts due to construction and operation of their projects to the extent practicable. Further, they have committed to contributing to compensatory wetland mitigation banks to offset unavoidable wetland impacts. Oregon LNG also proposes wetland mitigation on land near the mouth of the Youngs River and in the floodplain of the Nehalem River in Clatsop County, Oregon. Compensatory mitigation would satisfy wetland-related laws and regulations. We conclude that with mitigation, impacts on wetlands from the Oregon LNG Project and the WEP would not contribute significantly to cumulative impacts.

4.3.1.5 Aquatic Resources

The historical impacts on aquatic resources in the area of the WEP and the Oregon LNG Project include various changes in historical conditions, such as dams and diversions, residential, commercial, and industrial development, transportation facilities, utilities, and agricultural and forest practices. Undoubtedly, fisheries resources within stream reaches in the project areas are subject to potential cumulative impacts that exceed direct and indirect impacts of individual actions. Where they occur, cumulative impacts express themselves as changes in water quality, water quantity, aquatic complexity, passage obstructions, and possibly the diversity and vigor of species, populations, and biological communities.

Potential cumulative impacts include the effects of all proposed construction and operation actions (habitat modifications, dredging, pile driving, increased vessel traffic, water withdrawals and discharges, etc.) along with the effects of other past, current, and reasonably foreseeable future actions.

The negative anthropogenic impacts faced by Columbia River salmonids are numerous and varied. Dams within the Columbia River basin have resulted in altered flow regime due to impoundments and diversions, altered water temperatures, passage difficulties, and altered sediment transport. Habitat has been modified by dredging, filling, construction of flood control structures such as dikes, drainage and conversion of tidal swamps and other wetlands, mining, urbanization, and forestry activities. Hatcheries have affected populations including reduced genetic diversity. Other actions that have added to the cumulative change in fisheries include: harvesting, predation by marine bird colonies on dredge spoil islands, climate change, and contaminants and pollutants.

The result of these cumulative impacts has been a precipitous drop in salmonid stocks. Through habitat loss and other changes, the natural salmonid production in the Columbia River Basin has been reduced to about 12 percent of historical levels (NMFS, 2005e). Columbia River commercial landings peaked in 1911 at more than 49 million pounds. Around that time, runs began to decline due to overharvest. These declines were quickly exacerbated by environmental degradation due to mining, grazing, logging, water withdrawals for irrigation, and dams constructed for power production and water storage. Commercial landings reached a historic low (through 2002) of 898,500 pounds in 1998 (WDFW and ODFW, 2003).

In context with these historical and ongoing challenges, the potential impacts of the Oregon LNG Project and the WEP are minor. The majority of the potential impacts are construction related and, consequently, would be directly related to the duration of construction activities. Following construction, ongoing impacts (such as maintenance dredging and LNG marine carrier cooling water discharge) on fishery resources and special-status species are expected to be localized, small, and offset by mitigation. There may be some minor cumulative impacts from increased vessel traffic in the event that other shipping related actions are approved and become operational.

The loss of Dungeness crab to construction and maintenance dredging at the terminal berth and turning basin represents a cumulative impact on continuing losses to the Dungeness crab fishery from maintenance dredging of the navigation channel and bar. Pearson et al. (2003) stated that the worst-case projected fishery losses associated with the maintenance of the navigation channel represented about 0.3 percent of the annual crab landings for the Washington and Oregon region around the Columbia River. Pearson et al. (2003) also estimated that worst-case loss to maintenance dredging of the Columbia River bar would be about 0.2 percent. Losses to the crab fishery from the terminal construction would be additive to these ongoing losses to the crab fishery. The WEP would not contribute to impacts on Dungeness crab.

Impacts on the fish-bearing waterbodies crossed by the proposed pipelines would be localized to crossings where tree clearing and open-cut construction would occur. The cumulative impact related to forest management activities along the pipeline corridors would vary with location and opportunity for timber harvesting, but the addition of the pipelines within timber land would not be expected to create significant cumulative impacts on riparian habitat that supports fish habitat beyond ongoing forest management activities. The historical impacts along the pipeline routes include various land uses, such as dams and diversions; residential, commercial, and industrial development; transportation facilities; utilities; and agricultural and forest practices. Undoubtedly, fisheries resources within watersheds and stream reaches in the project areas are subject to potential cumulative impacts that exceed direct and indirect impacts of individual actions. Where they occur, cumulative impacts express themselves as changes in water quality, water quantity, aquatic complexity, passage obstructions, and possibly the diversity and vigor of species, populations, and biological communities. Based on the information in this document, we conclude that the cumulative impacts from all foreseeable actions on aquatic resources would not be significant on a regional scale.

4.3.1.6 Vegetation

Vegetation communities have been greatly changed since settlement in the mid-1800s. Timber harvesting began in the 1860s leading to loss of historic forest types with the conversion of timber land to agriculture and urban development. This has resulted in historic riparian areas being replaced with alder and invasives such as canary grass and blackberries (NMFS and FWS, 2006). The proposed projects, in addition to reasonably foreseeable future actions, would contribute to the continued modification of native plant communities. However, since the mid-1900s timber harvests and development have been under increasing federal, state, and local control which has been helping to protect and restore native vegetation communities.

Construction of the Oregon LNG terminal would permanently affect 22.7 acres of upland vegetation, including about 19.0 acres of deciduous forest and 3.7 acres of coniferous forest as shown in table 4.3.1-1. Terminal facilities would permanently replace existing upland vegetation habitat, but the loss of upland vegetation habitats would not represent a significant impact because of the generally disturbed nature of the terminal site. Construction areas not occupied by terminal facilities would be seeded/replanted and fully restored.

Table 4.3.1-1

Permanent Upland Vegetation Types Affected by Oregon LNG and the WEP

Facility	Coniferous Forest (acres)	Deciduous Forest (acres)	Agriculture/Pasture/ Orchard/Nursery (acres)	Previously Disturbed Land [a] (acres)
Oregon LNG Pipeline	391.8	31.4	23.1	14.0
Oregon LNG Terminal	3.7	19.0	0.0	0.5
WEP	21.3	118.5	48.1	761.9
Total	416.8	168.9	71.2	776.4

[a] Category includes existing right-of-way.

Construction of the Oregon LNG pipeline, access roads, and associated facilities would permanently affect about 446.3 acres of forest and agricultural upland vegetation and 14.0 acres of previously disturbed land. The WEP would permanently affect about 187.9 acres of similar type vegetation. Oregon LNG would avoid permanent impacts on about 46 acres of vegetation by using the HDD method to install the pipeline underneath older coniferous and deciduous forest, riparian habitat, and some roads. Disturbed upland forested communities not within 15 feet of the pipeline centerline

would be replanted in-kind with trees similar to the preconstruction condition. The permanent right-of-way would generally be maintained in an herbaceous state following construction. Maintained right-of-way or previously disturbed land would make up 776.4 acres of permanently affected upland vegetation for the combined Oregon LNG and WEP projects.

Cumulative impacts on vegetative communities would be minimized for FERC-regulated projects, including the Kalama Lateral Project, the WEP, and the Oregon LNG Project, because they would implement measures contained in our Plan and Procedures. Restoration efforts would include reseeding and replanting of vegetation and monitoring of revegetation success. Mitigation measures designed to minimize the potential for erosion and control the spread of noxious weeds would also be implemented. Based on the types of vegetation that would be affected and restoration measures that would be implemented, we conclude that cumulative impacts on vegetation would not be significant.

4.3.1.7 Terrestrial Wildlife

Historical impacts on wildlife along the proposed WEP and Oregon LNG pipeline routes include habitat fragmentation, loss, and degradation, as well as displacement of individuals because of development on private lands. Linear actions such as pipelines, roadways, and electrical transmission lines have contributed to habitat fragmentation and loss. Continuing roadside maintenance and forest management contribute to habitat degradation and species population decline. Extensive residential and commercial construction has occurred primarily since the 1950s. The introduction of invasive and noxious weeds through associated disturbances has contributed to habitat degradation.

State, local, and private actions will continue to affect wildlife in areas where they coexist with human development. Though specifics of future private development are hard to forecast, it is reasonable to assume that urbanization would continue to encroach into wildlife areas. Many negative effects including those associated with continued urbanization, water extraction, land use practices, and wastewater discharge, among others, are reasonably certain to occur. The creation of the Oregon LNG pipeline right-of-way and the additional clearing along the existing Northwest right-of-way would change the type of habitat available to wildlife on a localized level as these rights-of-way would be maintained in an early seral vegetation community. We conclude, however, that cumulative effects are expected to be negligible for any wildlife species.

4.3.1.8 Threatened, Endangered, and Other Special Status Species

Past development and agricultural activities have contributed to cumulative effects on threatened, endangered, and other special status species in the general geographic region of the Oregon LNG Project and the WEP. The result of these cumulative effects has been the contribution to the conditions that resulted in the listing of threatened and endangered species, including a precipitous drop in salmonid stocks as described previously in section 4.3.1.5. On a much smaller scale than the historical impacts listed above, the past, present, or reasonably foreseeable future actions listed in table 4.3-1, including the WEP and the Oregon LNG Project may contribute to cumulative effects on federally listed species whose range would overlap with the project area. Our consultations with NMFS and FWS and preparation of the BA are in progress, and our final determinations regarding the effects on species are pending.

There are 11 federally listed species potentially occurring in the both the Oregon LNG Project area and the WEP area. In sections 4.1.8 and 4.2.8 we provided project-specific effect determinations for these species. Of the 11 species, seven have the same effect determination for both projects. The four that have different determinations are listed in table 4.3.1-2 with the individual project determinations and a determination based on both projects combined. When Oregon LNG and the WEP are considered

together the combined effects of both projects results in potentially greater adverse impacts on species that overlap both projects (see table 4.3-1).

Table 4.3.1-2

Combined Federally Listed Species Effect Determinations

Federally Listed Species	Oregon LNG Determination	WEP Determination	Combined Project Determination
Marbled murrelet *(Brachyramphus marmoratus)*	LAA	NLAA	LAA
Northern spotted owl (*Strix occidentalis caurina*)	LAA	NLAA	LAA
Lower Columbia River chum salmon *(Oncorhynchus keta)*	LAA	NLAA	LAA
Eulachon *(Thaleichthys pacificus*)	LAA	NE	LAA

LAA = Likely to Adversely Affect; NLAA = Not Likely to Adversely Affect; NE = No Effect

The Oregon LNG pipeline would cross 21 waterbodies[1] that may provide habitat for federally listed fish and the WEP would cross 32 waterbodies[2] that may provide habitat for federally listed fish, for a total of 53 waterbodies. Reasonably foreseeable actions such as utility corridors, roads and urban development would likely affect these same waterbodies, but would be unlikely to do so at the same time and in the same location as the proposed projects.

The future shipping associated with operation of the Oregon LNG terminal would contribute cumulatively to effects on whale species present within the LNG marine carrier transportation route (see section 4.1.8). An increase in ship traffic or an increase in whale numbers could result in a higher potential risk of whale strikes. If all new future actions listed in table table 4.3-1 with associated vessel traffic operated at their maximum capacity, we estimate that river traffic would increase by 25 ships per month, or about 10 percent. This could slightly raise the risk of a whale strike. Although unlikely, if ship traffic increased tenfold in succeeding years and whale numbers remained constant, potential strikes on whales could increase tenfold. Such an increase could result in a risk of a whale strike rising from a projected 0.02 individuals per year per species to 0.2 individuals per year per species.

The Oregon LNG Project and the WEP are not expected to adversely affect Columbian white-tailed deer or gray wolves. We have not yet determined if Mazama pocket gophers are present in the Chehalis loop of the WEP. The loss of habitat that has led to the current listings of the gray wolves, Mazama pocket gopher, and Columbian white-tailed deer is a result of human activity and development. Although neither project would greatly affect these species, the action of constructing either project would add an incremental amount to the developed nature of the environment as a whole.

The Oregon LNG Project and the WEP would contribute to cumulative effects on marbled murrelets, northern spotted owls, yellow-billed cuckoos, and streaked horned larks. Much like other threatened and endangered species, historic habitat loss has been a large contributor to the current status of threatened and endangered birds in the Pacific Northwest. In section 4.1.8 we conclude that the Oregon LNG Project would adversely affect northern spotted owl and marbled murrelet due to habitat

[1] The following are counted as one waterbody each: Lewis and Clark River is crossed four times, Nehalem River twice, Rock Creek twice, and Milton Creek twice.

[2] Saar Creek is crossed twice, but counted as one waterbody.

impacts, but in section 4.2.8 we conclude that the WEP would be not likely to adversely affect these same species because there is only minimal tree clearing associated with the WEP. Considering these projects together, there would be incremental loss of late successional forests or forests that could become late successional during the life of the projects; therefore, we conclude the projects would have cumulative adverse effects on northern spotted owl and marbled murrelet. Since most of the impacts are associated with the Oregon LNG Project, Oregon LNG plans to mitigate impacts by acquiring large tracts of forest land in the Coast Range to be managed for future spotted owl and marbled murrelet habitat. Streaked horned lark and yellow-billed cuckoo may also be affected by both projects, but the cumulative impact of both projects would not result in an adverse effect on these species because both Oregon LNG and Northwest propose measures to avoid them.

There are no threatened or endangered amphibians present in the vicinity of the Oregon LNG Project. The WEP would add a minimal increment to proposed or existing habitat alteration due to ongoing forestry practices and residential and transportation infrastructure, and energy, industrial and commercial development that would cumulatively affect the Oregon spotted frog. The WEP would not be within critical habitat and potential habitat that would be affected would be adjacent to existing right-of-way.

The Oregon LNG Project and the WEP would not occur within designated critical habitat for Taylor's checkerspot butterfly or Oregon silverspot butterfly. At the most, both projects would contribute minimally to cumulative effects on these two species. Other actions such as ongoing and future residential, agricultural and road development would contribute more to cumulative effect.

The Oregon LNG Project and the WEP would contribute to the cumulative loss of suitable habitat for threatened and endangered plant species discussed in sections 4.1.8 and 4.2.8. Surveys completed to date by Oregon LNG and Northwest have not identified rare plants in the project areas and there is a low likelihood of rare plants occurring in nonsurveyed areas due to the previously disturbed landscape the projects would cross. To verify the absence of rare plants in the construction right-of-way, Oregon LNG and Northwest would conduct preconstruction surveys to identify plants that have been previously unrecorded and adapt or mitigate according. Maintenance activities within the pipeline rights-of-way would prevent most of the rare plant species from thriving.

The Oregon LNG Project and the WEP would likely impact species protected under the MBTA or BGEPA (see sections 4.1.7 and 4.2.7). Impacts on bird habitat along the pipeline corridors would be short term to long term, as vegetation cleared for pipeline construction would take decades to recover, although, some bird species are expected to exploit the new early seral vegetation of the pipeline rights-of-way. Oregon LNG and Northwest would replant disturbed areas with native vegetation, which would provide high-quality habitat for migratory birds over time. Oregon LNG would also acquire large tracts of forest land in the Coast Range to set aside for conservation, which would also benefit migratory birds and raptors. Construction and operation of the Oregon LNG terminal would result in some loss of habitat, but adjacent undeveloped areas would provide similar foraging and stop-over habitat for species protected by the MBTA with minimal displacement. No raptor nests would be removed during construction, and Northwest would use specialized construction methods to avoid Category 1 habitats such as waterbodies with listed species and patches of large trees with suitable nest sites for marbled murrelets, eagles, northern spotted owls, and other raptors. These methods would be employed to avoid impacts to nests within designated setback limits from the project. Nesting and roosting opportunities at the terminal site are currently limited, and Oregon LNG would take measures to deter those behaviors during operation, reducing the overall effect on birds. The action of constructing either project would add an incremental amount to the developed nature of the environment as a whole, resulting in a negligible cumulative effect on migratory bird species and eagles.

We conclude that past and present actions in combination with the Oregon LNG Project and the WEP would have cumulative effects on threatened, endangered and special status species, but would not affect the survival and/or recovery of any species.

4.3.1.9 Land Use, Recreation, and Visual

Land Use

The cumulative impact area for land use was considered to be the area adjacent to and in the vicinity of the WEP and the Oregon LNG Project. The proposed Oregon LNG terminal, the transmission line to the terminal, the pipelines for WEP and the Oregon LNG Project, and the other foreseeable actions in the vicinity of the terminal would result in a cumulative increase in the conversion of a variety of undeveloped land uses to developed industrial and right-of-way use in the cumulative impact area. The transmission line to the terminal would cross two areas of land zoned intermediate density residential. Other than those two areas, affected land and most of the land immediately surrounding components of the project are zoned commercial or industrial. The cumulative impacts of development in the area of the terminal would be low.

Construction of the WEP and the Oregon LNG Project, along with the other actions listed in table 4.3-1, would cumulatively result in impacts on forest land, particularly in Oregon. Timber operations would not be able to continue within a portion of the permanent rights-of-way for these projects or other utilities, thus the addition of new utility corridors would segment and lessen the amount of available timberland available for active management. Cumulative impacts on other land uses such as agriculture, public rights-of-way, open space, commercial/industrial, and residential would be relatively low.

Forest land makes up over 80 percent of the land that would be crossed by the Oregon LNG pipeline. The terminal site is not forested. The majority of coniferous forests impacted by the Oregon LNG Project are composed primarily of trees between 20 and 60 years old that have been planted for commercial timber on state and private lands (see section 4.1.6.2). Once the rights-of-way are properly restored and revegetated, with the exception of the treeless portion of the permanent right-of-way through what is currently forest, we conclude that Oregon LNG pipeline would not result in a significant cumulative impact on forest land. The right-of-way would not preclude forestry activities on adjacent properties. The WEP would also cross mostly forested areas; however, not many acres of forest would be converted because the WEP would primarily use the existing Northwest Pipeline right-of-way for construction and operation. The WEP would not contribute greatly to the conversion of existing forest land uses because the 44.3 acres of additional permanent right-of-way would be distributed along, and primarily adjacent to, the existing right-of-way.

Recreation and Public Interest Areas

The cumulative impact area for recreational-use vessels was considered to be the Columbia River from the mouth to the proposed terminal. The 125 LNG marine carrier visits to the Oregon LNG terminal each year would result in additional marine traffic within the lower Columbia River navigation channel. The increased 10 or more ships a month in marine traffic would cause cumulative impacts on uses within the lower Columbia River, including commercial shipping, cruise ships, commercial and recreational fishing, and recreational boating. However, because recreational users of the Columbia River have always had to accommodate commercial ship traffic, significant additional cumulative impacts on these activities are unlikely. Recreational boats would need to briefly move out of the way of passing LNG marine carriers, much as they currently do for other commercial ships.

The cumulative impact area for terrestrial recreational use was considered to be the vicinity of the WEP and the Oregon LNG Project. Both projects would cross state forests, trails, and local parks in which recreational activities occur. Impacts on recreational and public interest areas would mainly be temporary and caused by construction activities. In the long term, the projects are not expected to affect the use of recreational and public interest areas, and therefore there would be no cumulative affects as a result of the projects.

Visual Quality

The cumulative impact area for visual resources was considered to be the area within the viewsheds crossed by the WEP and the Oregon LNG Project. Visual impacts on residential and commercial developments and recreational users from LNG marine traffic would be limited because the viewshed already includes commercial ship traffic of about 3,500 vessels per year. The additional two to three LNG marine carriers per week would take only a few minutes to travel through the viewshed in the waterway at speeds between 4 to 6 knots. However, construction and operation of the new buildings or structures associated with the proposed LNG terminal, and other foreseeable actions along the Columbia River, would have a permanent effect on visual resources.

The most visible elements of the terminal would be the tops of the LNG storage tanks and the new 230-kV power line from the Warrenton substation to the terminal (a nonjurisdictional facility). The tops of the tanks would be seen from areas within and near the ship basin and waterway. The Oregon side of the Columbia River already includes industrial uses such as the Warrenton Hampton Affiliates facility (and other commercial buildings); and, therefore, the Oregon LNG would not significantly change the cumulative visual quality from the waterway.

The WEP and Oregon LNG pipelines would be installed beneath the ground surface. The WEP would essentially be within an existing right-of-way; and, therefore, the contribution to cumulative visual impacts would be minimal and in the form of increased tree clearing adjacent to its existing pipeline right-of-way. Because the Oregon LNG pipeline would have a new cleared right-of-way, it would contribute a greater amount to cumulative visual impacts than the WEP. However, the forest areas the pipeline would go through are primarily active forestry lands that would be harvested or thinned as prescribed by forest management. Once the rights-of-way are properly restored and revegetated, they should not represent significant visual elements, as they are subordinate within the existing landscape character, with the exception of the treeless portion of their permanent easements through what is currently forest.

The visual impacts of the Oregon LNG pipeline, combined with proposed electrical transmission and transportation actions and other actions listed in table 4.3-1 would result in cumulative visual impacts within the context of the existing forest landscape. However, these areas already include land uses that have altered that landscape, including timber harvesting activities; farming and other agricultural activities; industrial, commercial, and residential developments; and existing infrastructure such as roads and power lines. Therefore, we conclude that they would not result in a significant cumulative impact.

4.3.1.10 Socioeconomics

The cumulative impact area for socioeconomics was considered to be the counties crossed by the WEP and the Oregon LNG Project. Present and reasonably foreseeable future actions could cumulatively impact socioeconomic conditions in the vicinity of the WEP and the Oregon LNG Project. Employment, housing, infrastructure, public services, and traffic could experience both beneficial and detrimental impacts.

