August 7, 2014

REVIEW REPORT

THIRD PARTY REVIEW

Fraser Surrey Docks - Direct Transfer Coal Proposal

Submitted to:
Carrie Brown
Vancouver Fraser Port Authority
100 The Pointe
999 Canada Place
Vancouver BC V6C 3P4



Photo courtesy of Port Metro Vancouver

Report Number: 1314210036-008-R-Rev0

Golder Associates

Review Limitations

This report (the "Report") was prepared for the exclusive use of the Vancouver Fraser Port Authority for the express purpose of providing a third party review of specific components of an environmental impact assessment as described in the report. In evaluating the components, Golder Associates Ltd. (Golder) has relied in good faith on information provided by others. We have assumed that the information provided is factual and accurate. We accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of others.

Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the sole responsibility of the third parties. If a third party requires reliance on this Report, written authorization from Golder is required. Golder disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The scope of Golder's assessment are described in this Report, and are subject to restrictions, assumptions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report nor did Golder undertake any of its own studies or evaluation of risk. Conditions may therefore exist which were not detected given the limited nature of the assessment Golder was retained to undertake with respect to the site and project and additional environmental studies and actions may be required. In addition, it is recognized that the passage of time affects the information provided in the Report. Golder's opinions are based upon information that existed at the time of the writing of the Report and that was described by others in the documents reviewed. It is understood that the services provided for in the scope of work allowed Golder to form no more than an opinion of the actual conditions at the site and assessments undertaken at the time the work was carried out, and cannot be used to assess the effect of any subsequent changes in any laws, regulations, the environmental quality of the site or its surroundings. If a service is not expressly indicated, the reader should not assume it has been provided.

The results of an assessment of this nature should in no way be construed as a warranty that the remainder of the environmental impact assessment, or its underlying data, which could not be reviewed, is free from any and all errors, omissions, or inconsistencies.

Table of Contents

1.0 INTRODUCTION AND BACKGROUND 1

1.1 Golder's Role in the Review 1

1.2 Previous Review of Fraser Surrey Docks Environmental Assessment 2

1.3 Previous Air Quality Review Comments 2

1.4 Previous Human Health Assessment Review Comments 2

2.0 REVIEW COMMENTS ON THE AIR QUALITY ASSESSMENT 3

3.0 REVIEW COMMENTS ON THE HUMAN HEALTH RISK ASSESSMENT 4

3.1 Problem Formulation 5

3.2 Exposure Assessment 7

3.3 Toxicity Assessment 8

3.4 Risk Characterization 9

4.0 SUMMARY AND RECOMMENDATIONS 9

4.1 Air Quality Assessment 9

4.1.1 Recommendations 10

4.2 Human Health Risk Assessment 10

4.2.1 Recommendations 11

5.0 CLOSURE 12

6.0 REFERENCES 13

APPENDICES

APPENDIX A
Golder Associates Initial Review Report on Fraser Surrey Docks Proposed Direct Transfer Coal Facility (January 9, 2014)

APPENDIX B
Golder Associates Comments on the SNC-Lavalin Human Health Risk Assessment Workplan (February 7 and March 7, 2014)

APPENDIX C
Golder Associates Review Comments on the Draft Problem Formulation for the Human Health Risk Assessment (May 9, 2014)

APPENDIX D
Additional Clarification to the Human Health Risk and Air Quality Assessment Reports in Response to Golder Requests

APPENDIX E
Summary of Minor Discrepancies in HHRA

1.0 INTRODUCTION AND BACKGROUND

Golder Associates Ltd. (Golder) was retained by the Vancouver Fraser Port Authority (VFPA) to carry out a third party review of components of the Environmental Impact Assessment (EIA) carried out for the Fraser Surrey Docks (FSD) proposed coal load-out operation and to provide advice of a technical nature as part of their permit review process. Golder was asked to review the air quality (AQ) modeling and predictions made, the human health risk assessment (HHRA) and the potential aquatic pollution issues associated with the project. The Environmental Assessment covered other areas; however, our review is limited to these subject matters.

1.1 Golder's Role in the Review

During the air quality assessment (AQA) modeling and HHRA, Golder met with FSD's AQ and HHRA consultants to clarify understanding and approaches with FSD's specialists. In particular, Golder provided early review feedback on the emissions inventory, modeling scenarios and general approaches. For the HHRA, Golder reviewed and met with FSD's specialists to review the Problem Formulation for the HHRA and discussed the approach to addressing potential risks arising from the dust palliative compounds. The overall direction that arose from those discussions was one that Golder was in agreement with; however, Golder noted that such agreement was with respect to high level approach and our review comments would be provided after receiving the final AQ Assessment and HHRA, which have since been provided and reviewed in the present report.

Golder's role has remained that of a reviewer and Golder's specialists were available to provide feedback during the course of FSD's studies. However, Golder did not direct any of those studies. FSD elected to expand the spatial scope of the AQ and HHRA assessments to include project elements outside of VFPA's jurisdiction. While Golder supports this intitiative, as VFPA's reviewer, our comments were confined to those project aspects that fall within the VFPA's jurisdiction.

Starting with the initial review through to and including the present review, the VFPA maintained separation from Golder as a third party. In this respect, VFPA did not review Golder's draft reports nor did they vet the content of those reports or the present report. Golder provided occasional and high level progress update briefings to VFPA and served as a technical resource to VFPA as needed.

1.2 Previous Review of Fraser Surrey Docks Environmental Assessment

Golder previously (Golder 2014) provided review comments on the original FSD Environmental Assessment (including health assessment) relating to the above three subject areas. That review is provided as Appendix A to this report. Golder identified a number of concerns with the initial AQA and health assessment. Outstanding issues were also identified with the Aquatic Toxicity Assessment; however, FSD have since advised that the effluent from the water treatment plant will be directed to Metro Vancouver sewer. Further review of the aquatic toxicity components was therefore not part of the present third party review report. Should discharge to Metro Vancouver sewer be determined not to be feasible, Golder notes that additional work would be needed to enable seeking a permit for effluent discharge to the Fraser River and these have previously been communicated to FSD.

1.3 Previous Air Quality Review Comments

The previous review of the AQA noted that overall, the framework of the study appeared to follow a logical approach; however, the level of detail reported was insufficient to enable Golder to verify the suitability of the model approach and model inputs. Additionally, Golder noted the absence of a clear connection between the AQA predictions and the HHRA; these study components typically need a strong linkage to integrate between the data needs of a HHRA and the scenarios evaluated by an AQA.

Detailed technical comments were provided in Golder (2014) with a table of 90 separate comments. In many cases, these were readily answerable by the AQA consultant. However, additional AQA modeling was subsequently undertaken to support the HHRA. The comments on the initial AQA are detailed in Golder (2014) and are included here in Appendix A.

1.4 Previous Human Health Assessment Review Comments

The previous review of the health assessment carried out by FSD's consulting team identified what Golder felt were a number of shortcomings, largely arising from the view that the assessment did not follow a commonly accepted framework for an HHRA. This departure was such that Golder was concerned that:

- The suite of contaminants addressed by the health assessment were not appropriately identified;
- The receptors (exposed people) were not appropriately identified;

- The quantification of the exposure to project contaminants was not adequately quantified; and
- The risks identified were not assessed through the application of commonly accepted methods used by human health risk assessors.

As a result of these findings, the VFPA determined that they could not conclude their project review process based on the health assessment provided and required the proponent (FSD) to undertake a HHRA in accordance with commonly applied frameworks for such an assessment. This report provides a review of the resulting HHRA as well as the supporting AQA.

2.0 REVIEW COMMENTS ON THE AIR QUALITY ASSESSMENT

The final AQA report (Levelton, 2014) follows a logical approach, and provides a greater level of detail, explanatory text and referencing than the previous draft report (Levelton, 2014). Technical comments provided by Golder on the draft report and emissions inventory (provided in Appendix A) appear to have been incorporated into the final report.

While the report presents a reasonable estimate of air quality that is suitable for its intended purpose of supporting the HHRA, there are some areas of the report where added clarity could be provided. These comments are not expected to impact on the HHRA and it is recommended that they be addressed at the permitting stage.

- Section 9.0 of the air quality report provides ambient concentrations of COPCs resulting from combustion emission sources. It is unclear from the air quality report and HHRA how ambient concentrations of COPCs associated with the other project emission sources have been derived, and subsequently combined with ambient concentrations of COPCs resulting from combustion emission sources. Clarity should be provided at the permitting stage and addressed through the AQMP and associated recommended monitoring.
- The air quality report provides predicted total deposition rates associated with project activities, and also predicted deposition rates for certain COPCs resulting from combustion sources. It is unclear how deposition rates for the COPCs resulting from project activities have been derived from the predicted total deposition rates presented in the air quality report. It is also unclear how the deposition rates associated with the combustion sources (presented in Section 9.0 of the air quality) have been combined with deposition rates from other project emission sources to derive total project deposition rates of COPCs.

- The parameters included in Section 9.0 of the AQA report included a number of VOCs, PAHs and metals. Within Section 9.0, all the parameters appear to be cumulatively referred to as VOCs, which is not technically correct. For example, arsenic is not considered to be a VOC. This comment does not materially affect the ambient concentrations, rather it is considered to be a data presentation issue.
- While an emmissions inventory was done, it was not presented in the report. The inclusion of the emissions inventory in a report appendix would provide additional clarity for the reader on emission quantification.

An updated Air Quality Management Plan (AQMP) was not provided for review. We understand that through discussions with FSD and VFPA, there was agreement that the provision of an AQMP could be incorporated as a condition of Environmental Assessment approval. The AQMP should include monitoring parameters/locations, action and trigger levels, subsequent actions to be taken and the associated timeframe should action/trigger levels be exceeded, as well as reporting requirements. We also recommend that the monitoring program have an additional objective of confirming the AQA predictions. Specifically, the monitoring program should confirm that the modelled predictions are supported by the measured data.

Golder notes that the AQA was predicated on an assumption of upgraded emmissions controls for the agricultural products handling. As the AQA assessment links the coal transfer project to the agricultural products emmissions control upgrades, Golder recommends that this same linkage be set out in permit conditions. Alternatively, a revised AQA and HHRA may be required.

The air quality report indicates that FSD are currently applying for an Air Quality Emissions Permit from Metro Vancouver. It should be noted that comments provided by Golder herein do not explicitly consider requirements for a technical assessment to support a Metro Vancouver air emissions permit.

The review undertaken was limited to the final report pages. Final model input files and supporting files have not been reviewed by Golder.

3.0 REVIEW COMMENTS ON THE HUMAN HEALTH RISK ASSESSMENT

The *Human Health Risk Assessment: Fraser Surrey Docks Direct Transfer Coal Facility Revised Final Report* (SNC-Lavalin, July 18, 2014, referred to here as the "Revised Final HHRA") follows a logical approach, and provides a greater level of detail, explanatory text and referencing than the previous health assessment.

In addition to reviewing the overall report approach in the context of an established HHRA Framework, methods used, evaluation of uncertainty and the conclusions reached, Golder also carried out spot checks of some of the calculations and reported values in the Revised Final HHRA which included the following:

- A review of the report and approach taken, an identification of potential issues for clarification and consistency with the Health Canada risk assessment framework;
- Checking the worked example calculations (Appendix II of SNC-Lavalin revised final HHRA);
- Checking for consistency between results in tables and report text as well as corresponding appendices (over half of the tables were spot checked);
- Checking the toxicity reference values utilized in the Revised Final HHRA (approximately 40% of the values were spot checked);
- Checking the screening criteria utilized in the AQA (approximately 80% of the values were spot checked).

Our review comments on the Revised Final HHRA follow, presented by the four main risk assessment components identified in commonly used HHRA frameworks.

3.1 Problem Formulation

The first stage in the risk assessment process is the problem formulation which is based on knowledge of the site and predictions of contaminant concentrations in the environment. The problem formulation focuses on identifying the contaminants of potential concern (COPCs), the potential human receptors, and how exposure to the contaminants could occur. These three elements are integrated into a conceptual exposure model, which illustrates the pathways by which a receptor may be exposed to a contaminant. The purpose of the problem formulation is to distinguish between pathways for which further quantitative analysis is warranted and those that do not warrant further analysis either because the potential for risk is minimal, or because a simple solution for mitigating the potential exposure exists.

The problem formulation provided background information on the project description and location, the COPCs, people that could be exposed to the COPCs as well as the exposure pathways by which people could be exposed. A conceptual model was developed to provide a visual summary of the main elements under study in the Revised Final HHRA . While the conceptual model graphic (Figure 3-6 of the Revised Final HHRA) depicts a train rather than a direct transfer coal facility at a port, the exposure pathways and receptors are nevertheless appropriately

considered within the body of the Revised Final HHRA. The problem formulation follows the approach outlined in applicable Health Canada risk assessment guidance (Health Canada, 2012). The Problem Formulation step was also a suitable point in the HHRA process to provide an interim review and Golder requested (and was provided) an opportunity to review the draft Problem Formulation that was incorporated in the Revised Final HHRA. Golder's comments on this draft of the problem formulation are documented in Appendix C.

There are various approaches that are used by risk assessors for identifying COPCs including screening of potential COPCs against applicable environmental quality guidelines or standards to reduce the list of subtances assessed to a more easily manageable but still relevant list. SNC-Lavalin elected to retain all the COPCs they identified in the risk assessment which is a more conservative approach. Golder believes that the selection of COPCs in the Revised Final HHRA is sufficiently comprehensive to support the evaluation of human health risks.