Population and Housing

Workers employed for construction and operation of the Oregon LNG Project would live locally, commute, or temporarily relocate to the project area. Minor, temporary increases in population levels would occur as workers move into the area. Construction of the actions listed in table 4.3-1 occurring concurrently with that of the WEP and the Oregon LNG Project would result in relatively minor, temporary cumulative effects on population. Long-term cumulative effects on population in the terminal area are expected to be minimal, while no long-term effects along the pipelines are expected.

Considering the amount of vacant housing units available and the availability of hotel/motel rooms and campgrounds in the region (see sections 4.1.10 and 4.2.10), the number of nonlocal construction workers requiring housing would not significantly affect the local or regional housing market. If construction of the terminal were to occur concurrently with other actions listed in table 4.3-1, temporary housing may be slightly more difficult to find and/or more expensive to secure in Warrenton and Astoria during the summer tourist season. Housing along either the the WEP or Oregon LNG pipelines would not be significantly affected by the influx of out-of-town workers. Even considering other construction actions occurring at the same time, the counties crossed by the WEP are expected to be able to accommodate the additional temporary workforce. There would be no long-term, cumulative effects on housing.

Economy and Employment

The foreseeable actions listed in table 4.3-1 would have cumulative effects on employment and the economy during construction if more than one is built simultaneously. Construction of the terminal would employ more than 650 workers annually for four years. Oregon LNG has estimated that 90 percent of the workers would be from Oregon and Washington and 9 percent of the total workforce would be from Clatsop County. During pipeline construction Oregon LNG would employ about 425 workers, with about half from Oregon and Washington, while Northwest would employ about 1,400 workers distributed among the loops, 30 percent of which would be local workers already living in the counties where the construction would occur.

If several of the larger actions are built simultaneously, the demand for workers could exceed the local supply of appropriately skilled labor. The Portland MSA and Oregon counties along Oregon LNG have a civilian labor force of about 1,240,515 people and an average unemployment rate of 9.1 percent (U.S. Census Bureau, 2010). The counties along the WEP have a civilian labor force of about 2,268,850 and an average unemployment rate of 9.1 percent (Workforce Explorer, 2012). This suggests that the local labor force could meet some of the employment needs induced by construction of these projects, although it is unknown whether a sufficient number of these unemployed persons have the necessary skills to work on these projects. If all the major actions in the region are constructed during the same time period, and the demand for local workers exceeds supply, it is assumed that the remainder of the employment positions would be filled by non-local hires. The proposed terminal and pipeline projects, and other foreseeable actions listed in table 4.3-1 are expected to have cumulative benefits for the local economy in terms of employment, payroll expenditures, purchase of supplies and materials, and tax revenues.

Infrastructure and Public Services

The cumulative impact of the Oregon LNG Project, the WEP, and the other actions listed in table 4.3-1 on infrastructure and public services would depend on the number of actions under

construction at one time. If several actions were to be constructed simultaneously, the incremental demands could become difficult for police, fire, and emergency service personnel to address.

Local fire and emergency services may also be stretched in the case of an emergency during the operation of the terminal. To minimize potential impacts, Oregon LNG has indicated that trained personnel and firefighting equipment would be maintained at the LNG terminal in the event of an emergency. Oregon LNG's August 15, 2014 MOU with the ODE addresses development of an emergency planning and preparedness program for the terminal (see appendix C2). Oregon LNG has also prepared a draft ERP for the terminal in accordance with the 2006 version of our *Draft Guidance for LNG Terminal Operator's Emergency Response Plan* (FERC, 2006). In accordance with the EPAct, the ERP must offer a cost-sharing plan, and outline how Oregon LNG would fill resource gaps and supplement the first-responder capabilities of the local jurisdictions.

Both Oregon LNG and Northwest would also develop and implement pipeline emergency response plans. Northwest personnel currently consult with local fire departments and emergency response agencies to determine equipment, training, and support needs related to its existing pipeline and would continue to do so for the WEP. With implementation of the pipeline and terminal emergency response plans and Oregon LNG's MOU with the ODE, no long-term cumulative effect on infrastructure and public services is anticipated.

Transportation and Traffic

We received comments about the increase in shipping traffic on the Columbia River related to other foreseeable actions. Columbia River Bar crossings have fluctuated through the years with monthly averages in the 1990s being around 340 ships per month and decreasing to around 215 per month in the 2000s. The addition of 10 or 11 LNG marine carriers per month associated with the Oregon LNG terminal would contribute to the cumulative increase of shipping traffic in the Columbia River. We estimate other actions listed in table 4.3-1 that include increased river traffic would each add 2 to 6 ships per month. If all new future actions operated at their maximum capacity, we estimate that river traffic would increase by 25 ships per month. But, this change would not increase river traffic back to the levels of the 1990s bar crossings.

Commercial and recreational fishermen are already accustomed to the presence of large tankers. It is expected that when fishermen encounter an LNG marine carrier on the river, fishing vessels would have to temporarily move out of the way to avoid the safety and security zones surrounding the carrier during its transit. To minimize cumulative impacts associated with the increased LNG traffic, Oregon LNG may restrict LNG vessel arrivals and departures to nighttime periods during the high-use Buoy 10 fishing season, typically in August. In addition, Oregon LNG has committed to funding the acquisition of communication equipment which is currently missing from commercial fishing vessels and is necessary for communicating with the Coast Guard about pending LNG vessel transits. It would be made available to commercial fishing vessels permanently moored in the Columbia River from the Port of Astoria down river to the Columbia River Bar.

As described in section 4.1.10, traffic studies were conducted for several intersections in the area of the terminal site. Five of the seven intersections studied are currently failing to meet operational standards. Traffic from other construction actions that may occur during construction of the terminal would add to the already mounting congestion. Warrenton has plans for park, trail, street, utility, and marina improvements, but construction years are not certain.

For the purposes of evaluating long range cumulative impacts, traffic conditions were projected for the year 2034 both with and without the presence of the Oregon LNG terminal and assuming no mitigation. Under both scenarios, six of the seven intersections would fail to meet operational standards. The volume to capacity ratios and delays at the studied intersections generally showed slightly higher numbers with the terminal present but the overall level of service was the same as conditions without the terminal present. Therefore, the analysis projects that operations associated with the proposed terminal would not have significant cumulative impacts on future traffic conditions.

Construction of the Oregon LNG and the WEP pipelines would temporarily impact localized areas of traffic and these impacts could be cumulative if other actions were occurring in the vicinity at the same time. However, operation of the pipeline projects would not significantly contribute to any future traffic issues.

Native American Treaty Fishing

No direct impacts on Native American treaty fishing rights are anticipated as a result of the Oregon LNG Project because there are currently no designated tribal fishing grounds below the Bonneville Dam. However, anadromous fish populations do migrate through the lower Columbia River estuary where the terminal would be located. The WEP construction equipment and activities may temporarily block access to tribal usual and accustomed fishing areas, which include major rivers crossed by the WEP. Additionally, temporary impacts on fish habitat may affect fish productivity, which could reduce the number of fish available to tribal fisheries. However, these impacts would be localized and short term. We conclude that the cumulative impacts on Native American fisheries associated with tribal treaty rights would be similar to those described in section 4.3.1.5 for fisheries in general.

4.3.1.11 Cultural Resources

Section 106 of the NHPA requires federal agencies issuing approvals and permits to consider impacts on historic properties. In accordance with 36 CFR 800, an agency must consult with the appropriate SHPOs and Indian tribes, identify historic properties in the APE that may be affected, and resolve adverse effects.

The Antiquities Act of 1906, NHPA, Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979 protect cultural resources on federal and tribal lands. The NAGPRA would provide for the treatment of Native American graves and items of cultural patrimony found on federal lands.

Oregon state law (ORS 358.905-955) protects archaeological sites on nonfederal lands from damages. Washington state code (RCW 27.53) prohibits the sale and exchange of cultural items or damage to archaeological sites on public and private lands. It is Oregon state policy (under ORS 390.805-925) to protect historic and archaeological sites located adjacent to designated scenic waterways. On nonfederal lands, Native American graves and associated cultural items are protected under ORS 97.740-760 and RCW 27.44 in Washington.

Five archaeological sites have been identified along the Oregon LNG pipeline route, and 21 sites were identified within the APE for the WEP. However, the entire APE for the proposed projects has not yet been surveyed for cultural resources. Therefore, we have recommended that the process of complying with Section 106 be completed before we allow construction to begin.

In addition to the Oregon LNG Project and the WEP, other proposed actions listed in table 4.3-1 that have a federal nexus would need to consult with the SHPO, identify historic properties that may be affected, and implement measures to resolve impacts on affected properties. Nonfederal actions would need to comply with conditions that may be imposed by the state permitting agencies with regard to the protection of cultural resources.

Because it is not known how other foreseeable actions would affect cultural resources and the assessment of the Oregon LNG Project and the WEP is not complete, we cannot make any definitive statements about the nature of cumulative impacts on historic properties. However, we can conclude that given the state and federal laws and regulations that protect cultural resources, mentioned above, it is not likely that there would be significant cumulative impacts on historic properties resulting from the proposed projects in addition to other actions that may occur in the project area.

4.3.1.12 Air Quality and Noise

Long-term emissions for Oregon LNG would consist of emissions from stationary sources at the terminal, combined with marine vessel emissions from arriving and departing LNG marine carriers as well as supporting tug boats and escort boats (see section 4.1.12). Emissions would be permitted under the CAA through ODEQ and would not exceed air quality standards to minimize potential cumulative impacts on the airshed. Oregon LNG's proposed compressor station equipment would be electric; therefore, its operation would have negligible air emissions.

Boilers replaced at compressor stations as part of the WEP would contribute to operational air emissions. Emissions from the WEP and the Oregon LNG Project and other foreseeable stationary air emission sources would cumulatively impact the air quality in the project areas, but the impacts would not be significant.

Construction of the WEP and the Oregon LNG Project may affect ambient noise levels. Impacts during pipeline construction would be localized and would attenuate quickly as the distance from the noise source increases. Because pipeline construction would proceed as a moving assembly line along the pipeline route, the duration of these activities and resultant noise at any given location would be limited and temporary. Cumulative noise impacts due to construction of the LNG terminal and pipelines would be temporary and would only occur if another action listed in table 4.3-1 is being constructed in the near vicinity at the same time.

During operation, the pipelines would not be a meaningful source of noise during normal operation. The terminal and compressor stations would produce operational noise. The terminal and compressor stations would be required to comply with the most restrictive noise limits established by jurisdictional agencies. Therefore, we do not expect cumulative noise impacts.

4.3.1.13 Climate Change

A discussion of GHG emissions associated with the Oregon LNG Project and the WEP was requested by multiple commenters because of concerns related to climate change. Climate change is the change in climate over time, whether due to natural variability or as a result of human activity, and cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change, while a series of floods or warm years that statistically change the average precipitation or temperature over years or decades may indicate climate change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in its working groups to develop reports. The leading U.S. scientific body on climate change is the U.S. Global Change Research Program (USGCRP). Thirteen federal departments and agencies[3] participate in the USGCRP which began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990.

The IPCC and USGCRP have recognized that:

- globally, GHGs have been accumulating in the atmosphere since the beginning of the industrial era (circa 1750);
- combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture and clearing of forests is primarily responsible for this accumulation of GHG;
- these anthropogenic GHG emissions are the primary contributing factor to climate change; and
- impacts extend beyond atmospheric climate change alone, and include changes to water resources, transportation, agriculture, ecosystems, and human health.

Both the IPCC and USGCRP have concluded that, over the last half century, climate change is being driven primarily by human activities that release heat trapping GHGs (USGCRP, 2014). In 2014, the USGCRP published the most recent National Climate Assessment for the United States, which assesses the science of climate change and its impacts across the country. The report presents information on potential impacts from climate change by resource type and by geographical region. Although climate change is a global concern, for this cumulative analysis, we will focus on the cumulative impacts of climate change in the Northwest. The USGCRP's report notes the following observations of environmental impacts that may be attributed to climate change in the Northwest region of the United States:

- changes in the timing of streamflow related to changing snowmelt are already observed and will continue, reducing the supply of water for many competing demands and causing far-reaching ecological and socioeconomic consequences;
- in the coastal zone, the effects of sea level rise, erosion, inundation, threats to infrastructure and habitat, and increasing ocean acidity collectively pose a major threat to the region;
- the combined impacts of increasing wildfire, insect outbreaks, and tree diseases are already causing widespread tree die-off and are virtually certain to cause additional forest mortality by the 2040s and long-term transformation of forest landscapes;
- coastal storm surges are expected to be higher due to increases in sea level alone, and more intense persistent storm tracks (atmospheric river systems) will increase coastal flooding risks from inland runoff;
- average temperatures, which have already risen about 1.3 °F over the past century, are projected to increase 3 to 10 °F during this century; and

[3] The following federal agencies comprise the USGCRP: EPA, DOE, Department of Commerce, DOD, Department of Agriculture, Department of the Interior, Department of State, DOT, Department of Health and Human Services, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and Agency for International Development.

- region-wide summer temperature increases will threaten many freshwater species, particularly salmon, steelhead, and trout.

In December, 2014, the CEQ released a revised draft GHG emission guidance memo. As recommended in this new guidance, to the extent practicable, FERC staff has presented the GHG emissions associated with the WEP and the Oregon LNG Project and the potential impacts of GHG emissions in relation to climate change. The GHG emissions associated with construction and operation of the WEP and the Oregon LNG Project are discussed in sections 4.1.12.1 and 4.2.12.1. Currently there is no standard methodology to determine how the projects' relatively small incremental contribution to GHGs would translate into physical effects on the global environment. However, the emissions would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to climate change that may produce the impacts described above. Because we cannot determine the projects' incremental physical impacts due to climate change on the environment, we cannot determine whether the projects would result in significant impacts related to climate change.

4.3.2 Cumulative Effects from Other Proposed LNG Actions in Oregon

In addition to the actions listed in table 4.3-1, there is a proposed LNG export terminal on the Coos Bay navigation channel in Coos County, Oregon. The JCE & PCGP Project is described in section 3.2.2. The proposed terminal and associated pipeline would be built outside of the cumulative impact study area for the WEP and the Oregon LNG Project. However, we received comments regarding our potential approval of both the Oregon LNG and JCE & PCGP Projects; and therefore, we have included a discussion of the potential cumulative impacts of these two actions in this analysis. Table 4.3.2-1 provides a summary of each project's impacts.

Table 4.3.2-1

Impacts Summary for JCE & PCGP and Oregon LNG Projects

Environmental Factors	Units	JCE and PCGP Project	Oregon LNG Project
Annual LNG marine carrier visits	number	90	125
Dredged material volume			
Initial	cubic yards	4.3 to 5.6 million	1.2 million
Maintenance	cubic yards	115,000 every 3 years	300,000 every 3 years
Land affected			
Construction	acres	6,133	1,275
Operation	acres	1,622	606
Wetlands impacted			
Construction	acres	277	143
Operation	acres	42	57
Waterbodies crossed	number	211	184
Public lands crossed	miles	72 federal 3.3 state	0 federal 9.4 state
Forest lands impacted			
Construction	acres	2,949	510
Operation	acres	547	423
Late successional forest impacts	acres	188	0
Big game habitat crossed	miles	55	62
Federally listed species likely to be adversely affected [a]	number	12	21
Coho salmon critical habitat crossed (Oregon Coast ESU)	number	30	10

Table 4.3.2-1

Impacts Summary for JCE & PCGP and Oregon LNG Projects

Environmental Factors	Units	JCE and PCGP Project	Oregon LNG Project
Marbled murrelet critical habitat crossed	miles	2.1	2.9
Northern spotted owl critical habitat crossed	miles	37.4	<0.1

[a] Three species would likely be adversely affected by both projects: Coho salmon (Oregon Coast ESU), marbled murrelet, and northern spotted owl.

In general, these projects are too far separated geographically to result in cumulative impacts. For example, the waterbodies and wetlands crossed would be in different watersheds and dredging and dredged material disposal activities would have no overlap. Oregon LNG would not contribute to impacts on federal lands or late successional forests.

Cumulative air quality impacts are viewed on a more regional scale. However, both projects would be required to obtain an air quality permit, which may specify controls to limit emissions. The permit process would ensure that air emissions from these projects or other actions would not cause air quality to deteriorate beyond acceptable levels as specified by air quality regulations.

Three species, marbled murrelets, northern spotted owl, and coho salmon (Oregon Coast ESU), would likely be adversely affected by both JCE & PCGP and Oregon LNG being built. The cumulative impact of LNG marine carriers traveling to the Oregon LNG terminal and the Jordan Cove terminal could increase the risk of whale strikes; however, the likelihood would still be low. There are expected to be 125 carriers per year visiting the Oregon LNG terminal and 90 carriers visiting the Jordan Cove terminal, all of which would travel within the EEZ off the coast of Oregon. We conclude that the combined effects of these actions would not affect the survival and/or recovery of any species.

4.3.3 Cumulative Effects Conclusions

We conclude that construction of the WEP and the Oregon LNG Project, in conjunction with the actions listed in table table 4.3-1, has the potential to contribute to cumulative effects on the surrounding area. Each project would result in temporary and short-term effects during construction, but would be designed to avoid or minimize impacts on water quality, forest and marine resources, and wildlife. Additionally, potential impacts on sensitive resources would be mitigated, as appropriate, and mitigation generally leads to the minimization of cumulative impacts.

We recognize that unanticipated incidents during construction or operation could result in potential undefined impacts; however, a meaningful evaluation of those potential impacts would be speculative at best. Accordingly, we consider project monitoring and mitigation programs to be critical in addressing unanticipated impacts, should they occur. With Northwest and Oregon LNG's construction and operation methods, and strict adherence to our recommendations for additional mitigation, as outlined in the EIS, federal and state regulations, and permitting requirements, impacts associated with the proposed projects would be minimized, and would not constitute a significant impact in combination with other past, present, or reasonably foreseeable actions.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of FERC environmental staff and were developed with input from the USACE, DOE, Coast Guard, FWS, DOT, and EPA, as cooperating agencies. The federal cooperating agencies may adopt the EIS per 40 CFR 1506.13 if, after an independent review of the document, they conclude that their permitting requirements and/or regulatory responsibilities have been satisfied. However, these agencies would present their own conclusions and recommendations in their respective and applicable records of decision or determinations. Otherwise, they may elect to conduct their own supplemental environmental analysis, if necessary.

We determined that construction and operation of the Oregon LNG Project and the WEP would result in some adverse environmental impacts. Most of these impacts would be temporary or short-term during construction and operation, but long-term and potentially permanent environmental impacts on vegetation, wetlands, EFH, and individual fish and wildlife species would also occur as part of the projects. However, if the projects are constructed and operated in accordance with applicable laws and regulations, the mitigating measures discussed in this EIS, and our recommendations, most of the adverse impacts would be reduced to less than significant levels. This determination is based on a review of the information provided by Oregon LNG and Northwest, and further developed from data requests; site reviews; scoping; literature research; alternatives analysis; and contacts with federal, state, and local agencies as well as Native American tribes. As part of our review, we developed specific mitigation measures that we determined would appropriately and reasonably reduce the environmental impacts resulting from construction and operation of the projects. Therefore, we are recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission. A summary of the anticipated impacts from the projects and our conclusions regarding impacts are provided below by resource area.

5.1.1 Geological Resources

5.1.1.1 Oregon LNG Project

The Oregon LNG terminal facilities would be in the Coast Range physiographic province. The terminal would reside on land created by historic placement of dredged materials on the East Skipanon Peninsula along the southern shore of the Columbia River at about RM 11.5. The fill at the terminal site is underlain by alluvial sediments deposited by the Columbia River over the last 10,000 years to a depth of at least 350 feet. No mineral resources would be impacted by construction or operation of the terminal, and it is unlikely that any paleontological resources would be encountered during excavations associated with terminal construction.

The overall seismicity of the Pacific Northwest region is relatively high because of the presence of the CSZ off the coast. The terminal site would have a high risk of soil liquefaction during a large earthquake. Oregon LNG would use ground improvement (i.e., CDSM and stone columns) in the areas of critical facilities to make the ground more resistant to soil liquefaction, to mitigate the effects of lateral spreading, and to reduce potential settlement.

The terminal would be within the 100-year floodplain as well as the inundation boundary for a tsunami associated with a large CSZ earthquake. Oregon LNG would construct an earthen berm armored with riprap to protect the process area and LNG tanks during a tsunami and during other flooding events.

A 30 percent safety factor that was figured into the design of the berm height would also accommodate potential sea level rise.

A tsunami making contact with an LNG marine carrier along the waterway could cause the vessel to roll or pitch but would not likely cause any damage to the vessel. If an LNG marine carrier were at berth during a tsunami, an emergency release system would rapidly and safely disconnect the LNG loading arms from the vessel to prevent damage and a possible spill. We are recommending that Oregon LNG increase the maximum tsunami velocity in its final dock and mooring system design to prevent the risk of an LNG marine carrier being pulled off the dock if designed for tsunami loadings.

Oregon LNG performed a site-specific seismic hazard evaluation in order to develop criteria for use in the seismic design of the terminal. Oregon LNG did not identify any active faults at the site but incorporated potentially unidentified faults using background seismicity into its seismic hazard analysis. We are recommending that Oregon LNG file its final terminal geotechnical investigation results and seismic designs prior to construction. We are also recommending that a special inspector be contracted by Oregon LNG to observe the work performed at the terminal to ensure the quality and performance of the seismic resisting systems.

The Oregon LNG pipeline would cross the Coastal Range and Portland Basin physiographic provinces and geologic units ranging from alluvial sediment deposits to outcrops of igneous and sedimentary rock. Rather than blasting bedrock that cannot be excavated with a conventional track hoe, Oregon LNG would employ ripping or use a rock hammer that is attached to a track-hoe to break up the rock along the pipeline route. If blasting is determined to be necessary, Oregon LNG would implement measures to mitigate potential impacts on wells, wetlands, and structures, including developing a blasting plan.

Records indicate 19 mineral resource areas would be within about 0.25 mile of the pipeline. Two of these resource areas, a large unmined deposit of ferruginous (iron-rich) bauxite between MPs 71.0 and 79.0 and an active gravel quarry operation from about MP 80.3 to 80.8, would be crossed by the pipeline alignment. No current mining activities would be directly impacted by the pipeline. Although mining would be precluded within and adjacent to the permanent pipeline right-of-way, we do not anticipate this restriction would significantly impact future mining activity.

Geologic hazards that could affect the pipeline include earthquakes, tsunamis, soil liquefaction, faults, and landslides.

The pipeline would be designed in accordance with all applicable federal and state safety codes, which would govern pipeline thickness, welding standards for joints, and pipeline strength. We conclude that this would allow the pipeline to withstand nearly all ground shaking that could be anticipated to occur from an earthquake, with the possible exception of ground movement associated with a fault rupture.

Prior to pipeline construction, Oregon LNG would perform more detailed geotechnical investigations in the area along and adjacent to the proposed pipeline corridor to further evaluate the potential for geologic hazards such as landslides. We are recommending that Oregon LNG include in its pipeline design geotechnical report an evaluation of liquefaction hazards along the pipeline route and at the compressor station site as well as necessary mitigation measures. We are also recommending that Oregon LNG include in its pipeline design geotechnical report the results of investigations necessary to support final pipeline routing/mitigation measures through geologically hazardous areas, a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan.

Some parts of the pipeline and the aboveground pipeline facilities at the terminal would be within the 100-year floodplain. In areas where the pipeline would cross flood zones, Oregon LNG would implement counter-buoyancy measures such as using a thicker (heavier) steel pipe, using a concrete coating, or installing weights.

The pipeline route would cross some geologic formations with moderate and high paleontological sensitivity. If paleontological resources are encountered during construction of the project, Oregon LNG would notify FERC staff and implement preservation measures to ensure that any significant paleontological resource discovery is protected.

We conclude that the Oregon LNG Project would not have significant impacts on geologic resources. In addition, with the implementation of Oregon LNG's proposed mitigation measures and our recommendations, the geologic risk to project facilities would be minimized.

5.1.1.2 WEP

The WEP would generally be along the interface between the Puget Lowland and Cascade Range physiographic provinces and pass back and forth between them. Although the WEP would cross areas of shallow bedrock, Northwest does not anticipate that blasting would be used to construct the WEP as a precaution to protect the existing pipeline in the Northwest right-of-way. For harder igneous and metamorphic rocks, Northwest would use alternative excavation methods such as rock saws, hydraulic rock hammers, expansive grouts, or powerful excavators equipped with rock teeth.

Thirty-nine mineral resource features would be within 0.25 mile of the WEP, including several that would be crossed. Because the WEP would be constructed primarily within an existing established pipeline right-of-way, we conclude that the project would not have significant impacts on current or future mineral resource development. Further, none of the identified mine activities would represent a risk to the WEP.

Seismic hazards with potential to affect the pipeline include earthquakes, surface faults, and soil liquefaction. The pipeline would be designed in accordance with all applicable federal and state safety codes, which would govern pipeline thickness, welding standards for joints, and pipeline strength. We conclude that this would allow the pipeline to withstand nearly all ground shaking that could be anticipated to occur from an earthquake, with the possible exception of ground movement associated with a fault rupture.

The WEP would cross two fault zones, which are generally not conducive to mitigation measures because the precise rupture location is difficult to predict. Based on WDNR mapping, about 41 locations along the WEP pipeline would have a moderate to high, or high relative liquefaction hazard, for a total of about 20.5 miles. The risk of liquefaction at some of these locations that are associated with major waterbody crossings would be mitigated by use of trenchless construction techniques such as HDD. Before construction, Northwest would perform detailed liquefaction analyses at critical locations along the route and determine the need for additional site-specific mitigation during final design of the pipeline.

The WEP would cross mapped volcanic hazard areas, including 13 lahar hazards and a location susceptible to volcanic blast, lava flows, and damaging flows from Mount Baker. The existing Sumas Compressor Station is in a mapped Mt. Baker lahar hazard area. Because most of the WEP facilities within the lahar and lava flow hazard areas would be below ground, and given the infrequency of eruptions relative to the project lifetime, we do not consider volcanism to be a significant hazard for the WEP.

Northwest has identified 22 active landslide areas along the WEP within its existing right-of-way. During operation of its existing pipeline system, Northwest has implemented measures to mitigate the impacts of each landslide hazard such as visual monitoring, on-surface displacement surveys, installing drainage systems, regrading slopes, installing strain gauges to monitor ground movement, and excavating to relieve strain. Northwest would incorporate similar mitigation measures into the WEP. We are recommending that Northwest file with FERC final geotechnical investigations supporting final routing and mitigation measures, including a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan.

A number of abandoned underground mines are in the vicinity of MP 1301.0 and MP 1307.0. Northwest's existing pipeline right-of-way has not experienced any subsidence in these areas and the WEP would be installed within the existing right-of-way. Northwest would monitor the permanent right-of-way regularly and any subsidence that could pose a risk to the pipeline would be quickly identified so that corrective actions could be implemented.

The largest areas along the pipeline route that would be within the 100-year floodplain are at major river crossings. Northwest would use trenchless techniques to cross five of these rivers and would weight the pipeline to counteract buoyancy at waterbody crossings and in floodplains. Northwest would also bury the pipeline at sufficient depths to avoid impacts from scour and lateral migration at waterbody crossings.

Seven geologic units that would be crossed by the WEP have high paleontological sensitivity and may contain invertebrate and plant fossils. Northwest would implement a PRMMP to reduce the potential impact from project-related ground disturbance on paleontological resources.

We conclude that the WEP would not have significant impacts on geologic resources. In addition, with the implementation of Northwest's proposed mitigation measures and our recommendations, the geologic risk to project facilities would be minimized.

5.1.2 Soils and Sediments

5.1.2.1 Oregon LNG Project

Dredged fill material makes up the top 10 to 15 feet of the LNG terminal site. Although it is possible for dredged material to contain contaminants, such contamination is not documented in the EPA database. Construction of the terminal facilities would convert most of the site and existing soil resources to a permanent industrial facility. During construction, Oregon LNG would implement erosion controls in accordance with its Plan and Procedures. Permanent erosion control measures would be applied after final grading for stabilization, as specified in the Oregon LNG's Conceptual Mitigation Plan. Oregon LNG would implement its SPCC Plan during construction to prevent or manage accidental spills of any materials that may contaminate soils. Oregon LNG has stated it would also prepare and implement a spill plan for fuels and hazardous materials during terminal operation.

Oregon LNG would monitor the shoreline for the first five LNG marine carrier visits and thereafter at least once every 90 days (quarterly) for signs of erosion. Should the monitoring determine that potentially damaging erosion is occurring as a result of operations (rather than from significant storms or natural wave action) and that stabilization measures would reduce erosion potential, Oregon LNG would employ soft armoring techniques, such as increasing vegetation present along the shoreline and the use of brush layering, as an adaptive management strategy.

The pipeline would cross numerous soil types. Activities associated pipeline construction, such as clearing, grading, trenching, and backfilling, could adversely affect soil resources by causing erosion, compaction, and introduction of excess rock or fill material to the surface, which could hinder restoration. Oregon LNG would minimize compaction and rutting impacts, control erosion, and enhance successful revegetation during pipeline construction by using measures outlined in its Plan and Procedures.

Oregon LNG proposes to develop a Plan for the Unanticipated Discovery of Contaminated Environmental Media before starting construction of the pipeline. The plan would include procedures to test for contaminants if suspect soils are encountered. We are recommending that Oregon LNG include the terminal site in this plan. Any soils found to be contaminated would be managed according to Oregon LNG's SPCC Plan and applicable regulations.

We conclude that implementation of Oregon LNG's Plan, SPCC Plan, and other project-specific plans would effectively avoid, minimize, or mitigate the impacts of construction and operation on soil resources.

5.1.2.2 WEP

The WEP would cross numerous soil types. Most of the affected soils have been previously disturbed during construction of the existing pipeline facilities and these have been successfully stabilized since construction. The project would also include modifications to existing compressor stations that would be within the existing previously graded and graveled footprint. After construction, the disturbed areas would be regraveled, and temporary workspaces would be revegetated or restored to previous uses.

Areas with shallow depth to bedrock pose a risk of introducing rock into the topsoil in agricultural and residential areas. Minimization efforts would include segregating topsoil and storing topsoil separate from subsoil during construction. Excess rock in the top 12 inches of the topsoil would be removed before topsoil is replaced.

Northwest would minimize soil compaction and rutting, erosion, impacts on Important Farmland soils and increase revegetation potential by following its ECRP (see appendix J1) and its Plan and Procedures.

If contaminated soils or groundwater are encountered during construction, Northwest would follow protocol in its Unanticipated Discovery of Contamination Plan (see appendix J2). This plan includes procedures to test for contaminants if suspect soils are encountered as well as management and disposal of contaminated soils at a licensed disposal facility.

Implementation of Northwest's ECRP, Plan, Procedures and other project-specific plans would adequately avoid, minimize, or mitigate construction impacts on soil resources. Based on our analysis, we conclude that potential impacts on soils would be avoided or effectively minimized or mitigated.

5.1.3 Water Resources

5.1.3.1 Oregon LNG Project

No water wells, sole source aquifers, wellhead protection areas, or source water protection areas would be impacted by construction or operation of the terminal. We expect shallow groundwater impacts from construction and operation of the terminal to be minor, temporary, and minimized through best management practices.

Water quality is currently impaired for both the lower Columbia and Skipanon Rivers. Construction and operation of the terminal could cause impacts on surface water from dredging, dredged material placement, site grading and creation of impermeable surfaces, water appropriation and discharge, and potential spills or leaks.

Evaluation of the chemical data of the sediment in the area that would be dredged indicated no exceedances of the sediment quality guidelines for any of the individual analyses. In 2013, the Portland Sediment Evaluation Team reviewed the Oregon LNG sediment test results. The team recommended that since samples were collected in May 2008, the dredge prism would need to be reevaluated if initial dredging has not been completed by May 2015. Therefore, we are recommending that Oregon LNG prepare a plan to reevaluate these sediments prior to the close of the draft EIS comment period. The sediments that would be dredged consist mostly of fine to medium sand that is suitable for open water disposal. Oregon LNG would use a hopper dredge, which generally does not produce high turbidity, particularly in sandy sediments. Dredged material placement would create temporary increases in turbidity at the disposal location but the sand would settle fairly rapidly.

During terminal operations, stormwater that falls onto impervious surfaces at the terminal would be conveyed to the stormwater treatment system, treated, and then be used as makeup water for the cooling tower.

About 2.3 billion gallons of water would be needed annually for operations. Most of this water would come from the Columbia River, which would require a Limited Water Use License from OWRD. Given the large size of the Columbia River, significant impacts from water withdrawal are not anticipated.

During terminal construction, accidental spills and leaks of hazardous materials could have an adverse impact on surface water quality. Implementation of Oregon LNG's SPCC Plan would help prevent spills and should a leak or spill occur, minimize the potential for contaminants to reach surface waters.

All LNG marine carriers would also be required to comply with state spill prevention and contingency plans, including the applicable requirements in Chapter 317-40 of the WAC – Bunkering Operations. LNG marine carriers would be prohibited from discharging sewage, grey water, or garbage within 1 nautical mile of shore under CWA or MARPOL regulations, depending on the vessel registration or county of origin. Although emergency or accidental discharges could occur, we expect the impact of any such discharges from LNG marine carriers would be low.

The majority of LNG marine carriers that would dock at the facility would be export vessels that would discharge ballast water during the loading process. LNG marine carriers importing LNG would take on ballast water during unloading. All LNG marine carriers docked at the terminal would take on engine cooling water. Discharge of cooling waters would create a thermal plume but the temperature increases would be expected to stay within allowable ranges defined by NPDES permits and Section 401 water quality certifications.

Twenty private water supply wells would be within 150 feet of the pipeline construction right-of-way, including two wells within 50 feet. No public drinking water supply wells or wellhead protection areas would be within 150 feet of the pipeline route. Oregon LNG would avoid or minimize most potential impacts on groundwater resources by implementing its Plan, Procedures, and SPCC Plan. If adverse effects on a groundwater supply occur as a result of construction activity, Oregon LNG would provide a temporary source of water to those affected and would compensate for damages or repair the

water supply. We are recommending that Oregon LNG file a final field-verified list of all water wells (including private wells and public wells, if applicable) within 150 feet of the construction right-of-way and include monitoring details prior to construction.

The pipeline would cross 184 waterbodies (96 perennial, 87 intermittent, and 1 classified by Oregon LNG as perennial/intermittent). Among these would be seven major waterbody crossings (greater than 100 feet wide), which includes three crossings of the Lewis and Clark River. Oregon LNG would avoid in-water disturbance at 20 waterbody crossings by using the HDD crossing method. These include all of the major waterbodies except Deer Island Slough. Deer Island Slough would be crossed just upstream of an existing tide gate using dry open-cut methods.

Construction of the project would result in temporary or short-term impacts from in-water construction activities or construction disturbance on slopes adjacent to waterbodies. In-water construction would include clearing and grading of streambanks, in-water trenching, trench dewatering, and backfilling. These activities could increase turbidity and sedimentation, decrease dissolved oxygen concentrations, and introduce contaminants.

Temporary impacts on surface waters would occur from in-water construction activities and water appropriation and discharge for hydrostatic testing. Oregon LNG would minimize in-water construction impacts by implementing its Plan and Procedures and SWPPP, crossing waterbodies during periods of low water, and complying with in-water work windows. Oregon LNG would minimize water appropriation impacts by using its Plan and Procedures, reusing water where possible, and discharging water through approved dewatering structures. The pipeline would be buried more deeply at waterbody crossings as protection against scour and lateral channel migration. Periodic monitoring during operation would detect indications of scour and allow for corrective action.

We conclude that with implementation Oregon LNG's proposed mitigation measures and our recommended mitigation, impacts on water resources during project construction would be temporary and localized. During operations, once the pipeline right-of-way has been restored, the pipeline would not have measurable impacts on water resources. For the terminal, the primary operational impacts on water resources would be from maintenance dredging every 3 years, which would result in temporary increases in turbidity in the dredge area and disposal area.

5.1.3.2 WEP

The WEP would cross two EPA-designated sole source aquifers including the Cross Valley aquifer within the Snohomish Loop and Central Pierce County aquifer within the Sumner South Loop. The WEP route would pass through multiple CARAs and wellhead protection areas as designated by counties. The pipeline construction right-of-way would be within 400 feet of 97 Group A public water supply wells and 20 Group B public water supply wells, and within 200 feet of 214 private water supply wells.

Northwest would construct the WEP mainly during dry summer and early fall months when groundwater levels are typically at their lowest levels. Groundwater could still be encountered during construction near waterbodies and could require trench dewatering. Northwest would minimize impacts on groundwater through adherence to its Plan and Procedures. Northwest has developed Spill Plans for Oil and Hazardous Materials that outline spill prevention practices and emergency response procedures that would be followed in the case of incidents during construction. Northwest has also developed a Groundwater Supply Monitoring and Mitigation Plan to verify the location of groundwater supply wells and implement measures to mitigate potential groundwater impacts. Because Northwest would

implement these plans and would not use groundwater for construction or operation, we conclude that the WEP would not result in significant impacts on groundwater resources.

The WEP would cross 271 waterbodies (161 perennial, 73 intermittent, and 37 ephemeral), 7 of which are classified as major. All major waterbodies would be crossed using trenchless methods with the exception of the Toutle River and Kalama River. The Toutle River would be crossed using a wet open-cut trench because other methods were determined to be infeasible. The Kalama River would be crossed by replacing the previously abandoned 26-inch-diameter pipeline currently in an existing aerial span with the new 36-inch-diameter pipeline. Construction of the project would result in temporary or short-term impacts from in-water construction activities or construction disturbance on slopes adjacent to waterbodies. In-water construction would include clearing and grading of streambanks, in-water trenching, trench dewatering, and backfilling. These activities could modify aquatic habitat, increase sedimentation, increase turbidity, decrease dissolved oxygen concentrations, release chemical and nutrient pollutants from sediments, and introduce chemical pollutants. To minimize adverse impacts at waterbody crossings, Northwest would follow measures contained in its Plan and Procedures and ECRP.

Northwest plans to cross waterbodies during periods of low water flow levels whenever possible and comply with in-water work windows established by the WDFW. Northwest stated that exemptions to in-water work windows may be needed at certain crossings. However, Northwest has not yet stated which streams it may need to cross outside of the recommended in-water work windows, nor has it provided justification and agency approval for construction outside of these time frames. We are recommending that Northwest file documentation of approval from state agencies for any modifications to the WDNR in-water work windows.

Northwest would use existing roads as access roads for the WEP, most of which are currently used to operate and maintain the existing pipeline and facilities. No modifications or improvements to these roads would be necessary. Northwest would locate contractor and pipe storage yards in previously graded areas, away from any waterbodies. Therefore, we do not expect water quality impacts from storage yards or access roads.

Operation of the WEP generally would not affect surface waters, although maintenance activities requiring ground disturbance in or near waterbodies could result in temporary increases in turbidity. Such impacts would be minimized using the same types of erosion and sediment control measures used during construction. As part of continued operations and maintenance of the right-of-way, Northwest would monitor the 26-inch-diameter pipeline where it is abandoned in place. Northwest would take corrective actions if any of the pipelines within its right-of-way becomes exposed.

5.1.4 Wetlands

5.1.4.1 Oregon LNG Project

The basic function of the terminal requires a location adjacent to navigable water and, as a result, wetland impacts are unavoidable in the project area. However, Oregon LNG has designed its terminal to avoid and minimize impacts on wetlands to the extent feasible by minimizing the terminal footprint and maximizing use of the nonwetland area, avoiding higher function wetlands, and maximizing the use of existing roads for site access. The majority of wetland impacts at the terminal site would be permanent (33.9 acres) and result in the conversion of wetlands to commercial/industrial uses. Short-term impacts (2.0 acres) would also occur. Removal of wetland vegetation would deprive wildlife and aquatic resources of valuable habitat.

Construction of the pipeline would cause short-term impacts on about 84.1 acres of wetlands and permanently impact about 22.8 acres of wetlands in Oregon and Washington. The compressor station and other aboveground facilities associated with the pipeline were sited to avoid wetlands. Oregon LNG would avoid and minimize wetland impacts by reducing the construction right-of-way to 75 feet and locating the pipeline alignment and ATWS away from wetlands to the extent practicable.

Following construction of the pipeline, wetlands would be restored to preconstruction soil and hydrology conditions, and revegetated. Within the construction right-of-way, reestablishment of vegetation would begin within days or weeks of cessation of site work, with the exception of the trench excavation area. In the 10-foot-wide trench area, herbaceous wetlands would recover more slowly as a result of clearing, grubbing, and soil excavation. Oregon LNG would monitor wetland restoration efforts for a minimum of 3 years or until revegetation is successful. Operational vegetation maintenance activities would preclude forested wetlands in a 30-foot-wide corridor, and shrub-scrub wetlands from a 10-foot-wide corridor centered over the pipeline.

Oregon LNG would mitigate construction-related wetland impacts by implementing its SWPPP, Plan and Procedures, and by complying with the USACE's Section 404 and ODSL's Section 401 permit conditions. For unavoidable wetland impacts Oregon LNG would provide compensatory mitigation following the USACE, ODSL, and WA Ecology rules and guidance for no net loss of wetland functions and values. Permanent unavoidable impacts from the terminal construction would be compensated by improving a 120-acre parcel of land near the mouth of the Youngs River. Oregon LNG would compensate for temporary impacts on wetlands from pipeline construction through on-site wetland rehabilitation. Permanent wetland class changes from the pipeline construction would be compensated via purchase of credits in established mitigation banks near the project impacts. Oregon LNG also proposes wetland mitigation on private land in the floodplain of the Nehalem River in Clatsop County, Oregon. Based on the avoidance and minimization measures developed by Oregon LNG, as well as our recommendation to file a final Wetland Mitigation Plan prior to construction, we conclude that impacts on wetland resources would be effectively minimized or mitigated.

5.1.4.2 WEP

The construction of the WEP would temporarily impact about 176.6 acres of wetlands and permanently impact about 30.6 acres of wetlands. Because the pipeline would be installed along a maintained pipeline corridor, the majority of the wetlands impacted by the project would be PEM wetlands, which have been previously disturbed by pipeline installation and are maintained in an emergent state due to ongoing maintenance activities (i.e., mowing). The project would cause permanent impacts in areas where the pipeline deviates from the existing right-of-way and clearing of new areas of PFO or PSS wetlands would be required. Northwest would follow its Plan and Procedures during construction to mitigate impacts on wetlands and would use HDD techniques to avoid impacts on wetlands near certain river crossings.