Receptors of potential concern were identified by SNC-Lavalin and are as follows:

- Residents (maximum exposed North Delta resident and maximum exposed rail corridor resident);
- Urban park users (residents are a surrogate);
- Industrial workers;
- Commercial workers (industrial workers are a surrogate); and
- Recreational fishers on the Fraser River (industrial workers are a surrogate).

The selection of receptors of potential are concern are appropriate based on the surrounding land use and the preliminary air quality predictions provided by Levelton in the EA. Golder also provided input into the selection of receptors of potential concern at the review of an interim problem formulation draft (Appendix C). Similarly, the exposure pathways (provided in Table 3-14 of the SNC-Lavalin report) assessed in this HHRA are appropriate based on the potential sources of COPCs and surrounding land use.

Golder did not check specific receptor locations as identified by SNC-Lavalin (i.e., confirmation of locations of schools and parks listed in Section 3.1.2.2). SNC-Lavalin remain responsible for their selection of specific receptor locations in their HHRA.

SNC-Lavalin used arithmetic mean concentrations to characterize soil and coal contaminant concentrations. Golder agrees that under the circumstances assessed, this summary statistic is valid. Golder requested that SNC provide a sensitivity analysis with respect to the use of the arithmetic mean versus the generally more

conservative 95% upper confidence limit of the mean (UCLM) for a subset of parameters. A sensitivity analysis is a check on the extent to which the results, such as risk assessment findings are sensitive to different approaches (in this case, summary statistics).

The requested sensitivity analysis was conducted by SNC for several substances. The substances selected for the sensitivity analysis were those with the greatest difference between the mean and 95% UCLM and those with higher reported toxicities. The sensitivity analysis is presented in Section 7.1.1 and Appendix VIII of the Revised Final HHRA. The conclusion of the sensitivity analysis was that the use of the mean value rather than the 95% UCLM did not significantly increase the risk estimates for the substances selected and that overall the use of the mean does not impact the conclusions of the risk assessment. The sensitivity analysis focused on the effects of the use of mean versus 95% UCLM values for coal only (i.e., not soil).

Golder identified several transcription errors in the report as outlined in Appendix E; however, Golder evaluated the potential impact of those transcription errors and is of the view that these do not materially affect the conclusions of the HHRA.

3.2 Exposure Assessment

The exposure assessment provides an overview of how the concentrations used in the risk asessment were derived for air, soil, vegetation for the Baseline, Project and Cumulative cases. The exposure data utilized in the HHRA are from the Levelton air quality report (Levelton [2014]; acute and chronic air quality concentrations and deposition rates) as well as measured concentrations of COPCs in coal and soil obtained by SNC-Lavalin. SNC-Lavalin used these data to provide chemical specific deposition rates and associated inputs into their exposure model. Baseline air quality data were not available for several COPCs and SNC-Lavalin selected values from the literature for Canadian and European cities.

The exposure assessment provides the equations used to calculate the exposure doses, and summarizes the relative dermal absorption factors used to adjust dermal exposure to soil for comparison to oral toxicity reference values. The exposure equations and relative dermal absorption factors are consistent with those outlined in Health Canada risk assessment guidance (Health Canada 2012).

Golder reviewed the worked example calculation (Appendix III, Revised Final HHRA) in which SNC-Lavalin outlines how exposure doses and risk estimates where calculated for a specific chemical. The worked example calculations were found to be correct and compatible with Health Canada Guidance (Health Canada, 2012). The challenges posed by the lack of background air quality concentrations for some substances are a circumstance of the absence of background data. Golder requested that SNC-Lavalin provide a sound rationale for the use of the literature-based background air quality concentrations used for substances for

which no monitoring data are available. Golder also asked that SNC-Lavalin provide an assessment of how representative these literature values are for residential locations near a direct transfer facility. In particular, Golder requested that a sensitivity analysis include an assessment on acrolein for which hazard quotients currently approach unity - a sensitivity analysis was requested to provide clarity as to how the selection of the background concentration for this substance affects overall risk estimates. SNC-Lavalin has selected an alternate approach and instead conducted a sensitivity analysis of toxicity reference values used to generate the hazard quotients (risk estimates) which is detailed in Section 6.2.3 of the report. This alternative approach is reasonable.

Golder identified a few transcription errors as outlined in Appendix E; however, Golder evaluated the potential impact of those transcription errors and Golder is of the view that these do not materially affect the conclusions of the HHRA.

3.3 Toxicity Assessment

The toxicity assessment follows the hierarchy of sources for toxicological reference values provided by Health Canada guidance (Health Canada, 2012). Professional judgement was utilized in cases where regulatory agencies had derived toxicity reference values based on new scientific information. Golder agrees with the rationale provided for selection of alternate toxicity reference values (i.e., deviations from the Health Canada hierarchy when newer toxicity studies were available).

SNC-Lavalin found that there was limited toxicity information on the dust palliatives and their constituents and elected to assume that the entire amount of dust palliative applied was the most toxic comstituent of the palliative, epichlorhydrin, This assumption was based on the information provided in the manufacturer's safety and data sheets as well as available human and occupational toxicity information. It is noted that the occupational toxicity information was only utilized to provide a relative toxicological ranking of the constituents of the dust palliatives rather than for a toxicological assessment as is appropriate for the type of risk assessment. The application of a surrogate was discussed with Golder and supported under these circumstances. Additional rationale for the surrogate was provided in the Revised Final HHRA.

Golder identified a few transcription errors as outlined in Appendix E. We have considered the potential impact of these transcription errors and do not feel that they affect the overall conclusions of the risk assessment.

3.4 Risk Characterization

The risk characterization follows the approach recommended by Health Canada (2012) and involves the comparison of estimates of exposure dose to established toxicity reference values (reviewed as per our comments in Section 3.3) to determine the potential for adverse human health risks. SNC-Lavalin utilized established thresholds for risk characterization (Health Canada, 2012) in their determination of the potential for adverse health risks.

Risk estimates in the Revised Final HHRA are provided by major receptor type (maximum North Delta resident [toddler and adult], maximum rail corridor resident [toddler and adult] and adult industrial workers at the fenceline of the property). A qualitative assessment is provided for other receptors for which the major receptor types are surrogates (i.e., in this case the residential scenario is protective of an agricultural receptor). Risk estimates are provided for acute and chronic inhalation assessments for gaseous substances and a multi-media assessment for substances with the potential to bioaccumulate. The risk characterization includes a detailed uncertainty assessment providing a rationale for the type of uncertainty, the effect that it has on the risk estimates and whether it has the potential to over- or underestimate risk. SNC-Lavalin found that the majority of the sources of uncertaintly identified likely contributed to an overestimate of risk which is consistent with the appropriately conservative assumptions made in several areas of the assessment.

Golder identified several transcription errors between the tables in the report and the tables in the supporting appendices, as outlined in Appendix E; however, these transcription errors did not affect the conclusions of the HHRA. One apparent error was identified in the calculation of chronic inhalation risk estimates for industrial workers exposed to carcinogens. Golder requested that SNC-Lavalin confirm the calculation. SNC-Lavalin provided revised risk estimates (Appendix D) and while the risk estimates changed slightly, the overall conclusions did not.

4.0 SUMMARY AND RECOMMENDATIONS

Golder's review of the previous health assessment and AQA as well as the final AQA and the Revised Final HHRA evaluated the studies in the context of commonly used frameworks and common practices used in AQAs and HHRAs. In Golder's view, the approaches used are consistent with common practices in these discipline areas.

4.1 Air Quality Assessment

The AQA followed a logical approach and used methodology that is commonly utilized in such studies.

The AQA assessment document did not include the emissions inventory, which is a common component of the AQA. However, on asking, Levelton provided this inventory and our review indicates that it represents a reasonable emissions inventory for the intended purpose. VFPA should verify that their permit files contain both the assessment and the emissions inventory.

4.1.1 Recommendations

A revised AQMP was not provided with the AQA submission. Golder recommends that an updated AQMP, acceptable to the Port be provided as a condition of permitting. This plan should take into account the need for monitoring to confirm the AQ model and HHRA predictions, particularly where the HHRA predicted hazard quotients approach unity. The plan should also identify what reasonable mitigation could be applied in the event that monitoring indicated conditions that were near thresholds. Further detailed recommendations for monitoring and follow-up items to be addressed at the permitting stage are provided in Section 2.0 of this report.

4.2 Human Health Risk Assessment

The HHRA evaluated the people who would be potentially exposed to emissions from the project, provided a comprehensive listing of the substances that might be contained in those emissions and evaluated the pathways by which people could become exposed to those emissions. The area for potential exposure by people to air emissions is considerable and extends beyond the Port Authority's jurisdictional boundaries. Nevertheless, a reasonable approach was used, supported by conservative assumptions, to evaluate whether or not the offsite receptors (people) would be exposed to harmful conditions.

Golder evaluated the assumptions and approaches that were used in the Revised Final HHRA. Where Golder felt it was necessary, additional information was requested from SNC-Lavalin and in some instances, additional evaluation of health risks were requested.

It is common in an HHRA that there will be components of the study that may not be fully understood and assumptions must be made. This is common for such assessments and it is common that the risk assessor would make assumptions that are deliberately conservative (erring on the side of caution) and that the assessor would have a good understanding of areas of scientific uncertainty. As is common and proper practice, an assessment of that uncertainty was carried out in the Revised Final HHRA and Golder is of the view that the uncertainty assessment captures the important areas of uncertainty and reasonably evaluates their impact on the risk characterization. Golder is satisfied that the methods used and professional judgement made is in general conformance with recognized HHRA frameworks (in particular Health Canada, 2012) and that the estimates of human health risks are reasonable, and likely conservative.

While the HHRA concludes that receptors would not be subjected to unacceptable risks, Golder notes that some of the risk predictions approach a hazard quotient of 1. While the Health Canada guidance on this matter is not explicit, in Golder's view, a human health risk assessor would commonly take note of a hazard quotient of greater than 0.8. Golder believes that these calculated hazard quotients are the outcome of a sequence of appropriately conservative assumptions rather than an indication of "near risk". Nevertheless, we feel that it would be appropriate to either re-evaluate the conservative assumptions that were made and recalculate risks or to identify these elevated predictions as an item that should be addressed in the AQMP through monitoring and additional mitigation should the monitoring results indicate that to be warranted. Such monitoring would normally be a condition of permitting.

4.2.1 Recommendations

Some of the risk estimates are near the thresholds where a potential for risk appear to be indicated. These risk estimates are likely the result of a series of conservative assumptions; this is not unusual in an HHRA. Nevertheless, Golder recommends that the uncertainty be resolved through air quality monitoring. Monitoring data will bridge the gap between predicted and actual data. Golder understands that the specifics of such monitoring will be advanced directly by VFPA and possibly Metro Vancouver and may be part of the AQMP that is to be developed by VFPA's permitting process. Some of the specifics that should be addressed in the AQMP and monitoring program are outlined in Section 2 and 4.1 of this report.

In the event that monitoring identifies conditions that are worse than expected, we recommend that the HHRA be updated with these new data.

5.0 CLOSURE

We trust that the foregoing is sufficient for your present needs. Should you have any questions or concerns, please contact the undersigned.

GOLDER ASSOCIATES LTD.



Lee Nikl, M.Sc., R.P.Bio.
Principal, Senior Environmental Scientist



Audrey Wagenaar, M.Sc., P.Chem., DABT
Associate, Senior Environmental Scientist



Rachel Wyles, M.Eng., P.Eng.
Air Quality Specialist

LN/AW/rja

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

o:\final\2013\1421\13-1421-0036\1314210036-008-r-rev0\1314210036-008-r-rev0 risk&air quality - third prty rev. 07aug_14.docx

6.0 REFERENCES

Golder Associates Ltd. 2014. Third Party Review: Fraser Surrey Docks – Proposed Direct Transfer Coal Facility. January 9, 2014. Report No. 1314210036-001-R-Rev0.

Health Canada. 2012. Federal Contaminated Sites Risk Assessment in Canada. Part 1: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 2.0. September 2010, Revised 2012. Contaminated Sites Division, Safe Environments Programme, Health Canada.

Levelton Consultants Ltd. 2014. Fraser Surrey Docks Direct Coal Transfer Facility: Air Quality Assessment. Dated June 20, 2014.

SNC-Lavalin Inc. 2014. Human Health Risk Assessment. Fraser Surrey Docks Direct Transfer Coal Facility. Revised Final Report. Dated July 18, 2014.

APPENDIX A

Golder Associates Initial Review Report on Fraser Surrey Docks Proposed Direct Transfer Coal Facility (January 9, 2014)

January 9, 2014

REVIEW REPORT

THIRD PARTY REVIEW

Fraser Surrey Docks - Proposed Direct Transfer Coal Facility

Submitted to:
Vancouver Fraser Port Authority
100 The Pointe
999 Canada Place
Vancouver BC
V6C 3P4



Report Number: 1314210036-001-R-Rev0

Distribution:

3 copies - Vancouver Fraser Port Authority
2 copies - Golder Associates Ltd.

Golder Associates

Review Limitations

This report (the "Report") was prepared for the exclusive use of the Vancouver Fraser Port Authority for the express purpose of providing a third party review of specific components of an environmental impact assessment as described in the report. In evaluating the components, Golder Associates Ltd. (Golder) has relied in good faith on information provided by others. We have assumed that the information provided is factual and accurate. We accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of others.

Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the sole responsibility of the third parties. If a third party requires reliance on this Report, written authorization from Golder is required. Golder disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The scope of Golder's assessment is described in this Report, and is subject to restrictions, assumptions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report nor did Golder undertake any of its own studies or evaluation of risk. Conditions may therefore exist which were not detected given the limited nature of the assessment Golder was retained to undertake with respect to the site and project and additional environmental studies and actions may be required. In addition, it is recognized that the passage of time affects the information provided in the Report. Golder's opinions are based upon information that existed at the time of the writing of the Report and that was described by others in the documents reviewed. It is understood that the services provided for in the scope of work allowed Golder to form no more than an opinion of the actual conditions at the site and assessments undertaken at the time the work was carried out, and cannot be used to assess the effect of any subsequent changes in any laws, regulations, the environmental quality of the site or its surroundings. If a service is not expressly indicated, do not assume it has been provided.

The results of an assessment of this nature should in no way be construed as a warranty that the remainder of the environmental impact assessment, or its underlying data, which could not be reviewed, is free from any and all contamination, errors, omissions, or inconsistencies.

Table of Contents

1.0 INTRODUCTION 1

2.0 AQUATIC POLLUTION ISSUES 2

2.1 Toxicity of Coal 2

2.2 Toxicity of Dust Palliatives 2

2.3 Effluent Management 3

2.4 Environmental Management 5

2.5 Spills and Malfunctions 6

3.0 AIR QUALITY ASSESSMENT 7

4.0 HUMAN HEALTH RISK ASSESSMENT 9

4.1 Problem Formulation 10

4.2 Exposure Assessment 10

4.3 Toxicity Assessment 11

4.4 Exposure Assessment 12

4.5 Risk Characterization 13

5.0 REFERENCES 14

TABLES

Table 1: A list of dust palliatives provided in the Environmental Impact Study. 3

APPENDICES

APPENDIX A

Summary of Review Findings: Air Quality Assessment.

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by the Vancouver Fraser Port Authority to carry out a third party review of components of the Environmental Impact Assessment (EIA) carried out for the Fraser Surrey Docks proposed coal load-out operation. Specifically, Golder was asked to review the air quality modeling and predictions made, the human health risk assessment and the potential aquatic pollution issues associated with the project. Golder is aware that there are other concerns that have been raised; however, the scope of our review was limited to these three areas.

2.0 AQUATIC POLLUTION ISSUES

2.1 Toxicity of Coal

The review of the toxicity of unburned coal is sufficient and agrees with the general view that unburned coal is not toxic to aquatic organisms.

The overview provided on the toxicity of unburned coal reflects the literature on coal; while coal contains polycyclic aromatic hydrocarbons (PAH) they are not present in a form that is bioavailable to aquatic organisms within the coal. The literature review on the aquatic toxicity of unburned coal provided in the Environmental Assessment document is not exhaustive but for the purposes of this project is adequately described.

The characterization of runoff has not included the influence of coal dust palliative compounds. The need to address this depends on effluent management decisions.

We note that the authors did identify certain characteristics of the commodity to be shipped (metal and metalloid concentrations, PAH). Presumably, because data were available on the coal to be shipped, data on the characteristics of the stockpile runoff would be available from elsewhere and these data should be sourced if available and used to support the arguments presented. The conclusions provided on the runoff quality are provided based on coal alone but have not included consideration of the dust suppressant agents and "topper agents" (further comment provided below in the section on dust palliatives), some of which may be toxic to aquatic organisms. The runoff referenced will originate from coal that has contacted these various dust palliatives. The implications of this data gap will depend on whether the effluent will be directed to the sanitary system or the Fraser River. Further discussion on this matter is provided in Section 2.3.

It is worth noting that the nature of the Fraser Surrey Dock coal loadout facility is such that the storage of coal is not intended as part of the normal operation. Stockpiles of coal, which we understand to exist only under exceptional circumstances, will have a short storage duration at FSD (according to the documents, less than 4 days and only as a result of emergency situations) and we would therefore expect that the opportunity to form degradation products would be limited within such a short time frame. We further understand that coal handling and storage areas are such that drainage is captured and can be treated; however, should discharge to the environment be necessary, additional characterization of expected drainage quality may be necessary.

2.2 Toxicity of Dust Palliatives

We note that the use of dust suppressing and topper agents (collectively referred to here as dust palliatives) is a significant part of the mitigation strategy to prevent airborne particulate emissions from the project and we support this objective as a good practice. This concept should be developed through to completion so that unintended consequences such as aquatic toxicity do not result.

The document on the aquatic toxicity of unburned coal makes reference to "non-toxic dust suppressants". However, no information on these dust suppressants or

their toxicity is provided in that document. It is unclear how the conclusion that they are non-toxic has been reached. Intuitively, one might expect that the dust suppressants are intended to adhere to the coal particles; however, such substances are often added in excess or subject to spills. We are aware of at least one type of dust suppressant that has very high toxicity and resulted in an extensive fish kill in Wagg Creek, North Vancouver. There are other dust suppressing agents that have much lower toxicity. However, information on the aquatic toxicity of the selected dust suppressants is not provided.

While the use of dust palliatives shows promise in reducing risks from airborne coal dust, their aquatic toxicity has not been adequately described.

A list of agents is provided in Volume 2 of the EIA. Soil Sement has sufficient aquatic toxicity data to indicate that it has low aquatic toxicity (but is not "non-toxic"). Beyond that, however, toxicity data are largely unavailable (Table 1) for the remaining five dust palliatives identified. Rather than attempt to predict how the various mixtures used will be toxic, it would be preferable to have data from stored piles or wash out water from rail cars where the same or similar materials are used to identify whether or not toxicity to fish and aquatic invertebrates is likely to occur within runoff. This will take into account the adhesion/release from coal under field conditions and toxicity will better reflect factors such as bioavailability, the presence of toxicity ameliorating agents and interactions between the various dust palliatives used.

During our review it was unclear if additional dust palliatives were identified for use in other parts of the Environmental Assessment. Golder recommends that the substances to be used be identified with clarity and specified in the operations Environmental Management Plan.

Table 1: A list of dust palliatives provided in the Environmental Impact Study.

Dust Agent	Aquatic Toxicity Data Provided
Nalco Dustbind Plus	No toxicity studies conducted
Midwest Soil-Sement	Acute toxicity for 3 species
AKJ CTS-100	No information
AKJ CTS-100C	No Information (biodegradable)
Rantec Capture 3000	No toxicity data available
MinTech Min Topper S+0150	No information

2.3 Effluent Management

The treatment methods proposed by Omni Engineering represent known technologies, similar to those used in other locations.

Effluent management at this facility is described in the Omni Engineering Inc. (Omni) Technical Memorandum (2113-1). Omni notes that a "surprising amount of coal-laden wastewater" is produced from coal terminals and that the Fraser Surrey Docks facility will have a surplus water balance. The following comments are provided with respect to effluent management:

- It was difficult to find a comprehensive statement on effluent management other than the Omni Technical Memorandum. In some cases, differing effluent management is specified (Environmental Management Plan, Section 2.4). A statement providing verification that all areas where coal is stored or handled are contained with drainage directed to the water treatment plant would be useful. In our review, we have assumed that this was the case.
- For the most part, the wastewater management system seems to have been well considered and designed for the purposes stated. Treatment methods used are "known technologies" with which experience in other locations exists.
- The design of the effluent treatment system is predicated on discharge to Metro Vancouver sewer. The wastewater would presumably fall within the parameters of a "Restricted Waste" as defined in Schedule B of Metro Vancouver's Sewer Use Bylaw (No. 299, 2007) because of total suspended solids and likely PAHs and Omni correctly notes that a permit would need to be issued. Golder is aware that in many sewerage areas, Metro Vancouver has been restricting wastewater entry of significant volumes due to concerns about pipe capacity. They may also have concerns about influent wastewater quality. We would consider that details of effluent disposal can be left to the permitting stage but reference to at least high level acceptance by Metro Vancouver would provide some degree of confidence that the proposed effluent management scheme is feasible – which is an appropriate level of certainty for an environmental assessment.

The water/ effluent management strategy is predicated on discharge to Metro Vancouver sewer; however, no indication of Metro Vancouver's acceptance was provided.

Further effluent characterization and possibly treatment may be required if effluent discharge to the environment will be pursued by FSD.

In the event that Metro Vancouver declines to issue a permit, discharge to the environment will be necessary. The target total suspended solids (TSS) level for the settling pond system is approximately 500 mg/L, which could be viewed as a "deleterious substance" which is prohibited from discharge by the *Fisheries Act* or may cause pollution as prohibited by the *Environmental Management Act.* In addition, the wastewater would be comprised of a recycled (multi-pass) "extract" of the dust palliative agents contained in the coal. Additional characterization of the anticipated effluent quality would be needed to address the lack of toxicity data for the dust palliatives. Because of possible shortcomings in analytical methods for the dust palliatives, the absence of toxicity data and the inherent uncertainty in predicting the toxicity of chemical mixtures, toxicity testing should be carried out.

In the event that discharge to the Fraser River is required, an assessment of the environmental effects of the discharge will be needed.

In the event that discharge to the environment is required, FSD will need to identify with the Ministry of Environment whether or not an effluent permit is required. Whether one is required or not, Golder would expect that Port Metro Vancouver would require that a technical assessment of the effluent discharge be carried out. Such assessments require consideration of the receiving environment uses, characterization of the effluent quality (which would also need to meet the requirements of the *Fisheries Act*), plume dispersion modeling and evaluation of the potential water quality impacts.

2.4 Environmental Management

The Environmental Management Plan (EMP) was a separate document prepared by Triton Consultants Ltd. (Triton). EMPs often form part of the contracting documents and place a contractually binding set of controls on the contractor that should be included in the costs of the project. The specific details of how that is implemented will vary based on the procurement method (e.g., design-build, early contractor involvement, etc.).

The EMP does not identify whether soils in the construction zone are contaminated or how contamination will be identified in the field.

Fraser Surrey Docks has a history of industrial use. As is typical of such sites, subsurface contamination is a possibility. Investigations are normally carried out in advance of project implementation because, if contamination is identified, it affects the project schedule and costs. It is possible to undertake such investigations as part of the project but the approach needs to be specified so that it is understood by all parties. It appears that the EMP was prepared in the absence of *a priori* knowledge of subsurface conditions (contamination). While the soils management plan in the EMP provides a suitable, though high level sequence of events should contamination exist, the EMP provides no specifics on what steps will be taken to inform the proponent or contractor if such contamination exists. Only some contaminants would lend themselves to visual identification and then, typically only at high concentrations.

An alternative approach is to identify the site history and based on that site history, to identify the contaminants that could be there. Sampling would then be carried out on that suite of contaminants and provides a basis upon which to plan soil excavation, worker safety, and soil disposal/management options. Many industrial facilities have already carried out such studies; if such studies are available for the area in question, that information should be provided in the EMP and in the EIA so that there is confidence that contaminated soils and/or groundwater will be correctly identified and managed. If these steps were planned, they were not specified in the EMP. In the event that the soils are contaminated, there is also a reasonable likelihood that standing water in the construction excavation could also be contaminated. The EMP does not provide indication as to whether or not excavation dewatering will be necessary, how such water would be assessed for contamination/suitability for discharge nor how excavation dewatering would be treated and disposed of.

The effluent treatment system is not consistently described throughout the EIA and indicates different treatment processes. A clear decision and description of effluent management is needed.

The EMP for operations makes reference to the use of flocculants as well as sand filtration for sediment treatment. However, the detailed engineering design for the treatment process (Omni Engineering Inc.) does not indicate the use of flocculants or coagulants and does not appear to be designed to make use of those substances or to utilize sand filtration. This discrepancy between the Omni Engineering report and the EMP appears to be a disconnect in the EIA document. The EMP also states that FSD were, as of the EMP writing (September 2012), investigating a permitted discharge to sanitary sewer. However, Golder was unable to locate confirmation in the EIA that Metro Vancouver would accept such a discharge.

2.5 Spills and Malfunctions

Environmental knowledge of dust palliative effects is necessary to plan a response to a spill of these substances.

There is insufficient information provided on the toxicity of dust palliative chemicals that will presumably be stored and used at the facility in significant quantities. Spill response planning appears to have been carried out on the presumption that these substances are non-toxic. However, for those substances with information provided (Material Safety Data Sheets), only one in six substances had toxicity information available. Such information would be relevant to the level of storage containment, spill countermeasures, and environmental consequences of a spill.

The notification process in the spill response plan is reasonable though needs to be updated to reflect changes to the Fisheries Act.

The spill response plan appropriately identifies Port Metro Vancouver, Coast Guard and the Provincial Emergency Program (PEP). However, under the recent revisions to the Canada *Fisheries Act*, there are also spill reporting obligations that are legally enforceable. These obligations have been clarified and expanded to ensure that an Inspector or Fishery Officer under the Act is notified. The obligation to notify an Inspector/Officer is likely to be carried out through existing agreements with PEP and Environment Canada. However, the expanded requirements for addressing spills (or habitat damage, which is a new addition to the Act) require that as soon as practicable a report be prepared presumably, in the absence of case law, by a qualified professional. The spill response plan does not complete the continuum of requirements for a spill. Section 38(7) of the Act prescribes the reporting duty as follows:

> *"As soon as feasible after the occurrence or after learning of the danger of the occurrence, the person shall provide an inspector, fishery officer or an authority prescribed by the regulations with a written report on the occurrence or danger of the occurrence".*

Because the Fraser River provides important habitat for numerous rearing juvenile salmon and other species of aquatic life, the plan should provide some consideration for identifying whether the spilled particulate material has resulted in damage to habitat (e.g., through filling of interstices).