Unavoidable permanent impacts on PSS, PFO, and Category I and II wetlands would be mitigated through off-site wetland mitigation banking sites. Specific sites would be identified during the final permitting stage in coordination with the USACE and WA Ecology. Northwest expects credits available through active wetland mitigation banks would be sufficient to cover compensatory wetland mitigation required for the project. If approved mitigation banking site credits are not sufficient, USACE and WA Ecology approved in-lieu fee programs would be used to supplement banking credits. Based on the avoidance and minimization measures developed by Northwest, as well as our recommendation to file a final agency-approved Wetland Mitigation Plan prior to construction, we conclude that impacts on wetland resources would be effectively minimized or mitigated.

5.1.5 Aquatic Resources

5.1.5.1 Oregon LNG Project

The proposed LNG terminal site and marine transit route provides habitat for a variety of anadromous and resident fish species, as well as EFH. Terminal construction activities that would impact aquatic resources include berth and turning basin dredging, pile driving, and onshore facility construction including hydrostatic testing of the LNG storage tanks.

Dredging would convert estuarine slope habitat to deepwater channel, bottom-type habitat with little or no slope. The greatest changes would occur nearest the shoreline, where existing depths around 20 feet below MLLW would be deepened to 45 to 50 feet below MLLW. The changes in bathymetry could cause minor localized changes in distribution and number of epibenthic and benthic invertebrates but the fundamental processes that support the existing food web would not be affected. In particular, we expect that the dredged area would be rapidly recolonized by Dungeness crab from surrounding habitat.

Construction of the pier, access trestle, and dolphins would require the installation of 150 large diameter, hollow steel pilings. This loss of habitat from the pilings would be small and insignificant relative to available similar habitat in the lower Columbia River estuary and we would not expect the pilings to cause significant changes to current patterns or hydrology of the estuary. Oregon LNG would implement noise mitigation measures during pile driving to minimize the injury or disturbance to fish and marine mammals.

Aquatic resources could be impacted by onshore construction activities such as potential hazardous materials releases, stormwater runoff, and construction lighting. Oregon LNG would implement its SWPPP, Plan, Procedures, and lighting control measures to minimize these impacts.

Water from the Columbia River would be used for hydrostatic testing of the LNG storage tanks. About half of the testing water would be reused for the cooling towers and half would be discharged to the Columbia River via the City of Warrenton POTW. Because the volume of water that would be used for testing is small compared to the flow in the river and all water would be treated in compliance with local, state, and federal criteria before discharge, we do not anticipate adverse effects on aquatic resources from hydrostatic testing.

During LNG import and export operation of the terminal, LNG marine carriers could impact aquatic resources in the Columbia River through cooling and ballast water intake and discharges. Cooling and ballast water intakes on LNG marine carriers typically have intake screens size gaps and velocities that exceed ODFW and NMFS screening criteria, and small fish could be entrained or impinged on the water intake screens if they swim in close proximity. According to Oregon LNG and the Coast Guard, there is no feasible fish-screen technology that could be attached to LNG marine carriers to avoid possible fish entrainment or impingement during ballast and cooling water intake operations. LNG marine carriers would take on ballast water only when the terminal is operating in import mode and LNG is being unloaded. We concur with the Coast Guard's assessment that screening of LNG marine carrier water intakes would be infeasible and conclude that impacts on fish from unscreened ballast and cooling water intakes on LNG vessels would be minor.

Cooling water would be discharged back into the Columbia River at a higher temperature than the ambient river water. Based on water temperature and diffusion modeling information provided by Oregon LNG, the thermal plume generated by the proposed project would be limited in size and rapidly dissipate within the mixing zone. The thermal plume would occupy much less than 1 percent of the total

cross-sectional area of the Columbia River. As a result, we conclude that the localized temperature increases caused by the proposed cooling water discharge would not adversely affect migrating or rearing salmonids and migration would not be blocked.

The project would increase ship traffic in the lower Columbia River estuary by about two ships per week. When the terminal operates under import mode, LNG marine carriers would enter the estuary with a full load and not discharge ballast water into the estuary. When the terminal operates under export mode, the ships would undergo open-ocean ballast water exchange or ballast water treatment in accordance with OAR 340-143-0001, greatly reducing the likelihood of exotic species introductions via ballast water. Therefore, we conclude impacts from vessel fouling or ballast water discharge into the lower Columbia River estuary would not noticeably add to that currently experienced in the project area.

Fuel (e.g., diesel) used for vessel propulsion or auxiliary/emergency generators on an LNG marine carrier could potentially spill or leak. However, fuel on each carrier is protected by the vessel's double hull. Furthermore, each LNG marine carrier would maintain a SOPEP and would also be required to comply with state spill prevention and contingency plans. Therefore, we conclude that the likelihood of spills of hazardous materials from LNG marine carriers would be low.

We conclude fish stranding due to wakes caused by LNG marine carriers would be unlikely because the LNG marine carriers would travel at low speeds while in the Columbia River and there are no broad, shallow beaches along the LNG marine carrier route where fish could be stranded.

To mitigate impacts associated with the terminal construction and operation, Oregon LNG would enhance about 120 acres of diked pasture land on the Youngs River near the mouth of Youngs Bay where historical tidal floodplain would be reconnected to the estuary.

The effects on fish and aquatic habitat, including EFH, from pipeline construction would be primarily related to waterbody crossings and associated construction activities necessary to install the pipeline under waterbodies and through adjacent riparian corridors. Resident and anadromous salmonids are present, or assumed to be present at 41 of the proposed waterbody crossings. Effects from pipeline construction across waterbodies would be mostly related to short-term changes in water temperature, pH, dissolved oxygen, and turbidity. Oregon LNG would use HDD to cross 20 waterbodies, including all of the waterbodies listed (CWA 303(d)) as temperature sensitive, thereby avoiding loss of streamside vegetation.

To minimize impacts on fish and EFH, Oregon LNG would also cross waterbodies proposed for open-cut trenching in Oregon during in-water work windows designated by the ODFW and WDFW in Oregon and Washington, respectively. Oregon LNG would implement its fish salvage plan at open-cut waterbody crossings. In addition, waterbody crossing methods would follow Oregon LNG's Procedures as discussed in section 2.1.4.2.

To avoid fish passage issues at waterbodies that Oregon LNG characterized with a moderate to high scour potential, the pipeline would be buried deeper than 3 feet to prevent pipe exposure due to scour. Oregon LNG would also monitor crossings over the life of the project and address channel subsidence, bank erosion, channel scour, or other negative long-term effects of pipeline construction using case-specific responses in coordination with the appropriate resource agencies (e.g., NMFS, ODFW, and FWS). To compensate for the disruption of LWD recruitment potential and shifting of instream LWD, Oregon LNG would replace LWD removed during construction and restore the woody riparian corridor to replenish source areas for LWD recruitment. At waterbody crossings where LWD is

lacking, Oregon LNG would install LWD in consultation with ODFW and ODSL at appropriate locations within the channel to improve habitat quality.

Oregon LNG would obtain water needed for HDD and hydrostatic testing from City of Woodland or from the Columbia River and comply with NMFS screening criteria for water withdrawals. We conclude that water withdrawal from the Columbia River is unlikely to affect aquatic resources as water needed for construction is an extremely low percent of the volume of water present in the Columbia River. When discharged, the hydrostatic test water would be released at low velocities into a vegetated upland adjacent to the construction right-of-way through an energy dissipating device and a straw bale filter or sediment bag.

To mitigate impacts on aquatic resources associated with pipeline, Oregon LNG would remove eight fish barriers outside of the project right-of-way and enhance off-channel habitat on the Nehalem River near MP 33.5. Oregon LNG would select which fish passage barriers to remove in consultation with the Adaptive Management Team, with the goal to restore access to at least 1 mile of productive rearing and spawning habitat for the ESUs/DPSs affected by construction of the project.

The Oregon LNG Project would result in short-term impacts on aquatic resources during construction and long-term impacts during operation. These impacts would be minimized through implementation of measures in Oregon LNG's Plan and Procedures, SWPPP, and SPCC Plan as well as our recommendations. Furthermore, implementation of Oregon LNG's compensatory mitigation at the Youngs River, Nehalem River, and fish barrier removal sites would offset unavoidable impacts on aquatic resources, including EFH.

5.1.5.2 WEP

The WEP pipeline route would cross 271 waterbodies, including 90 waterbodies that may contain fish. Potential impacts on fish and other aquatic resources at or near waterbody crossings would depend largely on the type of crossing method used. Standard upland construction methods would be used to cross nonflowing, intermittent or ephemeral waterbodies. Northwest proposes to use trenchless methods to cross five waterbodies that have high-quality fisheries. Four waterbodies with fisheries would be crossed by span or aerial span. For other waterbodies that have flowing water at the time of construction, Northwest would use dry open-cut (flume or dam and pump) methods, except at the Toutle River, which would have a wet open-cut crossing. Northwest would follow WDFW's in-water construction timing windows for waterbodies not crossed by trenchless methods to minimize impacts on fish.

The wet open-cut crossing of the Toutle River has the highest potential for causing high levels of turbidity that could impair fish and benthic invertebrates. Northwest would complete the Toutle River crossing during the summer (i.e., between July 16 and August 15) when flow is at its lowest, which would minimize the width of the crossing at this location. Northwest also selected a crossing location where the Toutle River has a relatively slow current to reduce the distance sediment would be transported downstream.

Northwest would follow its Plan and Procedures for site restoration following waterbody crossings, including reestablishing streambank contours and revegetating disturbed areas. In addition, Northwest would provide additional stream habitat enhancements by preserving LWD that is present at the time of construction, and incorporating new LWD into its stream restoration.

For hydrostatic testing, Northwest would only withdraw water from major waterbodies to maintain adequate flow to support aquatic resources. In addition, Northwest proposes to withdraw water

during the fall and winter periods when seasonal river flows are typically at their highest. To prevent the inadvertent transfer of aquatic pathogens or nonnative species between basins, Northwest would discharge hydrostatic test water either to upland infiltration areas or back to the same stream basin from which it was withdrawn.

We are recommending that Northwest consult with the WDFW, FWS, and NMFS to develop a plan for placement of LWD or other waterbody improvement features at waterbody crossing locations determined by agency input. We are also recommending that Northwest coordinate with the FWS and WDFW to develop a Fish Salvage Plan that includes measures to minimize the impacts on native fish, including lamprey, during open-cut waterbody crossings.

We conclude that impacts on aquatic resources would be minimized by complying with Northwest's Plan and Procedures, our recommendations, and other project-specific measures proposed by Northwest. Waterbody crossings would temporarily impact fish and other aquatic resources but long-term effects would not be significantly different than the current conditions associated with the existing maintained right-of-way. The project would not have a substantial adverse impact on EFH.

5.1.6 Vegetation

5.1.6.1 Oregon LNG Project

Construction of the terminal facilities, including the access road, would permanently affect 23.2 acres of upland vegetation, most of which (82 percent) is deciduous forest. Oregon LNG would limit impacts on vegetation by using unvegetated areas to the extent possible for temporary and permanent construction areas.

During initial site clearing at the terminal, Oregon LNG would flag and remove noxious or invasive weed species to support successful revegetation with native plant communities. Following construction activities, Oregon LNG would restore nondeveloped areas around the terminal site with native seed mix and landscaped vegetation buffer. Oregon LNG would implement its Noxious Weed Control Plan and monitor the success of revegetation at the terminal for at least the first two growing seasons according to its Plan.

Coniferous forests and agricultural communities are the most common vegetative communities along the Oregon LNG pipeline alignment. The majority of coniferous forests are composed primarily of trees between 20 and 60 years old that have been planted for commercial timber on state and private lands. Construction of the pipeline and compressor station would disturb about 985 acres of forest (95 percent) and agricultural (5 percent) upland vegetation. About 423 acres of forest habitat would be permanently converted to an herbaceous community along the permanent pipeline right-of-way. Most of the coniferous forests that would be disturbed are commercial timber lands with trees that are predominantly uniform in structure between 20 and 60 years old. None of the coniferous or deciduous forest delineated within the construction or operational rights-of-way is considered old growth forest.

Oregon LNG would implement measures in its Plan and Procedures to avoid and minimize impacts on vegetation types, and to repair, rehabilitate, or restore unavoidably affected habitats. Near waterbodies, Oregon LNG would stabilize disturbed streambanks and restore riparian areas by planting a mixture of native tree, shrub, and grass/forb/legume species along the construction right-of-way. At a minimum, a 25-foot-wide riparian strip on each side of the waterbody would be permanently revegetated with native trees across the entire construction right-of-way, except for a 10-foot-wide herbaceous corridor to facilitate periodic pipeline inspections. Native tree and shrub species would be established

outside the 10-foot-wide herbaceous corridor. Restored riparian vegetation would be protected from removal during maintenance operations, except that trees within 15 feet of the pipeline that are greater than 15 feet in height may be cut and removed from the permanent right-of-way. We are recommending that Oregon LNG file a Riparian Restoration and Monitoring Plan prior to construction that includes a seed and planting mixture for riparian areas based on regional habitat differences.

The greatest vegetation impacts would be on forested areas which would be slow to grow back and the impacts on forested habitat would be permanent within about a 30-foot-wide corridor over the pipeline. However, most of this forest is commercial timber and the total amount of forest land that would be impacted is small relative to the surrounding area. We conclude that the project would be constructed and operated in a manner that minimizes impacts on vegetation with implementation of Oregon LNG's Plan and Procedures, Noxious Weed Control Plan, site-specific vegetation plans, and our recommendations.

5.1.6.2 WEP

Most of the vegetation removal (80 percent) for the WEP would occur in Northwest's existing right-of-way. This would reduce the need for timber clearing and disturbance to agricultural lands during construction.

The primary impact from the pipeline and associated aboveground facilities on vegetative communities would be the cutting, clearing, and/or removal of existing vegetation within the construction work areas. Long-term impacts on 209.1 acres of upland forested habitats (i.e., coniferous, deciduous, and mixed forests and corresponding scrub-shrub) would occur because of the time required to restore the woody vegetation to its preconstruction condition in the temporary construction right-of-way and ATWS. Permanent impacts would occur on 139.8 acres of woody species where herbaceous vegetation would be maintained within new permanent right-of-way and woody canopy would not be allowed to regenerate due to periodic right-of-way maintenance activities. Disturbed agricultural areas would be restored to preconstruction uses except woody and deep-rooted vegetation would not be allowed in the permanent right-of-way.

Following the completion of construction activities, upland vegetation would be restored to prevent erosion and facilitate site restoration. Northwest has consulted with NRCS about the most appropriate seeding mixtures, seeding dates, and practices to optimize the success of restoration. Revegetation of the noncultivated portions of the construction right-of-way would occur in accordance with its Plan and Procedures; the *Oregon & Washington Guide for Conservation Seedings and Plantings*; restoration plans developed with federal, state, and local agencies; and landowner requests. Northwest would minimize establishment of noxious weeds by implementing its noxious weed control plan, which is incorporated in its ECRP.

Most of the WEP would be constructed within Northwest's existing right-of-way and in areas that are already developed and highly fragmented. Therefore, we have concluded that constructing and operating the pipeline facilities would not significantly affect existing vegetation. The implementation of the ECRP and above measures would minimize the introduction of noxious weeds to the pipeline corridor and minimize impacts on vegetation.

5.1.7 Wildlife

5.1.7.1 Oregon LNG Project

Overall, habitat diversity, structure, and features are low at the terminal site; invasive plant species cover is high; and most of the East Bank Skipanon Peninsula is disturbed by human recreational use. Consequently, the diversity and density of wildlife in the uplands and marsh habitats are low. Wildlife present at these habitats is common and adapt to low levels of disturbance.

Direct impacts on a wildlife species or its habitat from construction of the terminal would include the displacement (associated with noise, lighting, or loss of habitat/food) of wildlife species within the project area and possibly direct mortality of some individuals. Typical operational noise would be relatively continuous during operating hours. Noise during plant operation would abate to background levels within 500 feet of the source. Over time, some species or individuals would habituate to disturbance, but the use of the habitat surrounding the terminal may be less than preconstruction levels. Animals are more likely to habituate to operational noise than to construction noise, and we conclude that impacts would be minimal.

Lighting throughout the terminal would be positioned in a manner so as not to be obtrusive to the natural environment surrounding the facility. Oregon LNG would implement additional measures to minimize impacts from terminal lighting on wildlife, especially due to the frequent use of the Columbia River in the area of the terminal by shorebirds, waterfowl, and other water birds migrating along the Pacific Flyway and the potential presence of sensitive wildlife species.

During pipeline construction, Oregon LNG would use specialized construction methods to avoid Category 1 habitats such as waterbodies with listed species and patches of large trees with suitable nest sites for marbled murrelets, eagles, northern spotted owls, and other raptors. Oregon LNG would provide off-site compensatory mitigation for permanent impacts on Category 3 and 4 forests by acquiring land at a 2 to 1 area ratio, and temporary impacts on Category 3 and 4 forests would mitigated at a 1 to 1 ratio.

Impacts on wildlife during construction could include injury or mortality through collisions with construction equipment and vehicles and displacement from the project area. Displacement would most likely be temporary as wildlife would return after restoration of the right-of-way is complete. Clearing of forested habitats would increase the amount of edge habitat in the area, which would reduce the amount of habitat available for wildlife that rely on intact forest habitats.

Oregon LNG planned the pipeline route and has proposed use of the HDD construction method to avoid riparian zone effects in many areas. Where possible, Oregon LNG would avoid removing important specimen trees, significant wildlife snags, and nest trees in riparian areas. Oregon LNG would also avoid removing natural habitat features, such as logs greater than 12 inches in diameter, downed large wood, and rocks. Effects on the riparian zone would be minimized by reducing the amount of clearing as much as possible, and by revegetating the cleared riparian areas as rapidly as possible following construction. The remaining permanent right-of-way and temporary workspaces would be restored to reestablish preconstruction habitat conditions. Oregon LNG would use the ODFW-recommended rapid-germinating forage seeding mix for permanent erosion control seeding to provide nutritional benefits to a variety of wildlife species.

Oregon LNG would take measures to avoid and minimize the taking of birds protected by the MBTA and BGEPA by constructing outside of sensitive time windows for nesting and implementing proposed compensatory mitigation for habitat that supports migratory birds. Fifteen bird species that may

occur within the Oregon LNG Project area are considered migratory birds of concern by the FWS. We are recommending that Oregon LNG consult with the FWS to develop a Migratory Bird Conservation Plan prior to construction. With Oregon LNG's proposed mitigation and our recommendation, we conclude that the overall impact of the project on migratory birds would be minor.

During pipeline operation, indirect impacts on wildlife populations could result through habitat alteration (cleared and maintained habitats). Direct mortality of individuals could also occur during right-of-way maintenance operations, such as mowing. Because the compressor station would be adjacent to Highway 30, the overall increase in noise from operation of the compressor station is not expected to significantly impact wildlife. Impacts on wildlife from operation of the compressor station would likely be limited to avoidance of the areas closest to the station. We conclude that with the implementation of avoidance, minimization, and mitigation measures proposed by Oregon LNG, the project would not result in substantial adverse impacts on wildlife.

5.1.7.2 WEP

The majority of the project would be constructed within Northwest's existing pipeline right-of-way, which was previously cleared and is currently managed in herbaceous or low-shrub conditions. Consequently, many of the species that occur within the project area are associated with open, low growing vegetation. However, there may be wildlife species that inhabit the surrounding forested habitats that could be disturbed by construction activities. Northwest would avoid impacts on birds by clearing vegetation outside of the sensitive time window for nesting birds (early spring and summer). Removal of mature trees and shrubs would be minimized because the WEP would be constructed in Northwest's existing right-of-way. Where feasible, existing large trees and shrubs in the construction right-of-way would not be removed if they are known nesting trees or are within defined buffers; instead, Northwest would shift the temporary construction workspace.

Noise and presence of construction equipment would cause wildlife, such as birds and larger mammals, to leave the vicinity of the construction activities. Some smaller, less mobile wildlife, such as small mammals, amphibians, and reptiles, could be injured by construction equipment or trapped in trenches.

Seven bird species that may occur within the WEP area are considered migratory birds of concern by the FWS. We are recommending that Northwest consult with the FWS to develop a Migratory Bird Conservation Plan prior to beginning construction.

The existing right-of-way has been maintained as herbaceous or low shrub community for more than 50 years; therefore, construction and operation of the WEP would not substantially alter the local wildlife populations. Vegetation maintenance would occur outside of bird nesting season (April 15 to August 1) according to Northwest's Plan. Northwest would limit public access to the permanent right-of-way through a series of measures that are already in place and include signage, fences, and gates where appropriate.

Operational noise disturbances along the pipeline would be limited to relatively infrequent maintenance activities, including aerial inspection, driving the alignment to perform visual inspection, mowing, and the use of chainsaws and other equipment. These noise effects would be temporary and localized. Operation of the WEP would not be expected to alter existing migration routes or wildlife movement. The proposed modifications at the existing, fenced-in compressor station yards would not result in additional operational impacts on wildlife and wildlife habitat.

5.1.8 Threatened, Endangered, and Other Special Status Species

As the lead federal agency in conducting the NEPA analysis, FERC is also analyzing project-related activities authorized by the USACE and recommended by the Coast Guard that would potentially affect federally listed endangered and threatened species. In compliance with Section 7 of the ESA and the MSA, FERC will submit a combined BA and a combined EFH assessment for the Oregon LNG Project and the WEP to the NMFS and FWS prior to issuance of the final EIS. The BA and EFH assessment will detail the environmental baseline for federally listed species, designated critical habitat, and EFH; direct, indirect, interdependent and interrelated, and cumulative effects; proposed conservation measures; and determinations of effect. A general summary of the information that will be included in the BA and EFH assessment is included in sections 4.1.8 and 4.2.8 of this EIS. Because our consultation with the NMFS and FWS and preparation of the BA is in progress, our final determinations regarding the effects on species are preliminary.