3.0 AIR QUALITY ASSESSMENT

An air quality assessment was undertaken by Levelton consultants to support the environmental assessment. The following documents/files were reviewed:

- Environmental Impact Assessment for the Direct Transfer Coal Facility. November 18, 2013. Volume 3, Appendix VIII Draft Air Quality Assessment and Draft Air Quality Management Plan;
- CALMET input files (apr01.inp, jun01.inp);
- CALPUFF input files (cpuf_area1.inp, cpuf_cul_stocks1.inp); and
- Variable emission files (baemarb.dat, cul_baemarb.dat).

The air quality assessment appears to have followed a logical approach and involved the following main aspects:

The air quality assessment appears to follow a logical approach and the level of assessment undertaken appears to be suitable.

- Quantification of emissions to air from project activities;
- Development of a meteorological dataset for use in the dispersion model;
- Use of a dispersion model to predicted ambient air concentrations;
- Selection of representative ambient background air quality concentrations;
- Combination of model predictions and background air quality concentrations;
- Comparison of the results to the Metro Vancouver ambient air quality criteria to assess the air quality impacts; and
- Provision of an air quality management plan (AQMP) that outlines methods to minimize and manage emissions to air from the project, and provides details on air quality monitoring.

The level of detail reported was insufficient to verify the suitability of some of the model approach and inputs.

The calculation of emissions to air from the project is a key aspect of the assessment because emissions are one of the main inputs into the dispersion model. In general, there was an insufficient level of information provided in the assessment documents to allow us to identify whether the project emissions were calculated appropriately. Additional information and clarification was requested from Levelton consultants who did provide a response after our review had been carried out. We note that the absence of the requested information does not mean that the modeling was invalid, only that we were unable to review certain of the details.

For other aspects of the air quality assessment, there was an insufficient level of detail, literature citation and/or justification provided to allow a detailed review of the

assessment approach. This was most notably the case for the sections of the air quality assessment report that explained the emissions calculations, how the emission sources were represented in the dispersion model, and the selection of inputs that were used in the dispersion model.

The air quality assessment is typically integral to the Human Health Risk Assessment; however, the two studies need stronger linkage.

Golder feels that there would be value in developing stronger linkages between the air quality emissions and dispersion modeling and the human health risk assessment. The air quality modeling is normally an important accompanying component of a human health risk assessment (see Section 4.0) because the air quality modeling provides necessary exposure data from which risks are calculated in the risk characterization stage of a human health risk assessment. Of specific relevance in this regard, the current air quality modeling has likely not assessed the contaminants of interest. In part, this may be due to the lack of a problem formulation step in the human health risk assessment (Section 4.1) where certain contaminants (e.g., metals/metalloids) would be identified. However, the overall approach pursued in the air quality model appears to lend itself to subsequent inclusion of additional contaminants of interest as identified by a human health risk assessment. It is not clear at this time whether or not human health receptor identification or exposure pathway identification would necessitate further model revisions.

It is possible that some aspects of the air quality assessment could underestimate ambient contaminant concentrations while other aspects could overestimate them – further detailed review is needed to confirm model results.

Detailed comments on specific aspects of the air quality assessment are provided in Appendix A. Some of the issues noted could have the potential to underestimate exposure at the receptors. For example, the air quality modeling appears to have relied on Metro Vancouver ambient air quality criteria which are based on a rolling average. To the extent that we were able to determine, it appeared that the model results are based on block averages. Rolling averages present more stringent criteria compared with block averages and therefore could underestimate contaminant concentrations. However, we also note that it is possible that the emissions calculations could have overestimated inputs to the model, an apparent example of which may be the representation of rail car unloading as not being confined within a building. The effect of the building on emissions calculations may have the effect of reducing fugitive emissions and thus modeled contaminant concentrations.

Golder notes that a number of the items where we have sought clarification or additional information (Appendix A) may be items for which Levelton have information that was not included in their report. It would be appropriate to provide them an opportunity to consider our comments, provide a response and re-run the computer model as appropriate.

4.0 HUMAN HEALTH RISK ASSESSMENT

The opinion statements provided in the EIA do not follow a commonly accepted framework for a Human Health Risk Assessment.

The Environmental Impact Assessment did not include a formal human health risk assessment; rather contained a "health effects assessment" based primarily on opinion statements from Dr. Leonard Ritter, Fellow of the Academy of Toxicological Sciences and a Professor Emeritus at the University of Guelph and Dr. Tom Watson, a biologist and Senior Environmental Scientist with Soleil Environmental Consultants Ltd. and a comparison of air quality assessment results to regulatory standards/guidelines.

Not following an accepted framework for Human Health Risk Assessment may have resulted in gaps in the contaminants, the pathways and the receptors (people) included in the assessment.

While the opinion statements provide background information about the risk assessment process, they do not follow typical procedures for a human health risk assessment to support those opinions. A human health risk assessment should be consistent with the process provided by Health Canada (2012, 2010a and b) and British Columbia Ministry of the Environment (BC MoE 2012). The discrepancies that could result from failing to follow these processes may be more consequential than a simple non-adherence to protocol; they may result in potential gaps in systematically identifying contaminants of potential concern, exposure pathways of potential concern and receptors of potential concern – all of which are part of the problem formulation step when following a recognized risk assessment process. These issues may then propagate through the remainder of a risk assessment into the subsequent stages (exposure assessment, toxicity assessment and risk characterization).

A human health risk assessment to support an environmental impact assessment may be comprised of several elements depending on the results of the problem formulation and typically include an air quality assessment, a particulate matter assessment and a multi-media assessment. A problem formulation is necessary so that the articulation of risk (provided through an opinion statement in the FSD environmental assessment) is broad enough to cover the issues of concern to stakeholders.

The opinion statements provided in the environmental assessment do include some quotes from other parts of the document; generally the problem formulation of a risk assessment in an environmental assessment will provide information about project linkages and data received from other discipline teams which would be linked to a human health risk assessment. These linkages were unclear. Some examples are linkages between concerns expressed in the consultation efforts and receptor/exposure pathway assessments to identify health risks or linkages between the health evaluation and emissions inventories and air quality results produced by the air quality practitioners.

Further comments on the evaluation of health impacts provided in the EIS are provided below.

4.1 Problem Formulation

Comprehensive identification of chemicals of potential concern – The opinion statements focus on coal dust which is important but is also a complex mixture comprised of particulate matter, silica, metals and polycyclic aromatic hydrocarbons (PAHs). A human health risk assessment for an environmental impact assessment would generally include air quality predictions of these substances at receptor locations identified to be of potential concern in the problem formulation. Wet and dry deposition rates at these receptors locations are needed for substances that have the potential to bioaccumulate. It is noted that the aquatic toxicity letter report, co-authored by Dr. Watson included some comments on PAHs and metals but these were not included for the human health assessment in the opinion statements.

The selection of contaminants to be assessed should follow a structured, transparent and appropriately comprehensive process. Some contaminants may have been missed and thus not assessed.

Generally a comprehensive list of contaminants is generated based on discussions with the air quality engineers and review of the emissions inventory that they have developed. Air quality predictions are generated for baseline and project cases and compared to environmental quality guidelines to determine project related change in concentration and whether these substances exceed environmental quality guidelines. It is noted that air quality predictions have been generated for PM2.5 and PM10 and selected criteria contaminants in Section 7.0 of the EIA document but not for other chemicals that could potentially be present from the facility. There is little linkage between these results and the opinion which focused exclusively on coal dust. Such linkages are important because they are relevant to the validity of the exposure assessment.

Receptor selection – Clear rationale is not provided in either Section 7 of the EIA document or the opinion statements as to which receptor locations were selected for the health assessment and why. An advantage of following the human health risk assessment process is that it provides a structured approach to selecting receptors used in the risk assessment, which in turn facilitates the exposure assessment and the selection of appropriate benchmarks and calculations in the toxicity assessment. There should also be input from the Socio-economic baseline studies (e.g., school locations) in determining these receptor locations.

The rationale for identification of receptors has not been provided; this gap could influence subsequent stages of a Human Health Risk Assessment

4.2 Exposure Assessment

An exposure pathway assessment was not carried out in either Section 7.0 of the EIA document or the opinion statements and a rationale for exclusion of pathways other than exposure to coal dust in air was not identified in our review. For example, in the opinion statement, a rationale for exclusion of assessment of particulate matter (PM2.5, PM10, etc.) has not been provided. Similarly, neither the opinion statement nor Section 7 of the EIA document provide a rationale for the exclusion of a multi-media assessment related to deposition of coal dust and associated contaminants to local residential areas and how this could affect soil or locally grown produce over time.

It would appear that pathways that should have been evaluated were not.

4.3 Toxicity Assessment

A toxicity assessment involves the identification of an appropriate benchmark (the receptor selection and exposure pathway assessment informs that selection) and the modeled concentrations are compared to that benchmark in the risk characterization step.

The health opinion statement in the EIA is based on a comparison to an occupational standard, which is not an appropriate standard to evaluate health effects for residential receptors.

The health assessment contained in the opinion statements is based on an occupational standard. It is not considered appropriate to use an occupational standard (threshold limit value) to provide comment on potential health effects for residential receptors. Occupational standards do not include the same degree conservatism as those standards developed to protect the general public because:

- Workers are aware that they are being exposed to a particular substance in the workplace and they are provided with and trained in the use of personal protective equipment to mitigate the exposure as needed;
- The threshold limit values are not protective of sensitive subpopulations (as indicated by Dr. Ritter) and may also not be protective of a continuous lifetime exposure; and
- Health Canada (2010b) indicates that occupational standards (threshold limit values) should not be utilized in human health risk assessments for the general public except under extenuating circumstances.

It is not clear why comparisons to a threshold limit value for coal dust are being made in the expert opinion contained in the EIA while all the screening in the air quality report is conducted for particulate matter and total suspended particulate – there appears to be a lack of consistency, or clarity within the EIA. An alternative approach would be the consideration of the toxicity associated with the individual constituents of coal dust.

The current science does not support a threshold for particulate matter below which no adverse health risks exist and the lower end of the range of concentrations associated with potential health effects is not much different that background concentrations for PM2.5 in many countries (WHO 2006). Health Canada no longer supports the Health Canada/Environment Canada “SUM15” reference level (i.e., threshold) approach for determining potential human health effects associated with exposure to particulate matter with a diameter less than 2.5 µm (PM2.5; Health Canada and Environment Canada 1999). While the Ritter document indicates that a typical approach would be to apply an uncertainty factor to account for sensitive subpopulations when deriving a toxicity reference value, this would generally only be applicable for substances for which there is a toxicity threshold.

This statement provided in the Ritter document on coal dust also appears to contradict the text provided on page 142 of the EIA:

> *"WHO* [World Health Organization] *have noted that epidemiological studies on large populations have not identified a threshold concentration for non-mortality endpoints below which ambient PM has no effect on health (SENES 2005; WHO 2006; CCME 2004). It is important be aware that a range of thresholds may exist within a population, depending on the type of health effect and the susceptibility of subgroups; noting, however that there is no threshold for effects at the population level, other than mortality (as noted above) and for the most sensitive subgroups have been identified (SENES 2005). WHO (2006) and SENES (2005) have indicated that threshold levels for effects other than mortality have not been identified, the air quality guidelines have been derived on the basis of mortality and reflect concentrations below which increased mortality outcomes due to exposure to PM air pollution are not expected based on the current body of scientific evidence."*

The Ritter document also provides a discussion about the carcinogenicity of coal dust and states that the International Agency for Research on Cancer (IARC) has indicated that there is inadequate evidence of carcinogenicity of coal dust in humans or experimental animals (IARC 1997). Several of the constituents (some metals/metalloids and PAHs) of coal are known human carcinogens so it would be relevant to assess these constituents individually.

4.4 Exposure Assessment

Some potential exposure pathways of concern do not appear to have been considered and health risks associated with these pathways would therefore not have been evaluated.

As indicated in the Problem Formulation comments (Section 4.1), the exposure assessment should be based on an appropriate selection of receptors (people) and exposure pathways. Some of the pathways that do not appear to have been addressed in the opinion documents include:

- Toddlers exposed to metals/metalloids, PAHs in soil;
- Residents consuming produce impacted by aerial deposition and increased contaminant concentrations in soil.

Other pathways may also be identified in undertaking a problem formulation.

Golder notes reference to SENES 2012 which was mentioned in the EIA. That document was not reviewed as part of our scope; however, it appears to be a human health exposure assessment but its linkages to a health risk assessment are less clear. It may provide useful data for a subsequent health risk assessment.

4.5 Risk Characterization

The information provided in the health assessments (opinion statements) does not allow a characterization of human health risks in the context of recognized frameworks for such assessment. A Human Health Risk Assessment following an accepted framework should be carried out.

As the result of the gaps identified above, it is not possible to determine whether there are potential risks to human health or not. Golder recommends that a human health risk assessment, utilizing methodology applicable to the jurisdiction in which the project is situated, be carried out.

Golder wishes to note that our review has focused on the methods used and conclusions reached. In identifying what we believe to be certain shortcomings, it is important that the reader not infer that we are concluding risks to be present. Rather, it is our view that the potential for human health risks should be evaluated using a standard human health risk assessment framework.

COLLEGE OF APPLIED BIOLOGY
Lee H. Nikl
Jan 9/14
R.P. Bio #601
CAB

GOLDER ASSOCIATES LTD.

Lee Nikl, M.Sc., R.P.Bio.
Principal, Senior Environmental Scientist

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
Jan 9, 2014

Rachel Wyles, M.Eng., P.Eng.
Air Quality Specialist

Audrey K Wagenaar

Audrey Wagenaar, M.Sc., DABT, P.Chem.
Associate, Senior Environmental Scientist

AW/LN/RW/lih

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

o:\final\2013\1421\13-1421-0036\1314210036-001-r-rev0\1314210036-001-r-rev0-third party review 09jan_14.docx

5.0 REFERENCES

British Columbia Ministry of Environment (BC MoE). 2008. Guidelines for Air Quality Dispersion Modelling in British Columbia.

BC MoE. 2007. Technical Guidance on Contaminated Sites #7 – Supplemental Guidance for Risk Assessments. Volume 3. October 2012.

Health Canada. 2012. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0;

Health Canada. 2010a. Federal Contaminated Site Risk Assessment in Canada, Part II:: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0; and

Health Canada. 2010b. Federal Contaminated Site Risk Assessment in Canada. Part V. Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals.

Health Canada and Environment Canada. 1999. National Ambient Air Quality Objectives For Particulate Matter Addendum To The Science Assessment Document A Report By The Federal - Provincial Working Group on Air Quality Objectives and Guidelines December 1997, Revised April 1999.

International Agency on Research on Cancer (IARC). 1997. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 68. Silica, some Silcates, Coal Dust and para-Aramid Fibrils. Available on-line at: http://monographs.iarc.fr/ENG/Monographs/vol68/index.php

Metro Vancouver. April 2013. 2011 Lower Fraser Valley Air Quality Monitoring Report.

World Health Organization (WHO). 2006. WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Global Update 2005. Summary of Risk Assessment. Available on-line at: http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

APPENDIX A

Summary of Review Findings: Air Quality Assessment.

Tracking Number	Document Section	Finding
1	All	It would be considered best practice that the draft air quality assessment and draft air quality management plan be submitted in final format to support the Environment Impact Assessment Report.
2	Section 2.0	The use of coal drainage wastewater for dust suppression is stated in Section 2.1.4.1. Additional information should be provided to confirm that this activity would not result in airborne particulate emissions from material entrained in the coal drainage wastewater.
3	Section 2.1.4.2	Paragraph 3: It appears that the units should be 0.00045 kg/MT.
4	Section 2.1.4.2	Is the minimum dust control effectiveness for the proposed dust suppression product of 90% backed up with actual data? (e.g., operational or field trials)
6	Section 4.0	It appears that baseline/background concentrations have not been used for TSP. It is suggested that background TSP could be estimated using available PM_{10} or $PM_{2.5}$ monitoring data and relationships available in literature.
7	Section 2.3	There is no or insufficient consideration of the potential impact on air quality during construction or decommissioning phases of the Project within the air quality assessment (it is noted that construction is considered within the Air Quality Management Plan (AQMP).
8	Section 4.0	Ambient monitoring stations used to derive background concentrations are located in residential areas, which may underestimate background concentrations in the industrial area. However; it is noted that this has likely been compensated for, in part, by including the adjacent agricultural terminal in the assessment.
9	Section 5.0	An emissions inventory showing emission calculations, input data and assumptions has not been provided, therefore it was not possible to verify emission calculations. Clarification has been requested from Levelton.

Tracking Number	Document Section	Finding
10	Section 5.0	It appears that Volume source #1 (rail car unloading) has been modelled as a volume source that approximates the size of the rail car. It is understood that this source will be located within a covered receiving shed, which will result in different emission release points such as building openings, building louvres/vents.
11	Section 5.0, Section 6.4	It is unclear why hourly particulate emission rates (TSP, PM_{10} and $PM_{2.5}$) are provided in the report, because the corresponding ambient air quality standards are 24 -hour averaging periods.
12	Section 5.0	It is noted that a baghouse to control fugitive particulate emissions is planned for the agricultural material railcar unloading enclosure. Further rationale on why a similar baghouse control is not planned for the coal railcar unloading enclosure should be provided.
13	Table 5-1, and throughout the document	The description of the initial lateral dimensions and initial vertical dimensions as sigma y and sigma z may be incorrect. It is suggested that the correct nomenclature is sigma y_0 and sigma z_0 respectively.
14	Section 5.4.1, Section 5.4.3	It is unclear what moisture content, particle speciation factors (k value) and material throughput were used in the emission quantification. Clarification has been requested from Levelton.
15	Section 5.4.2	It is unclear whether the literature emission factors for 'controlled' or 'uncontrolled source' were used in the emission quantification. Clarification has been requested from Levelton.
16	Section 5.4.2	If the 'uncontrolled source' emission factors were used, it is unclear how $PM_{2.5}$ emission factors were calculated. Clarification has been requested from Levelton.
17	Section 5.4.4	In section 5.4.4 it states "For the railcar and barge stockpiles a variable emission file was created which contained the actual hourly emission rates pertaining to the meteorological conditions for that hour." However, when the variable emission rate files are inspected (baemarb.dat and cpuf_cul_stocks1.inp) it is apparent from the file that emission rates sometimes don't change for hours or even days at a time. Clarification has been requested from Levelton.

Tracking Number	Document Section	Finding
18	All	Units (e.g., µg/m^3) should be included in all tables showing model results.
19	Section 5.5	The text in paragraph 1 does not seem to be consistent with Figure 5-3, specifically the text that states 'agricultural goods are then passed through material transfer points #2-6, and then loaded onto the ship'.
20	Section 5.5	Material transfer point #6 is not shown in Figure 5-3.
21	Section 5.5	The black text on Figure 5-3 is illegible.
22	Section 5.5	The text in paragraph 2 does not seem to be consistent with Figure 5-3, specifically the text that states 'pass through material transfer point #2, and then are loaded into the shed'.
23	Section 5.5	It is not explicitly stated that agricultural products are unloaded from railcars within an enclosed area. Clarification has been requested from Levelton.
24	Section 5.5	It is not explicit from Section 5.5 whether the agricultural rail car unloading, headhouse and transfer point 1 are enclosed within a building.
25	Section 5.5	It is unclear whether fugitive emissions from building enclosures have been considered, for example fugitive emissions that could occur from building vents, louvres or other openings such as doors. This comment relates to enclosures for railcar unloading, headhouse and transfer point #1 for handling agricultural sources.
26	Section 5.5	It is unclear from Figure 5-3 whether the transfer points 3 through 5 are located within the storage shed. Clarification has been requested from Levelton.
27	Section 5.5	Figure 5-3 appears to show small structures located on the roof of the storage shed, are these building vents or louvres? Clarification has been requested from Levelton.
28	Section 5.5.1	Baghouse Emissions (# 2). It is unclear what in-use adjusted fuel consumption, fraction of sulphur converted to PM, in-use adjusted hydrocarbon emissions factor and the episodic weight percent of sulphur in non-road diesel fuel have been used in the emission quantification. Clarification has been requested from Levelton.

Tracking Number	Document Section	Finding
29	Section 5.5.2	Clarification should be sought on why the emission factor for aggregate handling have been used for the material transfer points for agricultural material, rather than AP 42 Chapter 9.9.1 (US EPA 2003) head house and grain handling emission factors (legs, conveyors, belts, distributor, scale, enclosed cleaners, etc.). Clarification has been requested from Levelton.
30	Section 5.0	Details are not provided on how emissions for cumulative rail car and cumulative barge sources are calculated. Clarification has been requested from Levelton.
31	Section 5.0	Building downwash does not appear to have been considered for any of the point sources (baghouses).
32	Section 5.0, Table 5-12	The SO_2 Yard Locomotive Emission factor is listed as 0.003 g/L but in Railway Association of Canada (2012) Locomotive Emissions Monitoring Program 2009 the yard switching value is 0.18*(15/110)=0.025 g/L (Table 9).
33	Section 6.2	The rationale for using a dispersion meteorological that is 389 days (June 13, 2002 to July 7, 2001) is not clear. Generally meteorological datasets are derived based on calendar years. This dataset may provide a bias towards ambient concentrations predicted under summer (June) meteorological conditions. The potential bias should be investigated and an explanation provided.
34	Section 6.3	The geometric mass mean diameter values used appear to be high for all particle size fractions (1.25 µm for $PM_{2.5}$, 5 µm for PM_{10} and 20 µm for TSP). As a result, particle deposition could be overestimated and the resulting concentrations underestimated.
35	Section 6.3	The geometric standard deviation has been assigned the same value (1.24) for all size fractions. We would expect that the standard deviation will increase with increasing particulate size.
36	Section 6.3	A literature citation for the use of a zero frozen precipitation scavenging factor should be provided.
37	Section 6.3	It is unclear whether deposition has been activated in the model runs that were used to derive ambient concentrations. Clarification has been requested from Levelton.

Tracking Number	Document Section	Finding
38	Section 6.4	For the volume sources (rail car unloading) the initial sigma z value (δ_{zo}) value is greater than the effective height of the source.
39	Section 6.4	For the Yard Switcher sources the width to length ratio appears to be approximately 1:10. Further clarification is sought on whether CALPUFF is providing reasonable results for this source, give the aspect ratio is that high.
40	Section 6.4, Table 6-2	It appears that the naming convention for coal transfer points between Figure 5-2, Table 5-2 and Table 6-2 are not consistent. Within Table 6-2 it appears that Coal Transfer Point #3 was mislabeled as Coal Transfer Point #1, and a similar miss-labelling appears to have happened for Coal Transfer Point #4, #5+#6 and #7. Clarification has been requested from Levelton.
41	Section 6.4, Table 6-2	Based on the Yard Switcher emission rates (g/s) provided in Table 5-13 and the equivalent surface area (m^2) provided in Table 6-2 the calculated area emission rate ($g/m^2/s$) does not match Yard Switcher emission rates in Table 6-2. Clarification has been requested from Levelton.
42	Section 6.4, Table 6-2	Based on the Unit Train emission rates (g/s) provided in Table 5-13 and the equivalent surface area (m^2) provided in Table 6-2 the calculated area emission rate ($g/m^2/s$) does not match Unit Train emission rates in Table 6-2. Clarification has been requested from Levelton.
43	Section 6.4, Table 6-2	We were unable to identify where it was stated where the Railcar stock piles will be located, and consequently which model source the emissions have been assigned to. Clarification has been requested from Levelton.
44	Table 6-3	Not units are provided for point source emissions in the Table header.
45	Table 6-3	The emission rate for baghouse #1 does not appear to be consistent with the sum of the individual emission sources presented in Table 5-14.

Tracking Number	Document Section	Finding
46	Table 6-3	For fugitive airborne particulate area and volume sources (stockpiles, material transfers, agricultural transfers and conveyor transfers) the effective height used for these sources appears to be the same as the physical height of the source. For fugitive airborne particulate sources emissions will occur over the entire height of the source; therefore, the effective height should align with the vertical centerline of the plume off of the source which will not necessarily be equivalent to the source height.
47	Section 7.0	The Metro Vancouver ambient air quality objectives (Table 3-1) have been used to compare model results against. The short-term (8-hour and 24-hour) Metro Vancouver objectives are intended to be compared against concentrations calculated as a rolling average (Metro Vancouver, April 2013). It appears that concentrations have been calculated as block averages, rather than rolling averages in the modelling.
48	Section 7.3	Last paragraph - text relating to Table 7-6 indicated the table only includes emissions from the agricultural process, whereas Table 7-6 includes predictions from both the project and agricultural emissions (all sources). This should be clarified.
49	Section 7.3	For the predicted exceedence of the PM_{10} 24-hour average air quality standards, information on the frequency of exceedances could not be located. This would be helpful to provide context to the predicted exceedences.
50	Section 7.4, Section 5.4	It is unclear how emission factors have been derived for the rail and barge (In Transit) screening level assessment (exhaust and fugitive dust emissions). Clarification has been requested from Levelton.
51	Section 7.4	The screening level assessment appears to use the background concentrations established in Section 4.0 in the vicinity of the Project. Consideration should be given as to whether they are representative of the locations where the screening level assessment was undertaken, which in some cases are approximately 25-30 km away from the Project location.