Oregon LNG conducted biological surveys and Northwest's surveys are ongoing. We will use the results of these surveys to develop our BA. To assess potential impacts on special status species and designated critical habitat, FERC staff informally consulted with the ODFW and WDFW. Our consultation with NMFS and FWS is in progress. We have assessed the potential effects on federally listed species separately for each project. In cases where a species range overlaps with both projects, we present effect determinations specific for each project; these effect determinations may differ between the projects depending on likelihood of species occurrence and the proposed work. Therefore, we also provide an overall effect determination for these overlapping species in the cumulative effects section (see section 5.1.14).

5.1.8.1 Oregon LNG Project

Based on agency input and our analysis of the project, we preliminarily conclude that the Oregon LNG Project would ***not likely adversely affect*** 15 federally listed species and would ***likely adversely affect*** 21 federally listed species (see section 4.1.8). Of the 21 species likely to be adversely affected, 12 species (3 whales and 9 fish) would be associated with the terminal and LNG marine traffic, 2 species (1 bird and 1 plant) would be associated with the pipeline, and 7 species (1 bird and 6 fish) would be associated with the terminal and LNG marine traffic and the pipeline.

During operation, there would be a low probability of LNG marine carriers striking federally listed whales. To further minimize the chance of whale strikes, Oregon LNG would incorporate vessel strike avoidance measures into terminal use agreements with operators of LNG marine carriers. Construction of the terminal and pipeline would impact habitats used by federally listed fish species for migration, foraging, and spawning. Oregon LNG has proposed mitigation actions to compensate for unavoidable impacts on listed fish and their habitat through restoration of off-channel habitat in Youngs Bay and removal existing fish passage barriers. Clearing for forest land for pipeline construction could reduce available habitat for forest dwelling bird species listed under the ESA. Oregon LNG has selected a pipeline route to avoid old growth forest and would compensate for the loss of younger forests by purchasing large tracts of forest land that would be managed for conservation. No rare plants have been identified by Oregon LNG during surveys to date, but comprehensive surveys have yet to be completed due to limits on access to private property. The likelihood of rare plants occurring on unsurveyed lands is low and Oregon LNG would conduct preconstruction surveys to verify the absence of plants before ground disturbance.

Although the proposed project would adversely affect 21 federally listed species, we do not conclude that these effects would cause long-term effects that would affect the survival and/or recovery of the species or their critical habitat.

Oregon and Washington also list species under state ESA laws, of which 14 species may occur in the project area. These include one marine mammal, four birds, one reptile, and eight plants that are either listed as threatened, endangered, or candidate species The likelihood of LNG marine carriers striking grey whales is low as LNG marine carriers would cross state territorial seas at slow speeds at they approach or leave the terminal. Impacts on state-listed birds (Aleutian Canada goose, brown pelican, purple martin, and vespar sparrow) would be reduced by measures proposed by Oregon LNG to mitigate impacts on migratory birds. Impacts on the northwestern pond turtle would be avoided by using HDD to cross high value wetlands. Impacts on rare plants are unlikely as Oregon LNG conducted rare plant surveys in 2008 and 2013 for the terminal and pipeline and no state-listed plants were observed.

Oregon LNG's Conceptual Mitigation Plan contains a variety of mitigation measures, including off-site compensatory mitigation; on-site mitigation, avoidance, and minimization measures; and adaptive management strategies for federally listed species. We are recommending that Oregon LNG file its final Mitigation Plan, developed in consultation with USACE, ODFW, FWS, WDFW, and NMFS, prior to construction.

We are in the process of completing our BA, our consultation with FWS and NMFS is in progress, and our final determination regarding the effects on species is pending. Therefore, we are recommending that no ground disturbance occur until we have completed our Section 7 ESA consultation with the FWS and NMFS.

5.1.8.2 WEP

Based on agency input and our analysis, we preliminary conclude that the WEP would have ***no effect on*** gray wolves and would cause no long-term effects that would affect the survival and/or recovery of the species. We determined that the WEP would ***not likely adversely affect*** 13 federally listed species and would ***likely adversely affect*** 6 federally listed species. The species that the project would likely adversely affect are fish. There are 11 federally listed species potentially occurring in both the Oregon LNG Project area and the WEP area. These include four birds, five fish, and two plants.

Adverse impacts on federally listed species are mainly associated with waterbody crossings and riparian vegetation removal. Northwest would use HDD or direct pipe methods to cross most major waterbodies to avoid impacts on several species of federally listed fish. In addition, we are recommending that Northwest evaluate using HDD methods to cross two waterbodies that support bull trout, and consult with WDFW, NMFS, and FWS for habitat improvement features at waterbody crossings.

Although the proposed project would adversely affect six federally listed species, we do not conclude that these potential effects would cause adverse, long-term effect that would affect the survival and/or recovery of the species or their critical habitat.

We are in the process of completing our BA, our consultation with FWS and NMFS is in progress, and our final determination regarding the effects on species is pending. Therefore, we are recommending that no ground disturbance occur until we have completed our Section 7 ESA consultation with the FWS and NMFS.

Washington's state ESA laws list 24 species as endangered and 17 species as threatened statewide. Of these, two mammals, three birds, one amphibian, one reptile, three invertebrates, and one plant may occur along the WEP. Impacts on state-listed mammals (fisher and western gray squirrel) are unlikely as these species require mature forest that does not occur within or adjacent to the existing maintained pipeline right-of-way. Likewise, impacts on state-listed birds that rely on mature forests (marbled murrelet and northern spotted owl) are also unlikely. Impacts on the ground nesting streaked horned lark may occur if nests in agricultural areas are disturbed during construction, but Northwest would conduct preconstruction surveys to detect areas of active nesting and delay construction of that portion of the pipeline accordingly. Impacts on the Oregon spotted frog and northwestern pond turtle would be minimized by using HDD to cross sensitive wetlands and riparian areas.

Impacts on state sensitive fish (Pacific and river lamprey, Olympic mud minnow, leopard dace, and kokanee salmon) would be minimized by use of HDD to cross sensitive waterbodies. At open-cut waterbody crossings, state listed fish could be exposed to increased turbidity, habitat loss, and direct mortality. However, Northwest would implement measures contained in its Plan and Procedures and ECRP to reduce impacts from waterbody crossings. Impacts on state-listed invertebrates (Taylor's checkerspot butterfly, mardon skipper, and Oregon silverspot butterfly) are unlikely as their preferred habitats are not present in Northwest's existing right-of-way. Similarly, impacts on the hairy-stemmed checker-mallow are unlikely as Northwest conducted a rare plant survey in 2014, and no state-listed plants were detected in the project area.

5.1.9 Land Use, Recreation, and Visual Resources

5.1.9.1 Oregon LNG Project

Land uses impacted at the terminal include open space, wetlands, existing rights-of-way, and small amounts of residential and commercial/industrial. As part of the CZMA process, Oregon LNG must demonstrate that the portion of the Oregon LNG Project in the Oregon coastal zone would be consistent with the statewide planning goals, applicable local comprehensive plans, land use regulations, and selected state authorities. We are recommending that prior to construction, Oregon LNG file with FERC documentation of concurrence from the ODLCD that the Oregon LNG Project is consistent with the CZMA. The terminal site would be on a 96-acre parcel of land, which is owned by the State of Oregon and leased to the Port of Astoria by the ODSL, which subleases the parcel to LNG Development Company, LLC. The USACE is currently in litigation (quiet title action) with LNG Development Company, LLC in the U.S. District Court for the District of Oregon, Portland Division over which party has superior title to the terminal site.

The FAA determined the terminal facilities would not pose a hazard to air navigation. Under the terms and conditions of the FAA determination, Oregon LNG would place navigation lights on the LNG storage tanks and minimize the overall height of the tanks by mounting any ladders, walkways, valves, and vent lines on the side of the storage tanks. In addition, Oregon LNG would upgrade the radio navigational system at the Astoria Regional Airport. These measures would allow for the intrusion of the LNG storage tanks into the navigation airspace without disrupting visual or instrument flight paths.

The Lower Columbia River Water Trail and LCNHT would be within 0.25 mile of the terminal and would experience minor, temporary and short term traffic increases, dust, odors, and noise during construction. The terminal would not be visible from the Fort Clatsop Interpretive Center but may cause minor visual impacts for recreational visitors at other locations within the LCNHP, such as the Dismal Nitch and Station Camps, and at Fort Columbia State Park. The storage tanks, pier, and berthed carriers

would be visible from the Youngs Bay Bridge; however, views from the bridge would be from moving vehicles and of short duration.

Construction and operation of the terminal would not impact the marinas near the terminal and along the LNG marine carrier transit route within the Columbia River or commercial and recreational boats when moored in the marinas. However, recreational vessels would be restricted from the construction area during construction and from the 200-yard security zones at the terminal during operation. The security zones would present a minor inconvenience relative to the size of the river at this location. Construction of the terminal is not anticipated to affect commercial river uses in the federal navigation channel. During operations, the moored LNG marine carrier and security zone around the LNG marine carrier while the carrier is moored at the facility would not impact the movement of vessels in the shipping channel, nor would it limit movement in and out of the Skipanon Waterway.

The terminal would be visible from locations near Tansy Point. The presence of the LNG storage tanks and the offshore facilities (trestle and pier) would be noticeable and would change the visual quality of the area. From the Warrenton Boat Basin area, the most visible components of the terminal would be the tops of the LNG storage tanks and the 230-kV power line. The tops of the tanks would be seen from areas within and near the boat basin, but would not dominate views. The LNG storage tanks would be more visible from the waterway than from the boat basin. The terminal would not significantly change the visual quality of views from the waterway because the west side of the waterway presently includes industrial uses. The terminal would have little effect on the visual quality of most of the Astoria area. Components of the terminal would be seen to varying degrees from within the viewshed. At night, FAA-required lights on the LNG storage tanks would potentially be seen, as would navigation lights on the offshore facilities and berthed carriers. Operational lighting associated with the liquefaction facilities and cooling towers would also be visible from the Astoria area.

Oregon LNG's mitigation measures to reduce the visual impacts of the terminal components would include: coloring the tanks and other structures to mimic nearby colors in the landscape, screening facilities from views outside of the terminal area, and controlling potential impacts associated with lighting, including a dual aviation lighting system to reduce visual impacts at night. We conclude that the terminal would change the visual character of the East Skipanon Peninsula. Although the terminal facilities would introduce a new element into the viewshed, it would not appear out of character with the existing industrial facilities that are also visible along the shoreline in this area.

Land uses impacted by pipeline construction and operation include forest, agricultural, wetlands, existing rights-of-way, open space, open water, commercial/industrial, and residential. The pipeline would cross scenic Highways 101 and 26 by HDD. The permanent right-of-way along the HDD segment would not be cleared during construction or maintained by mowing during operation; therefore, impacts on the visually-sensitive corridor would not occur. Highway 30 would be crossed perpendicular to the highway right-of-way using the conventional bore technique. Impacts on the visually sensitive corridor of Highway 30 would be temporary in nature as some trees on the west side of Highway 30 would be removed and the area replanted with trees after construction is complete. The section of Washington State Scenic Byway (I-5) that would be crossed by the pipeline is also designated as the Lewis and Clark Trail State Scenic Highway. The I-5 crossing would be constructed using the conventional bore technique perpendicular to the highway. Aside from the temporary visual impacts from construction, the perpendicular right-of-way would only briefly be visible by passing motorists, and no portion of the pipeline itself would be visible once construction is complete.

The Oregon LNG pipeline would not cross any known landfills or hazardous waste sites, although the Astoria Marine Construction Company Superfund site is about 300 feet northeast of an HDD

crossing of the Lewis and Clark River. The HDD would exit beyond the Superfund site area, and would not disturb contaminated sediments in the streambed.

In general, impacts on the Clatsop and Tillamook State Forests, including Four County Point Monument and Four County Point Trail, would be temporary and would be limited to the period of active construction. Oregon LNG would continue to coordinate with ODF to investigate mitigation options to reduce the temporary workspace and temporary impacts on recreational activities. There would be a loss of timber production, both short- and long-term, in the state forests due to development of the pipeline.

In addition to the state forests, several other recreation areas would be crossed by the pipeline. The pipeline would cross the LCNHT by HDD, avoiding physical and visual impacts. We are recommending that Oregon LNG develop a plan to mitigate impacts on users of Lions Day Park. Oregon LNG has indicated it would work with the City of Woodland to minimize impacts on a proposed park and sports complex that would be crossed by the pipeline. Most of the pipeline route would avoid residential areas. Oregon LNG would implement site-specific construction plans and mitigation measures at the two residences that would be located within 50 feet of the pipeline construction workspace.

Oregon LNG would clear vegetation during construction of the pipeline resulting in both short-term and long-term impacts on visual resources, depending on the type of vegetation that is removed. After pipeline installation, Oregon LNG would recontour and revegetate the landscape to as near to preconstruction conditions as possible.

The compressor station would include visual screening along its western/southwestern side to help screen views from Highway 30 and other areas farther west. Existing, mature vegetation would also screen views of the compressor station along the north, east, or south sides of the site, including areas along both sides of Deer Island Slough.

With implementation of Oregon LNG's proposed impact avoidance, minimization, and mitigation plans, and our recommendations, we conclude that overall impacts on land use and visual resources would be adequately minimized.

5.1.9.2 WEP

About 94 percent of the WEP pipeline would be constructed within Northwest's existing pipeline right-of-way. About half of the land that would be affected by construction would be within Northwest's existing pipeline right-of-way or within the existing compressor station footprints. Land uses that would be impacted include forest, agricultural, wetlands, existing rights-of-way, barren land, open water, commercial/industrial, and residential.

Construction of the pipeline would temporarily preclude agricultural use within the construction right-of-way and ATWS. Depending on the nature of the plants cultivated and right-of-way restrictions, operation of the pipeline would have limited to no permanent impacts on crops. Construction of the WEP would result in temporary impacts on industrial/commercial land use. There would be no permanent displacement of any businesses or other permanent impacts on industrial/commercial land use; however, no structures would be permitted on the permanent right-of-way.

About 740 residences would be within 50 feet of the construction right-of-way and ATWS, and Northwest has prepared site-specific construction plans for these residences. Northwest would reduce or offset the construction right-of-way for short distances to avoid houses and minimize impacts. Construction and operation of the WEP would not result in the permanent displacement of any residences;

however, depending on the specific circumstances, Northwest may pay to relocate residents during construction activities.

Eighteen schools, colleges, or learning institutions would be within 2,000 feet of the WEP. The majority of the loops would be constructed during the summer when school is not open and Northwest has prepared site-specific mitigation plans for four schools where the construction right-of-way would be within 25 feet of school property. With Northwest's proposed mitigation measures, we conclude that impacts on schools would be minor.

If the WEP is authorized by the Commission, Northwest would need to demonstrate that its project is consistent with the CZMA before FERC would allow any construction activities to begin. Various permits for development within designated shorelines would be required under county Shoreline Master Programs and the counties may require additional mitigation as a condition of the permits.

Twenty sites listed in WA Ecology's Cleanup Site Search database would be crossed by the pipeline or be within construction work areas. Most of these are cleanup sites and temporary construction stormwater sites. If contaminated soils or groundwater are encountered during construction, Northwest would follow protocol in its Unanticipated Discovery of Contamination Plan.

The WEP would cross three scenic highways and one memorial highway by boring and impacts would be minimal. Several parks and trails would be affected by the WEP, primarily by temporary construction impacts that would include traffic delays and temporary road and trail detours or closures and temporary park closures. Following construction, Northwest would restore disturbed areas to preconstruction conditions and recreational activities would continue as before construction. We are recommending that Northwest develop and file final site-specific construction plans for each affected recreation area prior to construction.

Because the majority of the WEP would be constructed within Northwest's existing pipeline right-of-way and Northwest would implement measures to mitigate impacts in residential areas, near schools, and in recreational areas, we conclude that impacts on land use would be mostly minor and temporary.

Typical construction practices such as vegetation removal, trenching, and equipment and soil storage would cause minor temporary impacts on visual resources; however, there would be some long-term impacts on visual resources where mature trees are removed. In general, visual impacts would be minor because 94 percent of the pipeline would be constructed within Northwest's existing pipeline right-of-way.

5.1.10 Socioeconomics

5.1.10.1 Oregon LNG Project

Construction of the terminal would occur over a 48-month construction period. Terminal construction would stimulate about 9,584 jobs (direct, indirect, and induced) in Oregon, including about 2,755 direct jobs. About 2,480 construction workers would come from Oregon and Washington, with about 1 in 10 of those construction jobs (248 direct jobs) filled by people currently living in Clatsop County. Total direct construction costs for the LNG terminal would be about $5.8 billion. Direct personal income (including both wages and benefits) for the construction of the terminal facilities would be about $2.3 billion.

Oregon LNG would directly employ about 145 workers for terminal operations, which would generate over $14 million in direct net personal income annually. About 772 indirect jobs and 654 induced jobs would be created in Oregon and southwest Washington, generating over $86 million annually in personal income and $310 million in output.

The construction and operation of the LNG terminal would have positive economic benefits for the local communities because the project would generate direct and indirect jobs, income from wages, purchases, rental of housing, and taxes, which would help future growth and output in Clatsop County. Construction and operation of the LNG terminal would not significantly affect the availability of housing in the terminal area.

Oregon LNG estimates that the property tax from the terminal would generate about $51.9 million in average revenue annually. In total, construction would yield $219.8 million in Oregon income tax. Operation-related income taxes would total about $4.6 million annually for the life of the project, which is at least 60 years. Oregon LNG estimates that the corporate income tax and business and occupancy tax would be about $4.0 million total during terminal construction and $7.5 million during terminal operation.

In accordance with the EPAct, Oregon LNG's ERP must offer a Cost-sharing Plan, and outline how Oregon LNG would fill resource gaps and supplement the first-responder capabilities of the local jurisdictions. Oregon LNG would be required to file a final ERP including a Cost-sharing Plan prior to the beginning of project construction activities.

Potential conflicts between LNG marine carrier and cruise ship schedules would be avoided by coordination of inbound and outbound transit details between the Coast Guard, bar and river pilots, escort tug masters, and other escort assets 24 hours prior to arrival. The 200-yard security zone around the LNG marine carrier while the carrier is moored at the facility would not impact the movement of vessels in the shipping channel or the Skipanon Waterway. Oregon LNG has committed to funding the acquisition of additional communication equipment currently missing from commercial fishing vessels permanently moored in the project area and that is necessary for communicating with the Coast Guard about pending LNG marine carrier transits. Therefore, we conclude that LNG marine carrier traffic would not significantly impact other vessel traffic on the Columbia River.

There are currently no designated tribal fishing grounds below the Bonneville Dam, but the fish populations that support the Treaty Indian Fishery do migrate through the lower Columbia River estuary. No significant adverse impacts on Native American treaty fishing rights are anticipated as a result of the project.

Construction of the Oregon LNG terminal would affect roadway transportation and traffic in the project area by increasing the number of vehicle trips per day on area roads as a result of worker commuting and construction vehicle traffic. We are recommending that Oregon LNG work with the City of Warrenton and ODOT to prepare a Terminal Construction Traffic Management Plan. Operations would not contribute a large amount of traffic to the terminal area; however, intersections with already low levels of service could worsen during the first year of operations.

Construction and operation of the pipeline facilities would have a beneficial impact on the local economy. Pipeline construction would stimulate about 256 direct jobs in Oregon and Washington with payroll of $195 million. Total direct construction costs for the pipeline facilities would be about $680 million. Construction of the pipeline would stimulate about 515 indirect and induced jobs with $125 million in personal income, and $407 million in output. During operation, Oregon LNG would

directly employ about 4 workers to operate the compressor station. Pipeline operations would generate over $167 million per year in total output (including indirect and induced). Oregon LNG has estimated that total pipeline property taxes would be about $5 million. Construction and operation of the pipeline would not significantly affect the availability of housing in the project area.

Construction of the pipeline would affect transportation and traffic in the project area by increasing the number of vehicle trips per day on area roads as a result of commuting and construction vehicle traffic as well as temporary closures of some minor roads. Little or no disruption of traffic would occur at roads that are crossed by bore or HDD. Oregon LNG would develop a Traffic Mitigation Plan to manage and alleviate temporary impacts from pipeline construction traffic. Operation of the pipeline would not result in traffic impacts.

Based on analysis of demographic data showing there are no predominantly low-income or minority populations in the vicinity of the project facilities, construction and operation of the terminal and pipeline would not cause a high and disproportionate adverse effect on environmental justice populations.

5.1.10.2 WEP

The WEP would create economic benefits for local communities by generating additional tax revenue, employment opportunities, and local expenditures by workers. Construction of the WEP would require about 1,400 workers, with a maximum of 350 people working on any one spread at any one time. Northwest estimates that up to 30 percent of the workforce would consist of local hires and 70 percent nonlocal hires. As pipeline construction would be distributed along eight counties, the project is not expected to have a significant impact on the local population or housing in any of the eight counties. Operation of the WEP would not require additional permanent employees as existing Northwest staff would operate the new loops and compressor station modifications along with the existing Northwest pipeline system.

Northwest estimates that property tax would generate about $12.9 million in annual revenue. These taxes would be assessed at the county level and are based on the percentage of total pipeline mileage in a given county.