Tracking Number	Document Section	Finding
52	Section 7.4	The screening level assessment appears to use background concentrations derived on 98th percentile values. The BC air dispersion model guidelines (BC MOE, 2008) indicate that for a screening level assessment the maximum value (or 100th percentile value) background value should be used for screening assessments.
53	Section 7.4	It is not clear what source and receptor configurations are used for the screening assessment of in-transit trains.
54	Appendix A, Section A-1	The opening paragraph is Section A-1 Local Climate and Meteorology states that climate data (climate normals) from the Vancouver International Airport will be compared against CALMET predictions; however, in the subsequent sections of A-1 Vancouver International Airport data is not used in the comparisons, rather it appears that the data is compared to station 'T13 North Delta'.
55	Appendix A, Section A-1	Wind-roses comparing the Delta and Annacis Island observational wind data are not temporally consistent with wind-rose for CALMET extraction at the Delta, Annacis Island and the FSD Project location. Wind roses should allow comparison.
56	Section A-1	It is not clear whether the CALMET data was extracted at the same vertical height as the observation data to allow meaningful comparison between the modelled and observed data.
57	Section A-1	For the wind rose comparison between observation and CALMET data at the Annacis island location, CALMET is predicting significantly greater calm periods (10.6% CALMET data compared to 0.7% from observations).
58	Section A-1	No information is provided on the meso-scale meteorological model (MC2). The following information should be included in the assessment report: ■ What is the grid cell size of the MC2 data; ■ How far out (number of grid cells) does the MC2 data extend beyond the CALMET domain; ■ What QA/QC procedures were undertaken to ensure that MC2 represents regional predictions; and ■ Were default values used in generating the MC2 dataset.

Tracking Number	Document Section	Finding
59	Section A-2.2	Last sentence - it is unclear what the larger model domain refers to.
60	Section A-2	The source of the terrain data was not provided. Clarification has been sought from Levelton.
61	Section A-2	In our view, a more appropriate comparison of model and measured data for wind speed and direction could be obtained through comparison of the CALMET output gird cell at the observations stations, rather than the CALMET output at the Project location.
62	Section A-2	Plots of the modelled terrain and land use were not provided in the report. A land use plot would be particularly helpful to determine, in the absence of a coastline file in the model set up, whether the water/land interface is being represented appropriately within the model.
63	Section A-2	CALMET default surface properties (surface roughness, albedo, Bowen ratio, soil heat flux, anthropogenic heat flux, and leaf area index) were used within the geo.dat file, rather than values detailed in the Guidelines for Air Quality Dispersion Modelling in BC (BC MOE 2008).
64	Section A-2	Table A-2 within Appendix A: CALMET QA/QC states that 17 surface meteorological stations were used in CALMET, this is inconsistent with the CALMET.inp files which show that 19 surface meteorological stations are used.
65	Section A-2	Due to the high density of the surface stations within the modelling domain the radius of influence between the stations (both at ground and aloft) are more like to interact with one another. This may result in anomalous wind vectors around a station(s) under certain meteorological conditions. Section A-2.2.5 within Appendix A does not address this.
66	Section A-2	The Coriolis parameter should be updated based on the facility's latitude.
67	AQMP Section 7.1	No timeframe is given for actions to be taken if opacity readings are > 20%.
68	AQMP Section 7.2	There appears to be an inconsistency between Table 6-1 and Page 22 of the AQMP. Table 6-1 which indicated monitoring will commence 6 months prior to operations. Test on Page 22 indicated monitoring will commence 6 months prior to construction. Clarification should be provided on which statement is correct.

Tracking Number	Document Section	Finding
69	AQMP Table 6-1	The rationale for not undertaking monitoring during construction operations should be provided.
70	AQMP Table 6-1	The AQMP plan appears to focus on coal dust emissions. Emissions associated with agricultural material handling should be covered within the AQMP since agricultural handling has been identified as a source of air emissions, and the air quality assessment assumed a number of emission control would be used for agricultural material handling activities.
71	AQMP Table 6-1	It is recommended that a minimum of one year of baseline air quality data be collected to fully represent the seasonality of ambient air quality in the vicinity of the Project.
72	AQMP Table 6-1	The reporting on ambient air quality monitoring should include comparison against appropriate Metro Vancouver ambient air quality objectives.
73	AQMP Table 6-1	Information should be provided on the duration of monitoring and monitoring locations for NO_2.
74	AQMP Table 6-1	Information should be provided on how the location of NO_2 measurements will be recorded and reported.
75	AQMP Table 6-1, Item #1	The action that would trigger more frequent NO_2 monitoring should be specified.
76	AQMP Table 6-1	Based on information provided within Section 5.0 of the air quality assessment, it appears that emissions of NO_X will not be consistent from the Project, rather they will peak during the day when certain specific activities are taking place such as railcar movements and barge movements. It appears that train and barge movements are limited to certain time periods within the day, notably early morning and evening. Undertaking periodic, short term (< 24 hour) monitoring could 'miss' the periods of higher NO_X emissions. Continuous monitoring of NO_2 would be considered appropriate in this situation.
77	AQMP Table 6-1	Where the table refers to 'Levelton' this should be replaced with 'suitably qualified professional'.

Tracking Number	Document Section	Finding
78	AQMP Table 6-1, Item #2	For Activity source (c) coal loaded onto barge - the planned application of water with chemicals only under certain meteorological conditions is not consistent with air quality assessment which appears to have assumed constant watering of the barge stockpile. This means the emissions from this source, and resulting ambient air concentrations of particulates may have been underestimated.
79	AQMP Table 6-1	The emergency operations provided do not appear to be considered in the air quality assessment.
80	AQMP Section 7.1	Dust mitigation goals are referred to in the first paragraph of section 7.1, however the goals do not appear to be explicitly stated anywhere within the AQMP.
81	AQMP Section 7.1	Bulleted list - associated timelines should be provided for the actions (for example, within 24 hours).
82	AQMP Section 7.2	Additional information should be provided on how the NO_2 monitoring results will be 'extrapolated' to allow comparison against ambient criteria.
83	AQMP Section 7.2 (Facility Monitoring - Nitrogen Dioxide (NO_2)	Paragraph 3 states 'If the NO_2 monitoring results indicate potential health or air quality impacts from FSD's emissions, then mitigation measures will be recommended and implemented…' It is not clear how it will be established that the monitoring results indicate potential health or air quality impacts, and therefore what triggers implementation of additional mitigation measures and follow up monitoring.
84	AQMP Section 7.3	Under 'investigative actions' this should include an assessment of the sources that are operational at the time of the investigating (as this may different form when the compliant was received).
85	AQMP Section 7.4	Temporal trends in monitoring data should also be included in the analysis/reporting.
86	AQMP Section 7.4	Comparison to relevant ambient standards should be included in the reporting.
87	AQMP	It is unclear when, at what interval monitoring results will be compared to the model results within the air quality assessment, and how this information will be reported.

Tracking Number	Document Section	Finding
88	AQMP	There are no clear actions and associated timescale if ambient monitoring values exceed ambient standards.
89	AQMP	Given the quarterly monitoring proposed, it appears to be possible that ambient air quality standards could be exceeded at monitoring locations for a number of months before this is bought to the attention of FSD.
90	AQMP Appendix B	The memorandum provides information regarding a land based emergency coal stockpile. This does not appear to be considered within the air quality assessment or the AQMP.

APPENDIX B

Golder Associates Comments on the SNC-Lavalin Human Health Risk Assessment Workplan (February 7 and March 7, 2014)

February 7, 2014

Reference No. 1314210036-003-L-Rev0

Carrie Brown
Vancouver Fraser Port Authority
100 The Pointe
999 Canada Place
Vancouver BC V6C 3P4

COMMENTS ON SNC-LAVALIN'S REVISED (FEBRUARY 3RD, 2014) DRAFT SCOPE OF WORK FOR HUMAN HEALTH RISK ASSESSMENT

Dear Ms. Brown:

Golder Associates Ltd. (Golder) has read through the February 3, 2014 revised draft scope of work (workplan) for a human health risk assessment for the proposed Direct Transfer Coal Facility at Fraser Surrey Docks (FSD), prepared by SNC-Lavalin (SNC).

Golder has been involved with this project in the capacity of a third party reviewer and as an advisor to Vancouver Fraser Port Authority (the Port). We originally provided a report with our third party review of the Human Health Risk Assessment, Air Quality and Aquatic Toxicology work that was undertaken as part of the Environmental Assessment of the Project (Golder, 2014[1]). We have discussed our role with SNC and with FSD, specifically that while we are providing comments as a third party, we are not directing this study. We are in discussions with their technical consultants, particularly on points of judgment as are necessary during a risk assessment and supporting work such as the air dispersion modelling. Comments on the work plan are provided below.

1.0 HUMAN HEALTH RISK ASSESSMENT

On January 24th, Golder and SNC held a conference call to discuss specific problem formulation issues that we felt should be resolved. We have confirmed that the following topics were agreed as reasonable decisions and are now reflected in the workplan document.

- Alkylated PAHs: Golder and SNC were of the view that the analysis of alkylated PAH was not warranted. There are no TRVs available for alkylated PAHs, their analysis would result in potentially large time delays and analysis within a coal matrix may not be possible. SNC also sought input from Ross Wilson and

[1] Golder Associates Ltd. (Golder). 2014. Third Party Review: Fraser Surrey Docks – Proposed Direct Transfer Coal Facility. Report Number 1314210036-001R-Rev0. January 2014.

CANADA'S BEST MANAGED COMPANIES Platinum member

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

Len Ritter who agreed with these perspectives. We do not believe that pursuing analysis of alkylated PAH would advance the robustness of the HHRA. Some uncertainty in the risk assessment will result but we would expect that SNC will evaluate this, and other, sources of uncertainty in their report.

- Chrystaline silica analysis: Golder suggested the inclusion of chrystaline silica analysis and this has been reflected in the revised workplan.
- Baseline data (background) collection: SNC and Golder agreed that this was a necessary component of the study and we note that the workplan now reflects that baseline data collection will now be included, with details of this collection to follow. Further comments on baseline information for garden produce (details not provided in the workplan) are provided below.
- Chromium analysis: Speciation of chromium has now been added, as recommended at the January 20th, 2104 meeting.

Areas where the workplan does not provide sufficient clarification to comment are provided in the following bullets. For Golder's purposes, clarification from FSD's consulting team will be sufficient (i.e., we don't require a revised draft workplan).

- Analysis of coal treated with dust palliative agents: Golder felt that analysis for the list of parameters in Table A on the treated coal may not be necessary; however, this was a decision for FSD. With regards to the dust palliative agents themselves, SNC agreed to assemble information on the dust palliatives to identify whether or not they could form an inhalation hazard if bound to dust. This topic is not addressed in the draft workplan but SNC has communicated to Golder that this assembly is still in progress.
- We would appreciate clarification could be provided around the Physiologically Based Extraction Testing (PBET) testing. Clarification on what form of coal is being tested and whether it corresponds to the composition of dust that could potentially deposit in residential areas. It was not clear to us if the proposed testing would be performed on large, solid pieces of coal or on coal dust, where constituents in dust may be more bioavailable.
- The exposure assessment proposed includes assessment of direct soil contact and consumption of homegrown produce pathways. Specifics about how the home grown produce pathway will be assessed have not been provided (we assume that it will be modelled as there is no mention of sample collection). Golder acknowledges that the present circumstances of season would make the collection of home grown produce to characterize baseline conditions difficult if not impossible. We would appreciate discussion with SNC on how they propose to approach this matter. Some approaches may require an unrealistic level of conservatism whereas the objective of this HHRA is to provide an (reasonably conservative) informative human health risk assessment.
- The workplan does not clarify that background deposition rate (e.g., onto domestic produce) or the approach proposed to derive that. This issue should also show clear linkage with the Air Quality discipline.

2.0 AIR QUALITY

As indicated in Golder (2014), there are a number of details with respect to the air quality assessment that are important to the outcome of the assessment, particularly with regards to the data that it provides for the HHRA exposure assessment. In the absence of details within the workplan, we are not able to provide final comments on the air quality assessment. Comments that relate to the air quality information within the workplan are provided below:

- We agreed with the general approach to modelling the barge in transit in a telephone call with Levelton on January 28, 2014. It was mutually agreed that sensitivity analysis on the dimensions (aspect ratio) of the area source would be beneficial to understand what impacts this has on model results, since the current aspect ratio proposed by Levelton of 10:1 is towards the upper range of values generally used/discussed in literature.
- In the Exposure Assessment section of the workplan we would appreciate clarification on why the value of 19% of $PM_{2.5}$ at receptors will be assumed to be attributed to Diesel Particulate Matter (DPM), when the dispersion modelling can be used to predict what the actual contribution of the $PM_{2.5}$ concentration that results from project related DPM emissions.

The following comments are provided as an update on other aspects of the air quality assessment:

- We understand that some aspects of the assessment/modelling approach are still being finalized, and will still require discussion between Golder and Levelton (for example the background air quality concentrations to be used in the assessment).
- We note that a revised emissions inventory has yet to be provided.
- It was agreed that Levelton would provide feedback (e.g. in a short written summary) on how the third party review comments provided within Golder, 2014 have been addressed/incorporated into the updated assessment approach.
- There are some topics in the modeling approach that are currently under discussion between Golder and Levelton.

3.0 AQUATIC TOXICOLOGY

Golder provided a number of comments with regard to the management of effluent from the site and the underlying toxicity data. While we appreciate that the present workplan is specific to a HHRA, we note that the comments on aquatic toxicity, as provided in Golder (2014) have not yet been addressed.

4.0 NATURE OF REVIEW COMMENTS

Golder appreciates the detailed work plan provided by SNC Lavalin. Overall, we feel that at a high level the workplan captures an appropriate approach to a risk assessment. However, a risk assessment is a detailed evaluation that requires considerable underlying data, some of which have not yet been obtained and details of how those data will be obtained or evaluated have not yet been provided. Golder has been in discussions with FSD's consultants to discuss and resolve decisions that are made along the way.

Golder is aware that FSD have requested "sign off" based on interim deliverables but have not defined the form that such "sign off" might take. While we are sensitive to FSD's business needs for certainty of outcome, Golder notes that a risk assessment has not yet been produced and our final review comments cannot be provided until a final report has been provided. There remain numerous details that, during the execution of a human health risk assessment that can affect the outcome of a risk assessment and we therefore can not offer any form of express or implied certainty of outcome or findings. Golder reiterates that it is a third party reviewer. It is up to FSD to produce a suitable risk assessment.

5.0 CLOSURE

We trust that the above is sufficient for your present needs. Should you have any questions or concerns, please contact the undersigned at 604-296-4200.

Yours very truly,

GOLDER ASSOCIATES LTD.

Lee Nikl, M.Sc., R.P.Bio.
Principal / Senior Environmental Scientist

Audrey Wagenaar, M.Sc., PChem., DABT
Associate / Senior Environmental Scientist

LN/AKW/syd

o:\final\2013\1421\13-1421-0036\1314210036-003-l-rev0\1314210036-003-l-rev0-review of revised snc work plan 07feb_14.docx

March 7, 2014 Project No. 1314210036-004-L-Rev0

Carrie Brown
Port Metro Vancouver
100 The Pointe
999 Canada Place
Vancouver, BC
V6C 3P4

GOLDER RESPONSE TO FRASER SURREY DOCKS HHRA SCOPE OF WORK

Dear Carrie,

Golder Associates Ltd. (Golder) is pleased to provide our response to Fraser Surrey Docks' (FSD) letter of February 27th, 2014. As Levelton Associates contacted us this week for a meeting, we delayed in providing this letter in the event that there were significant updates to include in our response.

Fraser Surrey Docks kindly provided us with an editable version of the table attached to their letter. We have added our response in the box provided along the far right column of the table. Should any clarification of our comments be required, we invite FSD or their consulting team to contact us.

As a point of clarification, Golder was not involved, nor did Golder provide guidance to Port Metro Vancouver for the request to provide a human health risk assessment as suggested in FSD's letter. Golder was retained as a third party reviewer only after submissions were made by FSD. The specifics of our comments and recommendations are contained in our third party review report dated January 9th, 2014. As noted in our February 7, 2014 letter, there remain numerous details on the planned approach to the human health risk assessment that, during the execution of the risk assessment can affect the outcome. We therefore cannot offer any form of express or implied certainty of the risk assessment outcome or findings. We suggest that if this is a sufficient basis for FSD going forward, we discontinue the reference to "sign off" as I think that it may create confusion as to implied warranty of outcome which we categorically are unable to provide. We invite direct discussion with FSD should further clarification be required.

Yours very truly,

GOLDER ASSOCIATES LTD.





Lee Nikl, M.Sc., R.P.Bio.
Principal, Senior Environmental Scientist

Rachel Wyles, M.Eng., P.Eng.
Senior Air Quality Engineer

LN/RW/asd
Attachment: Table 1
o:\final\2013\1421\13-1421-0036\1314210036-004-l-rev0\1314210036-004-l-rev0-golder response to fsd 7mar_14.docx

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

TABLE 1
Fraser Surrey Docks Response to Golder Comments dated February 7, 2014

No.	ISSUE/TOPIC	FRASER SURREY DOCKS RESPONSE	GOLDER RESPONSE
1	Alkylated PAHs: Golder and SNC were of the view that the analysis of alkylated PAH was not warranted. There are no TRVs available for alkylated PAHs, their analysis would result in potentially large time delays and analysis within a coal matrix may not be possible. SNC also sought input from Ross Wilson and Len Ritter who agreed with these perpsectives. We do not believe that pursuing analysis of alkylated PAH would advance the robustness of the HHRA. Some uncertainty in the risk assessment will result but we would expect that SNC will evaluate this, and other, sources of uncertainty in their report.	Golder and SNC have agreed to that these parameters will not be included in the HHRA.	*This has already been addressed in Golder's February 7, 2014 letter.*
2	Crystaline silica analysis: Golder suggested the inclusion of crystalline silica analysis and this has been reflected in the revised workplan.	Golder suggested that coal samples be submitted for analysis of crystalline silica. Samples have been submitted for analysis of crystalline silica, and receptor exposure to crystalline silica will be evaluated in the HHRA.	*This has already been addressed in Golder's February 7, 2014 letter.*
3	Baseline (background) collection: SNC and Golder agreed that this was a necessary component of the study and we note that the workplan now reflects that baseline data collection will now be included, with details of this collection to follow. Further comments on baseline information for garden produce (details not provided in the workplan) are provided below.	SNC has designed the background (baseline) soil assessment program and is initiating sampling the week of February 24, 2014. The program includes the following: • Collection of 10-12 background soil samples from four areas identified by Levelton to represent areas where maximum air concentrations have been/are anticipated to be predicted. These areas include: 1. The residential neighbourhood to the east/southeast of FSD. As indicated in the November 18, 2013 Environmental Assessment, the nearest receptor to FSD is a residence located approximately 400 m from the FSD fenceline, and with the exception of at the FSD fenceline, maximum predicted air concentrations were for this receptor. This residence is in the neighbourhood that has been selected for characterization. 2 and 3. Barge segment 1 depicted in the attached plan. Background soil samples will be collected on either side of the Fraser River, from Steveston and from Whatham Island. 4. Rail segment 1 depicted in the attached plan; this segment is located in White Rock. Background soil samples will be collected from the surrounding area/residential neighbourhood. • Background soil samples will be collected from these areas from natural green spaces nearby residences/other sensitive receptors, as well as from parks. • Samples will be collected from the upper 10-15 cm of the soil column and will be submitted for analysis of total metals, chromium speciation and PAHs. In addition to the collection of the background soil samples, the HHRA will include a comparison of measured concentrations to regional background concentrations for metal COPCs (e.g. as referenced in BC MoE's Protocol 4), as well as a summary of background PAH concentrations in Canada reported for various land uses by the CCME in the document titled Canadian Soil Quality Guidelines, Carcinogenic and Other Polycyclic Aromatic Hydrocarbons (PAHs), Scientific Criteria Document, Revised, dated 2010.	*The clarification is appreciated. While the sufficiency of a wide-area sampling program scope sometimes requires the resulting data, we are of the view that this represents a suitable scope at this time and based on information available.*

TABLE 1
Fraser Surrey Docks Response to Golder Comments dated February 7, 2014

No.	ISSUE/TOPIC	FRASER SURREY DOCKS RESPONSE	GOLDER RESPONSE
4	Chromium analysis: speciation of chromium has now been added, as recommended at the January 20th, 2014 meeting.	Golder recommended that the coal samples be submitted for analysis of both chromium III and chromium VI. Samples have been submitted for analysis of both species, and receptor exposure will be evaluated in the HHRA.	*This has already been addressed in Golder's February 7, 2014 letter.*
5	Analysis of coal treated with dust palliative agents: Golder felt that analysis for the list of parameters in Table A on the treated coal may not be necessary; however, this was a decision for FSD. With regards to the dust palliative agents themselves, SNC agreed to assemble information on the dust palliatives to identify whether or not they could form an inhalation hazard if bound to dust. This topic is not addressed in the draft workplan but SNC has communicated to Golder that this assembly is still in progress.	SNC has assembled information regarding the constituents of the dust supressants and will forward to Golder for their review by March 3, 2014.	*Response pending review and discussion.*
6	We would appreciate if clarification could be provided around the Physiologically Based Extraction Testing (PBET). Clarification on what form of coal is being tested and whether it corresponds to the composition of dust that could potentially deposit in residential areas. It was not clear to us if the proposed testing would be performed on large, solid pieces of coal or on coal dust, where constituents in dust may be more bioavailable.	Samples analysed using PBET, as well as all other analyses, will be run on coal dust (vs. pieces of coal). The samples provided by the producers are < 200 µm, and where possible, the labs will further sieve the samples.	*The clarification is sufficient for this item.*
7	The exposure assessment proposed includes assessment of direct soil contact and consumption of homegrown produce pathways. Specifics about how the home grown produce pathway will be assessed have not been provided (we assume that it will be modelled as there is no mention of sample collection). Golder acknowledges that the present circumstances of season would make the collection of home grown produce to characterize baseline conditions difficult if not impossible. We would appreciate discussion with SNC on how they propose to approach this matter. Some approaches may require an unrealistic level of conservatism whereas the objective of this HHRA is to provide an (reasonably conservative) informative human health risk assessment.	SNC does not plan to collect baseline samples. As indicated, given the time of year, collection of vegetation samples would not be possible. SNC plans to model dust to above-ground plant uptake, as well as soil to plant uptake; they recognize the conservatism in such models, but will address the uncertainty in the HHRA. SNC will also compare the plant concentrations predicted using baseline soil data to those predicted from Project emissions to evaluate the incremental increase associated with the Project.	*The clarification is sufficient for this item, at this time. Golder notes that there are a number of details and supporting assumptions that will be contained in the calculation of baseline deposition data and interpretation.*
8	The workplan does not clarify that background deposition rate (e.g., onto domestic produce) or the approach proposed to derive that. This issue should also show clear linkage with the Air Quality discipline.	SNC is planning to use baseline soil data to predict baseline dust concentrations for metals and PAHs, and subsequent deposition on produce. From our understanding, although baseline dust concentrations are available, baseline data for the constituents of the coal (i.e., metals and PAHs) is limited or not available.	*The clarification is sufficient for this item, at this time. Golder notes that there are a number of details and supporting assumptions that will be contained in the calculation of baseline deposition data and interpretation.*
9	We agreed with the general approach to modelling the barge in transit in a telephone call with Levelton on January 28, 2014. It was mutually agreed that sensitivity analysis on the dimentions (aspect ratio(of the area source would be beneficial to understand what impacts this has on model results, since the current aspect ratio proposed by Levelton of 10:1 is towards the upper range of values generally used/discussed in literature.	Levelton and Golder have agreed that a sensitivity analysis on the dimensions of the area sources will be conducted and included in the updated air dispersion modelling report.	*This has already been addressed in Golder's February 7, 2014 letter.*

TABLE 1
Fraser Surrey Docks Response to Golder Comments dated February 7, 2014

No.	ISSUE/TOPIC	FRASER SURREY DOCKS RESPONSE	GOLDER RESPONSE
10	In the Exposure Assessment section of the workplan we would appreciate clarification on why the value of 19% of $PM_{2.5}$ at receptors will be assumed to be attributed to Diesel Particulate Matter (DPM), when the dispersion modelling can be used to predict what the actual contribution of the $PM_{2.5}$ concentration that results from project related DPM emissions.	Levelton has confirmed that they will predict DPM concentrations from Project missions, however, the 19% estimate (from Levelton, 2007) will be used to estimate baseline DPM concentrations.	*The clarification is sufficient for this item.*
11	We understand that some aspects of the assessment/modelling approach are still being finalized, and will still require discussion between Golder and Levelton (for example the background air quality concentrations to be used in the assessment).	Discussions on the Air Quality Assessment between Golder, Levelton and SNC are on-going. We understand that Levelton has had recent discussions with Golder, and that Levelton will be meeting with Golder the week of March 3rd to discuss Levelton's responses to Golder's comments in detail. The intent of this meeting is for Levelton and Golder to gain an agreement on the details of the assessment methodology.	*A meeting between Golder and Levelton took place on March 5, 2014. As follow up Levelton will provide a written summary on how Golder's comments have been addressed/incorporated into the updated approach.* *Levelton provided an updated emissions inventory to Golder for input/comment on March 5.*
12	We note that a revised emissions inventory has yet to be provided.	See Response 11.	
13	It was agreed that Levelton would provide feedback (e.g., in a short written summary) on how the third party review comments provided within Golder, 2014 have been addressed/incoroporated into the updated assessment approach.	See Response 11.	
14	There are some topics in the modelling approach that are currently under discussion between Golder and Levelton.	See Response 11.	
15	Golder provided a number of comments with regards to the management of effluent from the site and the underlying toxicity data. While we appreciate that the present workplan is specific to a HHRA, we note that the comments on aquatic toxicity, as provided in Golder (2014) have not been addressed.	Refer to Section 2.4.10 of the EIA dated November 18, 2014. At this time, the options referenced in Section 2.4.10 of the EIA remain under Project consideration. FSD continues to consult with Metro Vancouver and the MoE on wastewater management, and it is our understanding that once the management option is finalized, that the agency responsible will define data and/or testing requirements to support a discharge permit. FSD will inform PMV once the management option is finalized and the permitting requirements are understood. Given this, it is our understanding that no further work on this is required at this time.	*While Golder agrees that the detailed process of obtaining an effluent permit is reasonable to defer as a condition of approval, an EIA would normally be expected to have decided on an approach for effluent management and would have demonstrated that such effluent management will not result in significant adverse effects. It would also be expected that the potential adverse effects (e.g., aquatic toxicity) are known both in their intended use and in an "accidents and malfunctions" scenario.* *We appreciate that the decisions are underway and we agree that they can continue in parallel until such time as the EIA must conclude. Based on our experience however, the development of suitable control technology through bench and pilot scale testing can take a considerable period of time, particularly where effluent composition and thus control technology are not known.* *The appropriateness of deferring details of effluent management to the permitting stage would require that the undertaking be subject to the need for an effluent permit. We would suggest that FSD's consultants working on the aquatic toxicity aspects confirm whether or not an effluent permit would be required for discharge to the environment (e.g., whether the proposal is a scheduled activity or whether the MoE would require a permit under their discretionary authority).*

APPENDIX C

Golder Associates Review Comments on the Draft Problem Formulation for the Human Health Risk Assessment (May 9, 2014)

May 9, 2014 Project No. 1314210036-006-L-Rev0

Carrie Brown
Vancouver Fraser Port Authority
100 The Pointe
999 Canada Place
Vancouver BC V6C 3P4

COMMENTS ON SNC-LAVALIN'S DRAFT PROBLEM FORMULATION FOR HUMAN HEALTH RISK ASSESSMENT

Dear Ms. Brown:

Golder Associates Ltd. (Golder) is pleased to provide our interim comments on the May 2, 2014 draft Problem Formulation (PF) for a Human Health Risk Assessment (HHRA) for the proposed Direct Transfer Coal Facility at Fraser Surrey Docks (FSD), prepared by SNC-Lavalin (SNC).