Temporary impacts on traffic during construction would result from the workforce commuting daily to the construction site. The number of construction vehicle trips would be low on any particular roadway at any one time because staging areas and construction spreads would be distributed along the pipeline route and construction would move sequentially along the construction right-of-way. To maintain safe conditions and minimize impacts on roads, construction workers would use only designated public roads and approved access roads on private lands for access to the right-of-way and compressor stations.

The pipeline would be located within an existing pipeline right-of-way that crosses areas of varied minority and low-income population compositions, and the existing compressor stations that would be modified are also in areas of varied minority and low-income population compositions. We conclude that potential adverse impacts of the project would not unduly or disproportionately affect environmental justice populations.

5.1.11 Cultural Resources

5.1.11.1 Oregon LNG Project

A review of historic maps and photographs indicates that the northern end of the East Skipanon Peninsula, where the proposed LNG terminal would be located, did not exist prior to 1900. This area was created through the disposal of dredged materials, mostly since the 1930s. No cultural materials were found during an archaeological survey of a portion of the proposed LNG terminal site in 1976 for another project or in geotechnical trenches conducted at the terminal site by Oregon LNG. No shipwrecks have been identified in the immediate area of Oregon LNG's terminal marine facilities. Oregon LNG consulted with Oregon SHPO on January 7 and 9, 2009, and the SHPO indicated that a submerged archaeological investigation would not be required for the 152 offshore acres covering the pier, berth, and turning basin.

We have determined that LNG marine traffic in the waterway to the Oregon LNG terminal would not adversely affect historic properties along the waterway because of shoreline erosion or an oil or fuel leak from an LNG marine carrier. Because of Oregon LNG's mitigation measures for LNG marine carriers in the waterway, and the Coast Guard's risk mitigation recommendations, including a vessel traffic management system, LNG marine traffic should not have an adverse effect on the setting or association of the LCNHT near the mouth of the Columbia River. LNG marine carriers would be visible to visitors at various elements of the LCNHP along the shore of the lower Columbia River for several minutes at a time. These carriers would represent only a minor increase to the current use of the river by commercial vessels, so the viewshed would not be altered or cause a change from the present situation.

Oregon LNG conducted cultural resources surveys for the majority of the proposed pipeline route and associated ancillary facilities. The portion of the pipeline route between MPs 82.0 and 86.8 and parcels where landowners denied access could not be surveyed. Six sites were identified and submitted to the Oregon SHPO for review and concurrence on recommendations. If a Certificate is issued, Oregon LNG would conduct additional investigations on these sites, as well as between MPs 82.0 and 86.8. If the additional investigations were to indicate any of these six sites are eligible for listing in the NRHP, Oregon LNG would consider modifications to the project to avoid them. If the sites could not be avoided due to terrain or construction constraints, further investigations would be required to mitigate any adverse effect that would occur. Oregon LNG would implement its Discovery Plan if unanticipated cultural resources or human remains are encountered during project construction.

We do not expect the project to have any impact on previously recorded sites within the indirect APE (1.0 mile from the pipeline). The easternmost boundary for the LCNHP is about 0.6 mile west of the direct effects APE. Features within the LCNHP, such as the reconstruction of Fort Clatsop, are at least 0.9 mile west of the direct effects APE. The pipeline should have no impacts on the LCNHP.

The FERC staff consulted with Native American tribes to identify cultural or religious properties of importance to tribes that may be affected by the project. Oregon LNG has not yet produced the ethnographic studies requested by specific tribes to address potential project impacts on traditional cultural properties. Therefore, we are recommending that Oregon LNG not begin construction until it has filed the ethnographic studies; remaining cultural resources surveys; site evaluation reports and avoidance or treatment plans, as required. Further, we are recommending that Oregon LNG not begin construction until it has filed the tribes' and SHPOs' comments on its reports, studies, and plans, and the ACHP has commented on whether historic properties would be affected.

5.1.11.2 WEP

Northwest defined the APE for archaeological sites as a 200-foot-wide corridor centered on the pipeline. Northwest identified 16 previously recorded cultural resource sites within the APE. Eight of the previously recorded sites are recommended to be not eligible for the NRHP, requiring no further work. Four sites are unevaluated and require additional investigations. Four sites were evaluated as eligible for the NRHP, and Northwest would file a treatment plan for those historic properties.

In 2012, Northwest surveyed a 200-foot-wide corridor along 73.5 miles of pipeline for the WEP that had not been adequately covered by previous archaeological surveys. Five sites were documented, three were evaluated as not eligible for the NRHP, and no further work was recommended. Two sites were unevaluated, one of which would be avoided and the other would need archaeological testing.

Supplemental surveys to address design changes identified two previously recorded archaeological sites at two proposed ATWS. Northwest recommended further investigations at those locations to assess potential project effects.

The FERC staff consulted with Indian tribes to identify cultural or religious properties of importance to tribes that may be affected by the project. No Native American sacred, ceremonial, cultural, or religious sites, or burials were identified in the APE by Northwest, tribes, the BIA, the SHPO, the Washington Governor's Office of Indian Affairs, or the NPS.

To date, no comments have been received from the Washington SHPO or the contacted tribes regarding the findings of the original *Washington Expansion Project Cultural Resources Overview and Survey Repor*t and Discovery Plan. We cannot make official determinations of eligibility for cultural resources identified in the APE until after the SHPO and tribes comment. The Washington SHPO did review Northwest's revised addendum survey report and stated that no historic properties would be affected at the Highway 410 Reroute and 91 ATWS.

We are recommending that Northwest file documentation with the Secretary indicating that SHPO and the tribes approved its Discovery Plan. We are also recommending that Northwest not begin construction until the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and the FERC staff reviews and the Director of OEP approves remaining cultural resources reports, studies and plans, and notifies Northwest in writing that treatment measures may be implemented and/or construction may proceed.

5.1.12 Air Quality and Noise

5.1.12.1 Oregon LNG Project

Air quality impacts associated with the terminal construction would result from combustion of fuel-burning equipment/vehicles, fugitive dust associated with site preparation/grading and travel on the access road, and dredging activities. Construction emissions would not have a long-term impact on ambient air quality, and implementation of Oregon LNG's proposed emission control measures, as well as other measures specified by the ODEQ, would further reduce construction emissions.

Operation of the LNG terminal would result in direct air emissions from stationary equipment (liquefaction trains, heaters, flares, generators, pumps, etc.) and marine vessels (LNG marine carriers during loading and unloading operations). Emissions from the LNG marine carriers and from harbor craft would occur during carrier and tug operations. Modeling results show that emissions from terminal

operations would not cause impacts exceeding the NAAQS or exceed the PSD increments. Indirect air pollutant emissions from LNG marine carriers and project-related harbor craft would be less than 0.01 percent of estimated calendar year 2000 global marine vessel emissions. Therefore, while marine vessel emissions from the project would have an impact on air quality, the additional marine vessels would be a very small contributor to air impacts on a global scale.

Construction of the pipeline and compressor station would have temporary adverse impacts on air quality from fossil-fuel burning and fugitive dust. Routine operation of the electrically powered compressor station would produce negligible air emissions. Along the pipeline route, leaks and venting could occur at the compressor station and potentially from small leaks at flanges and valves.

Oregon LNG would be required to meet all federal and state air quality permitting requirements as a condition of operation. With Oregon LNG's compliance with federal and state air quality permitting rules, including the installation of mitigation measures and technologies required to meet federal and state air quality regulations, we conclude that the project would not result in significant air quality impacts.

Construction activities associated with the terminal would contribute noise in and around the project area over a 48-month construction period. Construction noise levels would vary depending on the construction phase, equipment quantities, and equipment locations. With the exception of pile-driving, perceptible increases in noise at NSAs as a result of terminal construction activity are not predicted by noise modeling. Pile driving would be limited to daytime hours and is anticipated to last 2 to 3 months.

The results of the conceptual operational noise analysis performed for the terminal show that the terminal would likely comply with the most restrictive noise limits for each NSA. Oregon LNG would refine the terminal operational noise analysis as the engineering design develops and include acoustical controls as necessary to ensure the terminal complies with the applicable noise limits. A detailed acoustical design would be developed as part of the final design process. We are recommending that Oregon LNG conduct a noise survey after the terminal is placed in operation and implement additional noise control measures if measured noise levels exceed limits at the nearest NSAs.

Construction activities associated with the pipeline and aboveground facility construction would contribute temporary noise in the areas close to the construction activity. Noise levels from individual construction equipment (such as trucks, bulldozers, backhoes, and side-boom tractors) would typically range from about 70 to 90 dBA at 50 feet from the source. Noise at any specific receptor would typically be dominated by the closest and loudest equipment, and the types and numbers of construction equipment near any specific receptor location would vary over time.

With the possible exception of HDD activities, construction work would be restricted to times between 7 a.m. and 7 p.m., Monday through Friday. Noise from HDD activities would impact the surrounding area and each drill would take from several days to weeks to complete. Although Oregon LNG currently proposes to limit HDD activities to daytime hours, site and soil conditions may require HDD activities at some locations to operate on a 24-hour basis. If 24-hour HDD activities are required, Oregon LNG would make all reasonable efforts to limit HDD noise to 55 dBA L_{dn}. We are recommending that Oregon LNG file an HDD noise mitigation plan prior to construction of any HDD crossing and implement this plan during HDD activities.

No noise is anticipated from operation of the pipeline. The primary source of aboveground facility operational noise would be the compressor station, and a secondary source would be the meter station at the pipeline interconnect. The compressor station would be a new noise source on a previously unused site. Oregon LNG has committed to incorporating acoustical controls to ensure the compressor

station would comply with the applicable noise limits. A suitable acoustical design would be developed as part of the final design process. We are recommending that Oregon LNG conduct a noise survey after placing the compressor station into service and install noise mitigation if necessary. With Oregon LNG's proposed mitigation measures and our recommendations, we conclude that the project would not result in significant long-term noise or vibration impacts at the nearest NSAs.

5.1.12.2 WEP

Construction of the WEP would result in temporary adverse impacts on air quality from fossil-fuel burning and fugitive dust. Pipeline construction is anticipated to occur over a 2-year period, while construction activities at each compressor station would take about 9 months.

During operation of the pipeline and the five modified compressor stations, emissions of criteria pollutants, GHGs, HAPs, and Washington-regulated TAPs would occur. Along the pipeline route, leaks and venting could occur at compressor stations and potentially from small leaks at flanges and valves. Emissions expected during operation of the pipeline would be relatively minor. No Federal Class I Areas would be impacted.

Northwest would be required to meet all federal and state air quality permitting requirements as a condition of operation. Northwest would comply with federal and state air quality permitting rules, including the installation of mitigation measures and technologies required to meet federal and state air quality regulations. Therefore, we conclude that the project would not result in significant air quality impacts.

During construction, Northwest would employ a combination of noise mitigation methods, including equipment noise controls and administrative measures, to minimize noise related to construction activity at NSAs near the WEP. These would include appropriate mitigation measures to achieve compliance during HDD installation operations and equipping haul trucks and other engine-powered equipment with adequate mufflers. Northwest would restrict timing of noisy construction or demolition work to 7 a.m. to 7 p.m. Monday through Saturday. We are recommending that Northwest file a noise mitigation plan prior to construction and implement this plan during HDD or direct pipe construction activities.

The pipeline would not be a meaningful source of noise during normal operation. The primary source of operational noise for the WEP would be the modified compressor stations. Northwest would be required to meet the most restrictive noise level limits established by jurisdictional agencies. The FERC limit of 55 dBA L_{dn}, which is equivalent to a continuous noise level of 49 dBA, is more restrictive than the state of Washington limits and would be the governing limit for those areas where a more restrictive county, local, or station-specific regulation does not exist. Northwest would implement mitigation measures at each site to ensure that the applicable standards are met at the nearest NSA. New turbines would be installed in acoustically rated buildings or enclosures that are designed to mitigate equipment vibrations from being transmitted off site. We are recommending that Northwest conduct noise surveys after completing the compressor station modifications to confirm that noise standards are met. With Northwest's proposed mitigation measures and our recommendations, we conclude that the project would not result in significant noise or vibration impacts at the nearest NSAs.

5.1.13 Reliability and Safety

5.1.13.1 Oregon LNG Project

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design, we conclude that the facility design proposed by Oregon LNG plus our recommended mitigation would provide acceptable layers of protection or safeguards which would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

As a cooperating agency, DOT assisted FERC staff in evaluating Oregon LNG's proposed design. On October 2, 2014, DOT provided a letter to FERC staff stating that DOT had no objection to Oregon LNG's methodology for determining the single accidental leakage sources for candidate design spills to be used in establishing the Part 193 siting requirements for the proposed LNG liquefaction facilities. DOT further clarified these design spill details to FERC staff in an email communication on April 1, 2015. Based on the hazardous area calculations we reviewed, we conclude that potential hazards from the siting of the facility at this location would not have a significant impact on public safety. The areas impacted by these design spills also appear to meet the DOT's exclusion zone requirements by either being within the facility property boundary, within land controlled by Oregon LNG, or over a navigable body of water. If the facility is constructed and becomes operational, the facility would be subject to DOT's inspection and enforcement program. Final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by DOT staff.

As a cooperating agency, the Coast Guard analyzed the suitability of the waterway for LNG marine traffic. Based on its review and its own independent risk assessment, the Coast Guard has determined that the waterway could be made suitable for the type and frequency of LNG marine traffic associated with the proposed import/export LNG facility. This opinion was contingent upon the availability of additional measures necessary to responsibly manage the maritime safety and security risks. If appropriate resources are not in place prior to LNG marine carrier movement along the waterway, the Coast Guard would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

The Oregon LNG pipeline would be built and inspected according to DOT safety standards. These standards protect against risks posed by pipeline facilities.

5.1.13.2 WEP

The WEP would parallel Northwest's existing facilities and Northwest currently meets routinely with affected fire departments and other emergency responders along its existing pipeline route. Northwest has an emergency response plan for its existing pipeline that it would update prior to construction. The WEP pipeline would be built and inspected according to DOT standards. These standards protect against risks posed by pipeline facilities.

5.1.14 Cumulative Effects

Past, present, and reasonably foreseeable actions could potentially contribute to a cumulative impact when considered with the proposed projects. Each of the projects considered would result in temporary and minor effects during construction, but each project would be designed to avoid or minimize impacts on water quality, forest and marine resources, and wildlife. Additionally, potential

impacts on sensitive resources resulting from these projects would be mitigated, as appropriate, and mitigation generally leads to the minimization of cumulative impacts.

The projects would have cumulative impacts on federally listed species, including certain fish, whales, marbled murrelets, and northern spotted owls. The Oregon LNG pipeline would cross 21 waterbodies[1] that may provide habitat for federally listed fish and the WEP would cross 32 waterbodies[2] that may provide habitat for federally listed fish, for a total of 53 waterbodies. Reasonably foreseeable actions such as utility corridors, roads, and urban development would likely affect these same waterbodies, but would be unlikely to do so at the same time and in the same location as the proposed projects.

LNG marine carrier traffic combined with other reasonably foreseeable actions would increase current ship traffic in the lower 11 miles of the Columbia River by about 10 percent. This would amount to about 25 ships per month and would pose a whale strike risk of about 0.2 individuals per year per species compared to 0.02 individuals per year, per species for the Oregon LNG Project alone.

The Oregon LNG Project and the WEP would result in incremental loss of late successional forests or forests that could become late successional during the life of the projects; therefore, we conclude the projects would have cumulative adverse effects on northern spotted owl and marbled murrelet. Most of the impacts are associated with the Oregon LNG Project, and Oregon LNG plans to mitigate impacts by acquiring large tracts of forest land in the Coast Range to be managed for future spotted owl and marbled murrelet habitat.

Construction of the Oregon LNG Project and the WEP, along with other reasonably foreseeable actions, would cumulatively result in impacts on forest land, particularly in Oregon. Timber operations would not be able to continue within a portion of the permanent rights-of-way for these projects or other utilities; thus, the addition of new utility corridors or widening of existing corridors would segment and lessen the amount of available timberland available for active forest management.

If construction of the terminal were to occur concurrently with other reasonably foreseeable actions, temporary housing may be slightly more difficult to find and/or more expensive to secure in Warrenton and Astoria during the summer tourist season. Housing along either Oregon LNG's or Northwest's pipeline would not be significantly affected by the influx of out-of-town workers. Even considering other construction actions occurring at the same time, the counties crossed by the Oregon LNG Project and the WEP are expected to be able to accommodate the additional temporary workforce.

Five of seven intersections studied in the terminal area are currently failing to meet operational standards. Traffic from other construction actions that may occur during construction of the terminal would add to the already mounting congestion. Warrenton has plans for park, trail, street, utility, and marina improvements, but construction years are not certain. For the purposes of evaluating long range cumulative impacts, traffic conditions were projected into the future both with and without the presence of the Oregon LNG terminal and assuming no mitigation. The volume to capacity ratios and delays at the studied intersections generally showed slightly higher numbers with the terminal present, but the overall level of service was the same as conditions without the terminal present. Therefore, the analysis projects that operations associated with the proposed terminal would not have significant cumulative impacts on future traffic conditions.

[1] The following are counted as one waterbody each: Lewis and Clark River is crossed four times, Nehalem River twice, Rock Creek twice, and Milton Creek twice.
[2] Saar Creek is crossed twice, but counted as one waterbody.

Construction of the Oregon LNG pipeline and the WEP would temporarily impact localized areas of traffic, and these impacts could be cumulative if other actions were occurring in the vicinity at the same time. Operation of the Oregon LNG pipeline and the WEP would not contribute to cumulative traffic impacts. In general, the Jordan Cove LNG terminal and Pacific Connector Pipeline Project is too far from the Oregon LNG Project and the WEP to be relevant for cumulative impacts. However, it would affect some of the same federally listed species and their habitats. The LNG marine carrier traffic would incrementally increase the cumulative impacts of whale strikes.

We recognize that unanticipated incidents during construction or operation could result in potential undefined impacts; however, a meaningful evaluation of those potential impacts is impossible, as quantification of potential impacts would be speculative at best. Accordingly, we consider project monitoring and mitigation programs to be critical in addressing unanticipated impacts, should they occur. With Northwest and Oregon LNG's construction and operation methods, and strict adherence to our recommendations for additional mitigation made in the EIS, federal and state regulations, and permitting requirements, impacts associated with the projects would be minimized, and would not constitute a significant impact in combination with other past, present, or reasonably foreseeable projects.

5.1.15 Alternatives

For both the Oregon LNG Project and the WEP, we evaluated the No Action Alternative, system alternatives, LNG facility design and siting alternatives, dredging alternatives, pipeline route alternatives and variations, and aboveground facility site alternatives, as appropriate.

The No Action Alternative would eliminate or delay the short and long-term environmental impacts identified in this EIS, but the objectives of the projects would not be met. Oregon LNG would be unable to export Canadian-sourced natural gas (and to a lesser extent U.S.-sourced gas from the Rocky Mountain region) to foreign markets as well as facilitate the availability of such gas supplies for delivery to Pacific Northwest markets. If the No Action Alternative were selected for the Oregon LNG Project, the WEP would likely not be constructed as currently proposed. The No Action Alternative for the WEP would cause Oregon LNG to either pursue other means of obtaining natural gas supply, which would require construction of additional pipeline facilities, or not to construct the Oregon LNG Project.

Our analysis of system alternatives included an evaluation of existing pipeline systems as well as existing and proposed LNG facilities that could be used to meet the stated objectives of the proposed projects. Existing pipeline system alternatives would involve the use of all or portions of other natural gas transmission systems in lieu of constructing the Oregon LNG pipeline and the WEP. However, existing pipeline systems would need to be expanded to reach the Oregon LNG terminal, and a system alternative that replaced the WEP would require construction of new pipeline, which would result in significantly greater environmental impacts than the proposed action. Therefore, we do not consider other proposed or existing pipeline systems to be reasonable system alternatives to the projects. We also determined that none of the existing or proposed LNG facilities would be an economically or practically feasible alternative to the Oregon LNG Project and the WEP.

For the WEP, we considered the system alternative of replacing Northwest's existing 30-inch-diameter pipeline with a larger-diameter pipeline; however, this could not be done without significant loss of service. Additionally, this alternative would result in greater temporary environmental impacts. We also considered the alternative of placing Northwest's abandoned 26-inch-diameter pipeline back into service, but this alternative would not be feasible due to inadequate capacity and uncertainties about the integrity of the pipeline.

We reviewed a number of site alternatives for the LNG terminal, including the offshore option. An offshore LNG terminal alternative would avoid some of the environmental impacts associated with LNG marine carriers, certain visual effects, and impacts related to dredging. Considering the additional impacts on marine resources, and safety and constructability issues associated with winter sea and weather conditions off the Oregon Coast, we do not consider an offshore terminal to be a reasonable alternative to the Oregon LNG Project.

After a regional screening for onshore locations, six site alternatives along the lower Columbia River were evaluated using safety, constructability, and environmental criteria. The Tansy Point alternative and proposed site on the East Skipanon Peninsula would be the most favorable locations for an LNG terminal compared to the other alternatives, with Tansy Point having some environmental advantages and the proposed site having advantages relative to safety, constructability issues, and proximity to residences. We conclude that none of the terminal site alternatives would have a significant environmental advantage over the proposed terminal site.

Oregon LNG evaluated alternative LNG terminal site configurations and selected the layout that would best reduce impacts on wetlands. Four terminal access road alignments were evaluated. The selected alignment would minimize environmental impacts as it would be a more direct route from the existing roadway system to the terminal location, would cross fewer areas of wetlands, and would cross fewer City of Warrenton zoning districts.

Various options were explored for disposing of the material dredged to construct the berth and turning basin at the terminal site. Upland disposal sites were eliminated from consideration because they would take sediment out of the river system. The Three Tree Point and Price Island deep scour-hole sites were eliminated because of concerns about potential impacts on green sturgeon and eulachon. Existing permitted beach nourishment sites were eliminated because of their distance from the terminal site. The USACE had indicated that it uses all of the available capacity at the Shallow Water Site each year, and the South Jetty Nearshore Site has unique restrictions on its use. Therefore, we conclude that the proposed Deepwater Site is preferable among existing permitted dredged material disposal sites.

We assessed two major route alternatives to the proposed Oregon LNG pipeline. Alternative Route 1 would be shorter and cross fewer parcels, but would cross 45 more waterbodies (including 5 more fish-bearing waterbodies) and 30 more roads than the proposed route. Alternative Route 2 would also be shorter than the proposed route and would have both environmental advantages and disadvantages over the proposed route. Therefore, we conclude that neither alternative would offer significant environmental advantages over the proposed route.

In the area of the Columbia River crossing and I-5 crossing, five minor route alternatives were considered. During the project review process, Oregon LNG incorporated a reroute of the Cowlitz County segment of the pipeline into its proposed route to address the concerns of WSDOT and USACE. We concur that the reroute is preferable to the original proposed route and the other minor route variations considered in this area. Oregon LNG also incorporated numerous minor route variations into its final route to avoid or minimize potential impacts on specific localized resources, including residences, high value agricultural lands, archaeological sites, wetlands, or waterbodies. Several alternative compressor station sites were evaluated but did not offer significant environmental advantages over the proposed site.

Because about 94 percent of the length of the WEP would be installed within Northwest's existing easement, we determined that any major route alternative would have significantly greater impacts than the proposed project and eliminated major route alternatives from further consideration.

We assessed minor route variations at four river crossings (Kalama, Toutle, Deschutes, and Skagit Rivers) and two wetland crossings (Queens Bog and unnamed bog) for the WEP. The analysis of each route variation included a number of environmental factors, such as proximity of residences, wetlands impacts, and an assessment of the geologic hazards. For each of these crossings, we conclude that the proposed routes are preferred over the other route variations.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

The following recommendations have been divided into two groups. The first addresses the Oregon LNG Project, which includes the LNG terminal, natural gas pipeline, compressor station, and associated aboveground facilities. The second group of recommendations addresses the WEP.

5.2.1 Oregon LNG Project

If the Commission authorizes the Oregon LNG Project, we recommend that the following measures be included as specific conditions in the Commission's Authorization. We believe that these measures would further mitigate the environmental impact associated with construction and operation of the proposed project.

1. Oregon LNG shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Commission's Authorization. Oregon LNG must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;

    b. justify each modification relative to site-specific conditions;

    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

    d. receive approval in writing from the Director of the OEP **before using that modification**.

2. For LNG facilities, the Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the terminal. This authority shall include:

    a. stop-work authority and authority to cease operation; and

    b. the design and implementation of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Authorization.

3. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the pipeline facilities. This authority shall allow:

    a. the modification of conditions of the Commission's Authorization; and

    b. the design and implementation of any additional measures deemed necessary (including stop-work authority) to assure continued compliance with the intent of the environmental

conditions as well as the avoidance or mitigation of adverse environmental impact resulting from construction and operation of the project.

4. **Prior to any construction of the Oregon LNG Project**, Oregon LNG shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EIs' authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities for the project.

5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary any revised detailed survey alignment map/sheets for the project at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Authorization. All requests for modifications of environmental conditions of the Authorization or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

   Oregon LNG's exercise of eminent domain authority granted under NGA Section 7(h) in any condemnation proceedings related to the Authorization must be consistent with these authorized facilities and locations. Oregon LNG's right of eminent domain granted under NGA Section 7(h) does not authorize it to increase the size of its natural gas pipeline to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

6. Oregon LNG shall file with the Secretary detailed alignment map/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage and ware yards, new access roads, and other areas for the project that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, and documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by Oregon LNG's Plan and/or minor field realignments per landowner needs and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

7. **Within 60 days of the acceptance of the Authorization**, and before construction of the Oregon LNG Project begins, Oregon LNG shall file an Implementation Plan for the project with the Secretary for review and written approval by the Director of OEP. Oregon LNG must file revisions to the plan as schedules change. The plan shall identify:

    a. how Oregon LNG will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Authorization;

    b. how Oregon LNG will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to on-site construction and inspection personnel;

    c. the number of EIs assigned per spread, and how Oregon LNG will ensure that sufficient personnel are available to implement the environmental mitigation;

    d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

    e. the location and dates of the environmental compliance training and instructions Oregon LNG will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel changes), with the opportunity for OEP staff to participate in the training sessions;

    f. the company personnel (if known) and specific portion of Oregon LNG's organization having responsibility for compliance;

    g. the procedures (including use of contract penalties) Oregon LNG will follow if noncompliance occurs; and

    h. for each discrete facility, a Gantt chart (or similar project scheduling diagram), and dates for:

        (1) the completion of all required surveys and reports;
        (2) the environmental compliance training of on-site personnel;
        (3) the start of construction; and
        (4) the start and completion of restoration.

8. Oregon LNG shall employ at least one EI at the terminal and at least one EI per construction spread for the pipeline. The EIs shall be:

    a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Authorization and other grants, permits, certificates, or other authorizing documents;

    b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;

    c. empowered to order correction of acts that violate the environmental conditions of the Authorization, and any other authorizing document;

d. a full-time position, separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Authorization, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

9. Beginning with the filing of its Implementation Plan, Oregon LNG shall file updated status reports with the Secretary on a **monthly** basis for the terminal and on a **weekly** basis for the pipeline facilities until all construction and restoration activities are complete. On request, these status reports shall also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on Oregon LNG's efforts to obtain the necessary federal authorizations;

b. the current construction status of the LNG terminal and each spread of the pipeline, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;

e. the effectiveness of all corrective actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Authorization, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Oregon LNG from other federal, state or local permitting agencies concerning instances of noncompliance, and Oregon LNG's response.

10. **Prior to receiving written authorization from the Director of OEP to commence construction of any project facilities**, Oregon LNG shall file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

11. Oregon LNG must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the terminal facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

12. Oregon LNG must receive written authorization from the Director of OEP **before commencing service** on each discrete facility of the project. Such authorization will only be granted following a determination that the LNG facility and the pipeline and associated facilities have been constructed in accordance with Commission approval and applicable standards, can be expected

to operate safely as designed, and the rehabilitation and restoration of areas disturbed by project construction are proceeding satisfactorily.

13. **Within 30 days of placing the authorized facilities into service**, Oregon LNG shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the authorization conditions Oregon LNG has complied with or will comply with. This statement shall also identify any areas affected by the project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

14. **Prior to commencing final design of the terminal**, Oregon LNG shall file with the Secretary, stamped and sealed by the professional engineer-of-record, the following:

    a. final geotechnical investigations necessary to support all final foundation designs in satisfying the criteria stated in Oregon LNG's application and subsequent data request responses. These investigations shall include how the identified potential zones of liquefaction at the terminal site, and in particular the protective berms, would be mitigated and the details of the liquefaction mitigation method(s), procedures, plan extent, and verification methods proposed to verify mitigation of liquefaction potential;

    b. detailed calculations of seismic slope stability and lateral movements anticipated after the liquefaction mitigation is implemented to verify the stability of critical structures and the tsunami berm for the LNG terminal design earthquake motions;

    c. final seismic specifications to be used in conjunction with the procuring Seismic Design Category I and II equipment;

    d. final Quality Control and Quality Assurance procedures that would be used for design;

    e. a final list of Seismic Category assignments for all structures, systems, and components;

    f. final Seismic Design Criteria for all Seismic Design Category I and II structures, systems, and components that satisfy the criteria stated in Oregon LNG's application and subsequent data request responses; and

    g. LNG tank and foundation design that demonstrate agreement with the FEED level documents. *(EIS section 4.1.1)*

15. **Prior to commencing with procurement, fabrication, or construction of the terminal**, Oregon LNG shall file with the Secretary, stamped and sealed by the professional engineer-of-record, the following information:

    a. the final design of the dock and LNG marine carrier mooring system; the final design shall incorporate a maximum tsunami velocity of 9 ft/s and the LNG marine carrier mooring system shall be designed for loadings with relatively sudden changes in water elevations associated with tsunami waves and tectonic subsidence;

b. final foundation design recommendations, including foundation design and/or liquefaction mitigation measures for all other structures;

c. all detailed design and construction documents (drawings, calculations, specifications, etc.) for Seismic Category I and II structures, systems, and components, including the LNG tanks and seismic isolation peer review report; and

d. Final Quality Control and Quality Assurance procedures that would be used for procurement, fabrication, and construction. (*EIS section 4.1.1*)

16. **Prior to commencing final design of the LNG storage tanks**, Oregon LNG shall file with the Secretary, stamped and sealed by the professional engineer-of-record, the following information:

    a. nonlinear response history analysis shall be performed of the LNG tank and isolation system. The analysis shall simultaneously include all three components of ground motion. Each of the site-specific time history vertical components of motion used in the analysis shall be scaled such that the response spectra of each motion envelops the site-specific vertical design response spectra developed for the project. Each of the horizontal component pairs of ground motions used in the analysis shall be rotated so that one of the components of the pair is the maximum component of response at the isolated period of the tank isolation system;

    b. nonlinear analyses for both maximum and minimum design liquid levels of the LNG tanks;

    c. separate nonlinear analysis to account for variations of design stiffness, minimum and maximum values of friction, and other properties as required by Sections 17.5 and 17.2.4.1 of ASCE 7-05; and

    d. documentation that the lateral displacement capacity of the seismic isolation bearings is not less than 24 inches. (*EIS section 4.1.1*)

17. **Prior to terminal construction**, Oregon LNG shall file with the Secretary documentation that it will employ a special inspector during construction to perform duties described in Section 6 of NBSIR84-2833, Data Requirements for the Seismic Review of LNG Facilities. (*EIS section 4.1.1*)

18. **During pipeline construction**, Oregon LNG shall include in its weekly status reports any observed stratigraphic offsets potentially related to ground rupture that could affect the pipeline. In addition, **prior to commencement of service**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, a design mitigation report that documents measures Oregon LNG implemented specific to the location and milepost of any observed stratigraphic offsets observed during pipeline construction. (*EIS section 4.1.1*)

19. **Prior to pipeline construction**, Oregon LNG shall file a pipeline design geotechnical report with the Secretary, for review and written approval by the Director of OEP. The report shall include:

    a. an evaluation of liquefaction hazards along the pipeline route and necessary location-specific mitigation measures by milepost;

    b. results of investigations necessary to support final pipeline routing/mitigation measures through geologically hazardous areas;

c. a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan; and

d. an evaluation of liquefaction hazards at the compressor station and necessary mitigation measures. *(EIS section 4.1.1)*

20. **Prior to construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, its Plan for the Unanticipated Discovery of Contaminated Environmental Media for both the terminal site and pipeline facilities. *(EIS section 4.1.2)*

21. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, the following:

    a. final field-verified list of all water wells and springs used for water supply within 150 feet of the construction right-of-way, including the distance from the construction right-of-way;

    b. measures for marking and protecting any water supply wells within or immediately adjacent to the construction right-of-way; and

    c. details of preconstruction and post-construction well monitoring such as timing and parameters. *(EIS section 4.1.3)*

22. **Prior to the close of the draft EIS comment period**, Oregon LNG shall prepare a plan for reevaluating the sediments within the dredge prism in consultation with the Portland Sediment Evaluation Team, and file the plan with the Secretary. *(EIS section 4.1.3)*

23. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary a plan for the use of herbicides within 100 feet of wetlands or waterbodies, along with documentation of consultation and approval by NMFS, FWS, and appropriate state agencies. *(EIS section 4.1.4*)

24. **Prior to construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary its final Wetland Mitigation Plan, along with documentation of consultation and approval by the USACE, Oregon Department of State Lands, and Washington State Department of Ecology. *(EIS section 4.1.4*)

25. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, a plan for placement of large woody debris (LWD) or other waterbody habitat improvement features. The LWD plan shall be developed in consultation with the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), FWS, and NMFS and include, at a minimum, details of when, where, and what structures (e.g., LWD) would be placed instream, and describe the process for making those decisions. *(EIS section 4.1.5*)

26. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, its final equipment decontamination plan. The plan shall be developed in coordination with ODFW and NMFS and identify wash station locations. (*EIS section 4.1.5*)

27. **Prior to pipeline construction**, Oregon LNG shall file its Riparian Restoration and Monitoring Plan with the Secretary for review and written approval by the Director of OEP. The plan shall include seed and planting mixture for the restoration of riparian areas that is based on regional

habitat differences, and include documentation of Oregon LNG's consultation and approval of the plan by the NRCS, ODFW, and other applicable agencies. *(EIS section 4.1.6*)

28. **Prior to construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary a Migratory Bird Conservation Plan, along with documentation of consultation and approval by the FWS. *(EIS section 4.1.7*)

29. Oregon LNG **shall not begin construction activities until** FERC staff completes any necessary Section 7 ESA consultation with NMFS and the FWS, and Oregon LNG receives written notification from the Director of OEP that construction may begin. *(EIS section 4.1.8*)

30. **Prior to construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary its agency-approved Mitigation Plan (for sensitive species and their habitats), developed in consultation with the USACE, ODFW, USFWS, WDFW, and NMFS. *(EIS section 4.1.8*)

31. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary its final impact assessments and mitigation documentation for marbled murrelet and northern spotted owl. *(EIS section 4.1.8*)

32. **Prior to terminal construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, its final pile-driving plan, including a schedule for pile driving. *(EIS section 4.1.8*)

33. **Prior to construction of the Oregon LNG Project**, Oregon LNG shall file with the Secretary documentation of concurrence from the Oregon Department of Land Conservation and Development that the Oregon LNG Project is consistent with the CZMA. *(EIS section 4.1.9*)

34. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP:

    a. the results of a survey of previously unsurveyed areas along the pipeline route and an updated list of residences and commercial structures within 50 feet of the construction right-of-way;

    b. for all residences identified within 25 feet of a construction work area, a final site-specific construction plan that includes all of the following:

        (1) a dimensioned site plan that clearly shows:

            i. the location of the residence in relation to the pipeline;

            ii. the boundaries of all construction work areas;

            iii. the distance between the edge of construction work areas and the residence and other permanent structures;

            iv. equipment travel lanes;

            v. location of topsoil and subsoil storage;

            vi. safety fencing and other safety features;

            vii. other nearby structures and residential features (including decks, fences, driveways, etc.), indicating which would be removed and any areas with restrictions after construction;

viii. trees and other landscaping, indicating which would be removed and where trees would not be allowed after construction;

ix. nearby utilities including wells, water and sewer lines, and septic systems;

x. nearby roads or waterbodies; and

xi. the edge of the new permanent right-of-way;

(2) a detailed description of construction techniques that would be used (such as reduced pipeline separation, centerline adjustment, use of stove-pipe or drag section techniques, working over existing pipelines, pipeline crossover, bore, etc.);

(3) an estimate of the amount of time required for construction;

(4) a description of how Oregon LNG would ensure the trench would not be excavated until the pipeline is ready for installation and the trench is backfilled immediately after pipeline installation; and

(5) a description of restoration and revegetation measures and procedures for the property;

c. a description of how and when landowners would be notified of construction activities; and

d. documentation of landowner concurrence if the construction work areas would be within 10 feet of a residence. *(EIS section 4.1.9)*

35. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary the coordination plan for the Four County Point Trail and the Four County Point Monument along with documentation of consultation with the Oregon Department of Forestry. (*EIS section 4.1.9*)

36. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, a plan that identifies and provides measures to mitigate impacts of pipeline construction and operation on Lions Day Park and its users. Oregon LNG shall develop this plan in consultation with the Port of Woodland. (*EIS section 4.1.9*)

37. **Prior to terminal construction**, Oregon LNG shall file with the Secretary, for review and written approval by the Director of OEP, a Terminal Construction Traffic Management Plan prepared in consultation with the City of Warrenton and Oregon Department of Transportation. The plan shall address total vehicular traffic at the construction site, volume of traffic from other employees and schedule of shift changes, and describe potential restrictions of construction traffic if necessary. (*EIS section 4.1.10*)

38. **Prior to pipeline construction**, Oregon LNG shall file with the Secretary documentation that copies of the Discovery Plan were provided to the Washington and Oregon SHPOs, together with their comments on the plan. If the SHPOs do not find the plan acceptable, Oregon LNG shall file a revised Discovery Plan that addresses their concerns, for review and written approval by the Director of OEP. (*EIS section 4.1.11*)

39. Oregon LNG **shall not begin construction** of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads **until**:

    a. Oregon LNG files with the Secretary:

        (1) remaining cultural resources survey reports and ethnographic studies;

        (2) site evaluation reports, and avoidance or treatment plans, as required; and

        (3) comments on the reports, studies, and plans from the Oregon and Washington SHPOs and appropriate interested Indian tribes;

    b. the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and

    c. FERC staff reviews and the Director of OEP approves the cultural resources reports, studies and plans, and notifies Oregon LNG in writing that treatment measures (including archaeological data recovery, if necessary) may be implemented and/or construction may proceed.

    All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE.**" (*EIS section 4.1.11*)

40. Oregon LNG shall make all reasonable efforts to ensure that predicted noise levels during operation of the LNG terminal are not exceeded at nearby NSAs and shall file with the Secretary a full load noise survey **no later than 60 days** after each of the liquefaction trains is placed into service. If the noise attributable to the operation of the LNG terminal exceeds an L_{dn} of 55 dBA at any nearby NSAs, Oregon LNG shall reduce operation of the LNG terminal or install additional noise controls until a noise level below an L_{dn} of 55 dBA at nearby NSAs is achieved. Oregon LNG shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*EIS section 4.1.12*)

41. Oregon LNG shall file a noise survey with the Secretary **no later than 60 days** after placing the entire LNG terminal into service. If a full load condition noise survey is not possible, Oregon LNG shall provide an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG terminal into service and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the LNG terminal under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Oregon LNG shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Oregon LNG shall confirm compliance with the above requirement by filing an additional noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*EIS section 4.1.12*)

42. **Prior to construction of any HDD crossings**, Oregon LNG shall file with the Secretary, for the review and written approval by the Director of OEP, an HDD noise mitigation plan to reduce the projected noise level attributable to the proposed drilling operations at NSAs *with predicted noise levels above a day-night sound level (L_{dn}) of 55 decibels on the A-weighted scale (dBA).* During

drilling operations, Oregon LNG shall implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSAs. (*EIS section 4.1.12*)

43. Oregon LNG shall file a noise survey with the Secretary **no later than 60 days** after placing the compressor station in service. If a full load condition noise survey is not possible, Oregon LNG shall provide an interim survey at the maximum possible horsepower load and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the compressor station under interim or full horsepower load conditions exceeds existing noise levels at any nearby NSA, Oregon LNG shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Oregon LNG shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*EIS section 4.1.12*)

44. **Prior to the end of the comment period on the draft EIS**, Oregon shall file with the Secretary technical substantiation for the use of 10 minute exposure times for the toxic releases. If any exposure times would exceed 10 minutes, the AEGL durations shall be at least the exposure duration. (*EIS section 4.1.13*)

45. **Prior to the end of the comment period on the draft EIS**, Oregon shall file with the Secretary a toxic dispersion analysis for the NGL design spills that accounts for hexane and mercaptans, in addition to the benzene, toluene and xylene content. (*EIS section 4.1.13*)

46. **Prior to the end of the comment period on the draft EIS**, Oregon shall file with the Secretary a computational fluid dynamic analysis of the mechanical fragmentation of the liquid into droplets, heat transfer effects and vaporization, liquid and vapor fractions, trajectories, velocities, and turbulence within and exiting the shroud. (*EIS section 4.1.13*)

47. **Prior to the end of the comment period on the draft EIS**, Oregon shall file with the Secretary adequate validation for the revised model that was used to analyze overpressures. Alternatively, Oregon LNG shall provide acceptable mitigation to prevent public impacts due to 1 psig overpressures that are modeled to the ½ psig to account for uncertainty in the model. (*EIS section 4.1.13*)

Recommendations 48 through 111 shall apply to the LNG terminal facilities. Information pertaining to these specific recommendations shall be filed with the Secretary for review and written approval by the Director of OEP either: **prior to initial site preparation**; **prior to construction of final design**; **prior to commissioning**; **prior to introduction of hazardous fluids**; or **prior to commencement of service**, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.112. See Critical Energy Infrastructure Information, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. 31,228 (2006). Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements, would be subject to public disclosure. All information shall be filed a **minimum of 30 days** before approval to proceed is requested.

48. **Prior to initial site preparation**, Oregon LNG shall provide procedures for controlling access during construction. (*EIS section 4.1.13*)

49. **Prior to initial site preparation**, Oregon LNG shall file an overall project schedule, which includes the proposed stages of the commissioning plan. (*EIS section 4.1.13*)

50. **Prior to initial site preparation**, Oregon LNG shall file the quality assurance and quality control procedures for construction activities. (*EIS section 4.1.13*)

51. **Prior to initial site preparation**, Oregon LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. (*EIS section 4.1.13*)

52. **Prior to initial site preparation**, Oregon LNG shall develop an Emergency Response Plan (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG marine carrier to activate sirens and other warning devices.

    Oregon LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its ERP at 3-month intervals. (*EIS section 4.1.13*)

53. **Prior to initial site preparation**, Oregon LNG shall file a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit related security/emergency management costs, this comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Oregon LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost-Sharing Plan at 3-month intervals. (*EIS section 4.1.13*)

54. The **final design** shall include information/revisions pertaining to Oregon LNG's response numbers 3 through 8, 12, 18, 20 through 23, 27 through 36, 38 through 50, 54, 57 through 60, 63, 73, 74, 76 through 79, 81, 83 through 85, 96, 99, 100, 102, 105, 107, 108, and 109 of its March 18, 2014 filing, which indicated features to be included or considered in the final design. (*EIS section 4.1.13*)

55. The **final design** shall include change logs that list and explain any changes made from the Front-End Engineering Design provided in Oregon LNG's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. (*EIS section 4.1.13*)

56. The **final design** shall provide up-to-date Process Flow Diagrams with heat and material balances and P&IDs, which include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

    e. piping with line number, piping class specification, size, and insulation type and thickness;

    f. piping specification breaks and insulation limits;

    g. all control and manual valves numbered;

    h. relief valves with set points and sizes; and

    i. drawing revision number and date. (*EIS section 4.1.13*)

57. The **final design** shall provide an up-to-date complete equipment list, process and mechanical data sheets, and specifications. (*EIS section 4.1.13*)

58. The **final design** shall provide complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. (*EIS section 4.1.13*)

59. The **final design** shall provide complete plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. (*EIS section 4.1.13*)

60. The **final design** shall provide facility plans and drawings that show the location of the firewater and foam systems. Drawings shall clearly show: firewater and foam piping; post indicator valves; and the location, and area covered by, each monitor, hydrant, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam system. (*EIS section 4.1.13*)

61. The **final design** shall include an updated fire protection evaluation of the proposed facilities carried out in accordance with the requirements of NFPA 59A 2001, chapter 9.1.2 as required by 49 CFR Part 193. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. (*EIS section 4.1.13*)

62. The **final design** shall provide detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario. (*EIS section 4.1.13*)

63. The **final design** shall specify that for hazardous fluids, piping and piping nipples 2 inches or less in diameter are to be no less than schedule 160 for carbon steel and no less than schedule 80 for stainless steel, or are designed to withstand external loads, including vibrational loads in

the vicinity of rotating equipment and operator live loads in areas accessible by operators. (*EIS section 4.1.13*)

64. The **final design** shall include drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A. (*EIS section 4.1.13*)

65. The **final design** shall provide an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: shall continuously monitor for the presence of a flammable fluid; shall alarm the hazardous condition; and shall shutdown the appropriate systems. (*EIS section 4.1.13*)

66. The **final design** shall provide electrical area classification drawings. (*EIS section 4.1.13*)

67. The final design shall provide spill containment system drawings with dimensions and slopes of curbing, trenches, and impoundments, as well as the sizing and design of the down-comer that would transfer spills from the tank top to the ground level impoundment system. (*EIS section 4.1.13*)

68. The **final design** of the hazard detectors shall account for the calibration gas when determining the LFL and toxic setpoints. (*EIS section 4.1.13*)

69. The **final design** shall provide an analysis of the localized hazards to operators from a potential liquid nitrogen release and shall also provide consideration of any mitigation that may be prudent. The analysis shall include an account of the nitrogen vapor dispersion from the release, in addition to the nitrogen content already in the air. (*EIS section 4.1.13*)

70. The **final design** shall include a hazard and operability review of the completed design prior to issuing the P&IDs for construction. A copy of the review, a list of recommendations, and actions taken on the recommendations, shall be filed. (*EIS section 4.1.13*)

71. The **final design** shall include the cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. (*EIS section 4.1.13*)

72. The **final design** shall include a drawing showing the location of the ESD buttons. ESD buttons shall be easily accessible, conspicuously labeled and located in an area which would be accessible during an emergency. (*EIS section 4.1.13*)

73. The **final design** shall include a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice required by 49 CFR 193, and shall provide justification if not using an inert or non-flammable gas for cleanout, dry-out, purging, and tightness testing. (*EIS section 4.1.13*)

74. The **final design** shall include the sizing basis and capacity for the final design of pressure and vacuum relief valves for major process equipment, vessels, and storage tanks, as well as for vent stacks.

75. The **final design** shall provide the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3, as required by 49 CFR 193. (*EIS section 4.1.13*)

76. The **final design** shall provide the results of consultation with DOT regarding whether the edition of ASME VIII being used for the facility design is in accordance with 49 CFR Part 193. (*EIS section 4.1.13*)

77. The **final design** shall equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record shall be reported in the semi-annual operational reports. (*EIS section 4.1.13*)

78. The **final design** shall include a thermal relief valve between the car-sealed-open valve in line LNG-100-32-01SS-8CC and failed-close valve XV-100. (*EIS section 4.1.13*)

79. The final design shall include consideration for reverse flow of the feed gas to the Amine Contactor in the event valve XV-1200 fails to close. (*EIS section 4.1.13*)

80. The **final design** shall include a thermal relief valve in line LNG-2111A, upstream of valve FV-2016. (*EIS section 4.1.13*)

81. The **final design** shall include a thermal relief valve downstream of the check valve in line MR-2628-16-06SS. (*EIS section 4.1.13*)

82. The **final design** shall include a thermal relief valve upstream of valve FV-2728 in line MR-2628-16-06SS. (*EIS section 4.1.13*)

83. The **final design** of the refrigerant storage system shall allow the isolation of individual pressure relief valves while providing full relief capacity, during pressure relief valve maintenance or testing. (*EIS section 4.1.13*)

84. The **final design** shall include a shutoff valve at the suction of each high pressure LNG sendout pump. (*EIS section 4.1.13*)

85. The **final design** shall require review of the check valve location with respect to the recycle line connection at the discharge of the high pressure LNG sendout pumps. (*EIS section 4.1.13*)

86. The **final design** shall specify that nitrogen purge connections to equipment and piping containing flammable fluids shall be equipped with double isolation. (*EIS section 4.1.13*)

87. The **final design** shall direct the discharge from the LNG vaporizer rupture discs to a safe location for containment and vapor dispersion that is uncongested and away from personnel. (*EIS section 4.1.13*)

88. The **final design** shall include a pilot relief valve or operated vent valve sized for thermal relief at the discharge of each vaporizers, upstream of the isolation valves. (*EIS section 4.1.13*)

89. The **final design** shall include plant shutdown due to low, low instrument air pressure. (*EIS section 4.1.13*)

90. The **final design** shall include provisions to isolate the Dry Flare Knock-out Drum Heater. (*EIS section 4.1.13*)

91. The **final design** shall include provisions to isolate the Wet Flare Knock-out Drum Heater. (*EIS section 4.1.13*)

92. The **final design** of the firewater system shall use piping specifications that have a pressure limit not less than the maximum operating pressure of the system. (*EIS section 4.1.13*)

93. The **final design** shall provide the details of the impingement shrouds final design as well as procedures to maintain and inspect the impingement shrouds. (*EIS section 4.1.13*)

94. Oregon LNG shall certify that the **final design** is consistent with the information provided to DOT as described in the design spill determination letter dated October 2, 2014 (FERC eLibrary Accession Number 20141002-4005) as well as in the related email communication from DOT to FERC on April 1, 2015 (FERC eLibrary Accession Number 20150403-4010). In the event that

any modifications to the design alters the candidate design spills on which the Title 49 CFR Part 193 siting analysis was based, Oregon LNG shall consult with DOT on any actions necessary to comply with Part 193. (*EIS section 4.1.13*)

95. The **final design** shall provide a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 3,000 Btu/ft^2-hr zone from an impoundment. This analysis shall be filed with Secretary for review and approval by the Director of OEP. Refrigerant and NGL trucks at the truck station shall be included in the analysis. The flow rates and durations of any cooling water used in high thermal radiation areas shall be justified with calculations. (*EIS section 4.1.13*)

96. The **final design** shall provide details of LNG storage tank structural design that demonstrates the tanks can withstand overpressures from ignition of design spills. (*EIS section 4.1.13*)

97. The **final design** shall provide plant geometry models or drawings that verify the confinement and congestion represented in the front-end-engineering design or provide revised overpressure calculations indicating that a 1 psi overpressure would not impact the public. (*EIS section 4.1.13*)

98. **Prior to commissioning**, Oregon LNG shall file plans and detailed procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. (*EIS section 4.1.13*)

99. **Prior to commissioning**, Oregon LNG shall provide a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids; and during commissioning and startup. Oregon LNG shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. (*EIS section 4.1.13*)

100. **Prior to commissioning**, Oregon LNG shall provide results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually. (*EIS section 4.1.13*)

101. **Prior to commissioning**, Oregon LNG shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. (*EIS section 4.1.13*)

102. **Prior to commissioning**, Oregon LNG shall file a tabulated list and drawings of the proposed hand-held fire extinguishers. The list shall include the equipment tag number, extinguishing agent type, capacity, number, and location. The drawings shall show the extinguishing agent type, capacity, and tag number of all hand-held fire extinguishers. (*EIS section 4.1.13*)

103. **Prior to commissioning**, Oregon LNG shall file the operation and maintenance procedures and manuals, as well as safety procedures. (*EIS section 4.1.13*)

104. **Prior to commissioning**, Oregon LNG shall maintain a detailed training log to demonstrate that operating staff has completed the required training. (*EIS section 4.1.13*)

105. **Prior to introduction of hazardous fluids**, Oregon LNG shall complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). (*EIS section 4.1.13*)

106. **Prior to introduction of hazardous fluids**, Oregon LNG shall complete all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System and the Safety Instrumented System that demonstrates full functionality and operability of the system. (*EIS section 4.1.13*)

107. **Prior to commencement of service**, progress on the construction of the proposed systems shall be reported in **monthly** reports filed with the Secretary. Details shall include a summary of activities, problems encountered, contractor non-conformance/deficiency logs, remedial actions taken, and current project schedule. Problems of significant magnitude shall be reported to FERC **within 24 hours**. (*EIS section 4.1.13*)

108. **Prior to commencement of service**, Oregon LNG shall notify FERC staff of any proposed revisions to the security plan and physical security of the facility. (*EIS section 4.1.13*)

109. **Prior to commencement of service**, Oregon LNG shall develop procedures for off-site contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Oregon LNG staff. (*EIS section 4.1.13*)

110. **Prior to commencement of service**, Oregon LNG shall label piping with fluid service and direction of flow in the field in addition to the pipe labeling requirements of NFPA 59A. (*EIS section 4.1.13*)

111. **Prior to commencement of service**, Oregon LNG shall receive written authorization from the Director of OEP. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Safety and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Oregon LNG or other appropriate parties. (*EIS section 4.1.13*)

Recommendations 112 through 115 shall apply throughout the life of the Oregon LNG facility.

112. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Oregon LNG shall respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. (*EIS section 4.1.13*)

113. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil-off/flash gas, etc.), plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/loading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" also shall be included in the semi-annual operational reports. Such information would provide FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility. (*EIS section 4.1.13*)

114. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. *(EIS section 4.1.13)*

115. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to FERC staff. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids related incidents include:

    a. fire;

    b. explosion;

    c. estimated property damage of $50,000 or more;

    d. death or personal injury necessitating in-patient hospitalization;

    e. release of hazardous fluids for five minutes or more;

    f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

    g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

    h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

    i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

    j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

    k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

    l. safety-related incidents to hazardous fluids vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. (*EIS section 4.1.13*)

5.2.2 Washington Expansion Project

If the Commission authorizes the WEP, we recommend that the following measures be included as specific conditions in the Commission's Order. We believe that these measures would further mitigate the environmental impact associated with construction and operation of the proposed project.

1. Northwest shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Commission's Order. Northwest must:

   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;

   b. justify each modification relative to site-specific conditions;

   c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

   d. receive approval in writing from the Director of OEP **before using that modification**.

2. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the project. This authority shall allow:

   a. the modification of conditions of the Commission's Order; and

   b. the design and implementation of any additional measures deemed necessary (including stop-work authority) to assure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from construction and operation of the project.

3. Prior to any construction, Northwest shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EIs' authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs before becoming involved with construction and restoration activities for the project.

4. The authorized facility locations shall be as shown in the EIS, as supplemented by filed alignment sheets. As soon as they are available, and before the start of construction, Northwest shall file with the Secretary any revised detailed maps/survey alignment sheets for the project at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these maps/alignment sheets.

   Northwest's exercise of eminent domain authority granted under NGA Section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Northwest's right of eminent domain granted under NGA Section 7(h) does not authorize it to increase the size of its natural gas facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

5. Northwest shall file with the Secretary detailed maps/alignment sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage and ware yards, new access roads, and other areas for the project that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, and documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by FERC's Plan and/or minor field realignments per landowner needs and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of the Order, and before construction begins**, Northwest shall file an Implementation Plan for the project with the Secretary for review and written approval by the Director of OEP. Northwest must file revisions to the plan as schedules change. The plan shall identify:

   a. how Northwest will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

b. how Northwest will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to on-site construction and inspection personnel;

c. the number of EIs assigned per spread, and how Northwest will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location and dates of the environmental compliance training and instructions Northwest will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel changes), with the opportunity for OEP staff to participate in the training sessions;

f. the company personnel (if known) and specific portion of Northwest's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Northwest will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt chart (or similar project scheduling diagram), and dates for:

(1) the completion of all required surveys and reports;

(2) the environmental compliance training of on-site personnel;

(3) the start of construction; and

(4) the start and completion of restoration.

7. Northwest shall employ one or more EIs per construction spread. The EIs shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position, separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Northwest shall file updated status reports with the Secretary on a **weekly basis for the WEP until all construction and restoration activities are complete**. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

    a. an update on Northwest's efforts to obtain the necessary federal authorizations;

    b. the current construction status of the project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

    c. a listing of all problems encountered and each instance of noncompliance observed by the EIs during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

    d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;

    e. the effectiveness of all corrective actions implemented;

    f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

    g. copies of any correspondence received by Northwest from other federal, state or local permitting agencies concerning instances of noncompliance, and Northwest's response.

9. **Prior to receiving written authorization from the Director of OEP to commence construction of any project facilities**, Northwest shall file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Northwest must receive written authorization from the Director of OEP **before commencing service** on each discrete facility of the project. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the project are proceeding satisfactorily.

11. **Within 30 days of placing the authorized facilities for the project into service**, Northwest shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the Certificate conditions Northwest has complied with or will comply with. This statement shall also identify any areas affected by the project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

12. **Prior to construction**, Northwest shall file with the Secretary, for review and written approval by the Director of OEP, the following:

    a. results of final geotechnical investigations necessary to support final pipeline routing/mitigation measures through geologically hazardous areas; and

    b. a final landslide inventory, specific landslide mitigation measures with locations, and a post-construction landslide monitoring plan. (*EIS section 4.2.1*)

13. **Prior to construction**, Northwest shall file with the Secretary documentation of WDFW approval for any modification to the WDFW in-water work windows at waterbody crossings. (*EIS section 4.2.3*)

14. **Prior to construction**, Northwest shall file with the Secretary its agency-approved Wetland Mitigation Plan developed in consultation with the USACE and Washington State Department of Ecology (WA Ecology). (*EIS section 4.2.4*)

15. **Prior to the close of the draft EIS comment period**, Northwest shall file with the Secretary site-specific justification for Category III and Category IV wetlands identified in table 4.2.4-2 of the EIS, where it proposes to use a construction right-of-way width greater than 75 feet. (*EIS section 4.2.4*)

16. **Prior to the close of the draft EIS comment period**, Northwest shall file with the Secretary a Fish Salvage Plan developed in coordination with the FWS and WDFW that includes measures to minimize the impacts on native fish, including lamprey, during open-cut waterbody crossings. (*EIS section 4.2.5*)

17. **Prior to construction**, Northwest shall file with the Secretary, for review and written approval by the Director of OEP, a plan for placement of large woody debris (LWD) or other waterbody habitat improvement features. The LWD plan shall be developed in consultation with the Washington Department of Fish and Wildlife (WDFW), FWS, and NMFS and include, at a minimum, details of when, where, and what structures (e.g., LWD) would be placed instream, and describe the process for making those decisions. (*EIS section 4.2.5*)

18. **Prior to construction**, Northwest shall file with the Secretary, for review and written approval by the Director of OEP, a Vegetation Restoration and Monitoring Plan developed in coordination with NRCS, WDFW, FWS, and other applicable agencies. The plan shall be milepost-specific and based on the regional habitat types along the WEP. (*EIS section 4.2.6*)

19. **Prior to construction**, Northwest shall file with the Secretary a Migratory Bird Conservation Plan, along with documentation of consultation and approval by the FWS. (*EIS section 4.2.7*)

20. Northwest **shall not begin construction activities until** FERC staff completes any necessary Section 7 ESA consultation with NMFS and the FWS, and Northwest receives written notification from the Director of OEP that construction may begin. (*EIS section 4.2.8*)

21. **Before the close of the draft EIS comment period**, Northwest shall file with the Secretary an evaluation of the feasibility of using HDD to cross French Creek (at MP 1402.4 along the Snohomish Loop) and Breckenridge Creek (at MP 1478.9 along the Sumas Loop) to avoid impacts on bull trout. (*EIS section 4.2.8*)

22. **Prior to construction**, Northwest shall file with the Secretary, for review and written approval by the Director of OEP:

    a. a final site-specific construction plan for each residence identified within 25 feet of a construction work area (including residences in appendix I6 of the EIS and any additional identified residences), that includes all of the following:

        (1) a dimensioned site plan that clearly shows:

            i. the location of the residence in relation to the pipeline;

            ii. the boundaries of all construction work areas;

            iii. the distance between the edge of construction work areas and the residence and other permanent structures;

            iv. equipment travel lanes;

            v. location of topsoil and subsoil storage;

            vi. safety fencing and other safety features;

            vii. other nearby structures and residential features (including decks, fences, driveways, etc.), indicating which would be removed and any areas with restrictions after construction;

            viii. trees and other landscaping, indicating which would be removed and where trees would not be allowed after construction;

            ix. nearby utilities including wells, water and sewer lines, and septic systems; and

            x. nearby roads or waterbodies; and

            xi. the edge of the permanent right-of-way;

        (2) a detailed description of construction techniques that would be used (such as reduced pipeline separation, centerline adjustment, use of stove-pipe or drag section techniques, working over existing pipelines, pipeline crossover, bore, etc.);

        (3) an estimate of the amount of time required for construction activities;

        (4) a description of how Northwest would ensure the trench would not be excavated until the pipeline is ready for installation and the trench is backfilled immediately after pipeline installation; and

        (5) a description of restoration and revegetation measures and procedures for the property.

    b. a description of how and when landowners would be notified of construction activities; and

    c. documentation of landowner concurrence if the construction work areas would be within 10 feet of a residence. *(EIS section 4.2.9)*

23. **Prior to construction**, Northwest shall file with the Secretary documentation of concurrence from WA Ecology that the WEP is consistent with the CZMA. (*EIS section 4.2.9*)

24. **Prior to construction**, Northwest shall file with the Secretary documentation of additional coordination with the land management agencies listed in table 4.2.9-10 of the draft EIS and the final site-specific plans, including traffic and trail plans, for each affected recreation area listed in table 4.2.9-10 of the draft EIS. (*EIS section 4.2.9*)

25. **Prior to construction**, Northwest shall file with the Secretary documentation of the FAA's approval of a Notice of Proposed Construction or Alteration, if required, and the FAA's approval of Northwest's final plans for construction on the Crest Airpark public airfield property, including safety lighting. (*EIS section 4.2.9*)

26. **Prior to construction**, Northwest shall file with the Secretary copies of comments from the Washington SHPO and interested Indian tribes on the Discovery Plan. If the SHPO or tribes do not find the plan acceptable, Northwest shall file a revised Discovery Plan that addresses their concerns, for review and written approval by the Director of OEP. (*EIS section 4.2.11*)

27. Northwest **shall not begin construction** of facilities and/or use of staging, storage, or temporary work areas **until**:

    a. Northwest files with the Secretary:

        (1) remaining cultural resources survey reports;

        (2) site evaluation reports, and avoidance or treatment plans, as required; and

        (3) comments on the reports, studies, and plans from the Washington SHPO and appropriate interested Indian tribes;

    b. the ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and

    c. FERC staff reviews and the Director of OEP approves the cultural resources reports, studies and plans, and notifies Northwest in writing that treatment measures (including archaeological data recovery, if necessary) may be implemented and/or construction may proceed.

    All material filed with the Commission containing **location, character, and ownership information** about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CONTAINS PRIVILEGED INFORMATION – NOT FOR PUBLIC RELEASE.**" (*EIS section 4.2.11*)

28. **Prior to construction of any HDD or direct pipe method crossings**, Northwest shall file with the Secretary, for the review and written approval by the Director of OEP, a noise mitigation plan to reduce the projected noise level attributable to the proposed drilling operations at NSAs *with predicted noise levels above a day-night sound level (L_{dn}) of 55 decibels on the A-weighted scale (dBA)*. During drilling operations, Northwest shall implement the approved plan, monitor noise levels, and make all reasonable efforts to restrict the noise attributable to the drilling operations to no more than a L_{dn} of 55 dBA at the NSAs. (*EIS section 4.2.12)*

29. Northwest shall file a noise survey with the Secretary **no later than 60 days** after placing the modified compressor stations in service. If a full load condition noise survey is not possible, Northwest shall provide an interim survey at the maximum possible horsepower load and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the compressor stations under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSA, Northwest shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Northwest shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*EIS section 4.2.12)*