1.0 INTRODUCTION AND BACKGROUND

Golder has been retained by the Vancouver Fraser Port Authority (the Port) as a third party reviewer and as a technical advisor to Vancouver Fraser Port Authority (the Port). Golder initially provided review comments on a health assessment, aquatic toxicity evaluation and air quality assessment carried out as part of an application to the Port on behalf of Fraser Surrey Docks (Golder, 2014[1]).

Since those comments were provided, the Port required FSD to undertake a HHRA in a manner that is compatible with applicable guidance. Golder has been providing reviewer and technical advisory services to the Port on that risk assessment and the associated air quality (AQ) assessment. During the course of the HHRA, we have provided feedback to SNC (FSD's service providers responsible for the HHRA) on aspects of the risk assessment where there has been an exercise of professional judgement. However, FSD, through their consultant (SNC) remain solely responsible for all decisions.

[1] Golder Associates Ltd. (Golder). 2014. Third Party Review: Fraser Surrey Docks – Proposed Direct Transfer Coal Facility. Report Number 1314210036-001R-Rev0. January 2014.

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

2.0 GENERAL COMMENTS

Golder concurred that the draft PF would be a “rough” draft, intended to provide an articulation of the technical understanding and direction of the subsequent HHRA. We do not feel that revisions to the PF are necessary as our comments can be addressed in the final HHRA, which we would expect to contain an updated PF.

As a third party reviewer, Golder is not directing SNC’s study nor are we acting as a consultant to FSD or SNC. In our view, Golder’s role has not been accurately described in the introductory section (1.1) of the draft PF. We request that this be revised to accurately describe our role, removed or left to the Port to describe Golder’s role.

We are aware that the AQ Assessment, which is in progress by Levelton was not available to SNC as of the writing of the PF and the present review comments are prepared cognizant of the fact that more details on the AQ assessment will be available to SNC for the conclusion of their HHRA. Golder further understands that we will be reviewing the Levelton AQ report when it is finalized. We understand that SNC and Levelton had met to discuss early findings of the AQ assessment, which we agree was appropriate, and we further understand that SNC will update the PF as necessary to incorporate the findings, limitations and uncertainties of the final Levelton study at such time as it becomes available. The final HHRA report should clearly show linkages between the AQ assessment and how it was used in the HHRA.

Overall, and in the agreed context of a rough draft, the PF outlines the basis for a subsequent HHRA that has been designed around recognized frameworks. The comments that we have provided are of a nature that, should they be accepted by SNC, can be incorporated into the subsequent HHRA. Golder understands that it will provide third party review of that HHRA, on behalf of the Port. Technical comments on the draft PF are provided in the subsequent section.

In the General Limitations and Confidentiality Section, authorization for reliance should be extended to include the Port.

3.0 TECHNICAL COMMENTS ON THE DRAFT PROBLEM FORMULATION

Project Duration (pg 8) – Some information on the project duration and anticipated intensity has been provided from year 1 through year 5; however, the project duration should be confirmed and stated explicitly. The problem formulation indicates that the duration of the Project is “expected to last for five years **or more** [our emphasis]”. While the details of how risk will be calculated have not been provided, in the event that the project duration is incorporated into the calculation of risk, a clear articulation of the project (and thus exposure) duration is appropriate. Notwithstanding the current plans, it would seem that design life and possibly the capital works economic planning would extend longer than the 5 years indicated. The project duration is also an input into fate and transport modelling. In the event that the facility will remain in place and in use, the HHRA carried out on a fractional project life could potentially underestimate risks.

Residential Receptors (pg 10) – We feel that overall, the selection of receptors was appropriate although some additional considerations are needed. The closest residential properties to FSD are located in North Delta, across the South Fraser Perimeter Road, approximately 400 m to the southeast of the FSD fenceline. A more comprehensive rationale should be provided for selection of the residential receptors. While proximity to the site is important, so is the predominant wind direction to determine whether these might indeed be the most exposed residential receptors.

Commercial Receptors (pg 12) – The distance to the nearest commercial receptors needs to be provided in the HHRA.

Human Receptors of Concern (pg 33) – As noted in the comments above, we feel that the receptors have generally been adequately considered. However, based on the information presented, we believe that the following receptors should be added:

- The problem formulation eliminates the aboriginal receptor on the basis that the residential receptor is consuming 100% of their fruits and vegetables from their gardens and indicates that therefore residents would be a conservative surrogate for the aboriginal receptors. Aboriginal receptors may have higher consumption rates for some specific fruits or vegetables (e.g., berries) than the general residential population which may not be reflected in the residential exposure estimates. The extent to which this receptor group may or may not be exposed should be evaluated. For instance, it is possible that berry collection in the largely urbanized study area is not significant. The study should evaluate whether or not this is the case and provide a rationale regarding the need for inclusion of this receptor group.
- The description in the draft PF indicates that air quality conditions over the Fraser River are elevated. However, the draft PF does not map the location of the predicted elevations in air quality parameters. The PF also indicates that the river is not used in this area. The Fraser River adjacent to FSD is an area of active commercial and aboriginal fishing where fishing vessels are on location for the fishery opening. In a telephone discussion with SNC on May 8, 2014, SNC indicated that the air quality exceedances were in an area where fishing does not occur. We feel that at this stage in the HHRA, commercial and aboriginal fishers be retained as receptors and an acute exposure scenario be evaluated in the HHRA. It is unclear from the information presented that their exclusion would be appropriate and we feel that the HHRA will be more robust if this decision/assessment is demonstrative rather than presumptive.
- The report does not identify the residents in the Queensborough and New Westminster Quay areas as exposed receptors. An assessment of risk for those residents should be provided as they are located within several hundred meters of the facility. (see also comments on baseline AQ results below).

Description of Surrounding Lands (pg 10) – A rationale should be provided as to why a 3 km radius was used to identify receptors of potential concern.

Worst–Case Assumptions (pg 5) – The document indicates that the assessment has been conducted using a worst-case series of assumptions. It would be more appropriate to indicate that the assumptions are conservative rather than “worst-case” as it may be possible to conceive of an even worse hypothetical case than the one presented. The objective of a conservative case is to provide plausible (not unrealistic) but conservative (err on the side of caution) scenarios. For clarity, we also note that the use of “worst-case” assumptions does not limit the overall uncertainty in the assessment as highly conservative assumptions can induce greater uncertainty in the findings.

Baseline Air Quality Results – NO_2 (pg 17) – The text indicates that the model predicts higher NO_2 concentrations in the region concentrated above the Fraser River and that long term exposure is not expected to be likely. It would be worth clarifying whether these elevated concentrations would also be observed at the New Westminster Quay and Queensborough residential areas which are located a short distance across the Fraser River from FSD (see also comments under the subheading of human receptors of concern).

Coal Analysis (pg 19) – There is a statement indicating that metals/metalloids and PAHs in coal are not generally bioavailable under typical environmental conditions at the bottom of the page. Metals/metalloids and PAHs could be bioavailable in coal dust. We would appreciate clarification that the physiologically-based extraction testing (PBET) testing was not performed on coal but in a form that would be representative of the dust. Please confirm that PBET testing was conducted on crushed coal or something similar that would simulate bioavailability of coal dust and contributions to soil.

Summary Statistics for Metal/metalloid, PAH and Crystalline Silica Concentrations in Coal and/or Background Soil Samples – Mean concentrations of metal/metalloid, PAH and crystalline silica (for coal samples only) concentrations are provided in Table 3-4 (coal) and Table 3-6 (background soil) and are used to estimate exposure concentrations for use in the risk assessment. The distribution of chemical data in the document is not presented in the document (we recommend that it be presented in the HHRA) but based on the sample numbers provided, it appears that it would be appropriate to use a more conservative estimate such as a 95% upper confidence limit of the mean (95% UCL) or a 90^{th} percentile (depending on whether data were sufficient to calculate a 95% UCL). The distribution of the chemical data should be presented for each substance so that it can be determined whether a mean is representative or not. The use of a mean is not consistent with "worst-case" assumptions used in other parts of the risk assessment. The guidance from Health Canada on the selection of summary statistics does allow for the use of the average concentration; however, the selection of summary statistic is based on the size and characteristics of the data set. It does not advocate that the arithmetic mean should be used by definition because a detailed quantitative risk assessment is being pursued. With a limited sample size in some media, we feel that the evaluation needs to include more conservative summary statistics as noted above.

Dust Palliatives (pg 25) – It is not clear how the dust palliatives will be assessed and how percentage composition will be utilized to determine environmental concentrations of these substances. The statement that evaluation of General Electric (GE) products will be protective of the other agents based on their relative toxicity is not substantiated based on the information provided in the problem formulation. A comparison of toxicity information is needed to confirm whether this statement is accurate. We are unable to provide additional views on the incorporation of dust palliatives into the RA because the methods were not detailed.

Screening of Contaminants of Potential Concern (COPCs) (pg 27) – Table 3-8 presents a large number of contaminants of potential concern. The process of screening and identifying contaminants of concern was not clearly detailed in the draft PF; however, it appears that all contaminants were retained. It is common, though not ubiquitous, practice to reduce the list of contaminants to be studied through a screening procedure. Regardless of the approach selected, that approach and justification for the approach should be clearly stated. The discussion provided on page 44 with respect to the identification of soil exposure pathways appears to contradict the screening process used.

Conceptual Model – the Conceptual Model sketch does not appear to depict all exposure pathways noted in the text. Specifically, it appears that re-suspension of dust, described in S.3.4.4.4 of the draft PF is not depicted in the graphic.

Maximum Predicted Air Concentrations (Table 3-2) (pg 16). It appears that there may have been a transcription error for the TPM and dustfall standards which are presented as Metro Vancouver criteria when they are consistent with those developed by BC MoE.

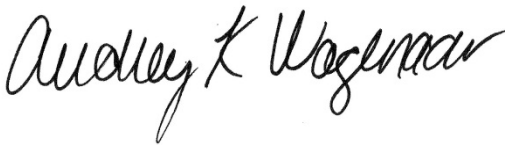
4.0 CLOSURE

We trust that the above is sufficient for your present needs. Should you have any questions or concerns, please contact the undersigned at 604-296-4200.

Yours very truly,

GOLDER ASSOCIATES LTD.





Lee Nikl, M.Sc., R.P.Bio.
Principal / Senior Environmental Scientist

Audrey Wagenaar, M.Sc., DABT, PChem.
Associate / Senior Environmental Scientist

LHN/AKW/ch

o:\final\2013\1421\13-1421-0036\1314210036-006-l-rev0\1314210036-006-l-rev0-review of snc ra problem formulation_9may_14.docx

APPENDIX D

Additional Clarification to the Human Health Risk and Air Quality Assessment Reports in Response to Golder Requests

LEVELTON CONSULTANTS LTD.
Richmond Office
150-12791 Clarke Place
Richmond, BC V6V 2H9
T: 604.278.1411 F: 604.278.1042
info@levelton.com
www.levelton.com

Memorandum

To:	Jill Buchanan Jeff Scott Jurgen Franke	**Date:**	08/07/2014
Re:	Response to comments from Golder (July 7, 2014)	**From:**	Chris Koscher, B.Sc.(Hons.), EP
Project Name:	Fraser Surrey Docks Air Quality Assessment	**Levelton File #:**	EE12-1611-00

Dear Jill / Jeff / Jurgen:

This memorandum provides responses to comments received by email from Lee Nikl at Golder Associates Ltd. (Golder) on July 7, 2014 at 2:38 PM, following Golder's review of the final air quality assessment report for Fraser Surrey Docks Direct Coal Transfer Facility. Comments from Golder have been extracted from the aforementioned email and are shown in *italics* below. Responses from Levelton Consultants Ltd. (Levelton) are provided in red. Where indicated below, responses will be provided by SNC Lavalin Environment (SNC).

- *Section 9.0 of the air quality report provides ambient concentrations of COPCs resulting from combustion emission sources. It is unclear from the air quality report and human health risk assessment how ambient concentrations of COPCs associated with the other project emission sources have been derived, and subsequently combined with ambient concentrations of COPCs resulting from combustion emission sources.*

  Response to be provided by SNC.

- *The air quality report provides predicted total deposition rates associated with project activities, and also predicted deposition rates for certain COPCs resulting from combustion sources. It is unclear how deposition rates for the COPCs resulting from project activities have been derived from the predicted total deposition rates presented in the air quality report.* ***It is also unclear how the deposition rates associated with the combustion sources (presented in Section 9.0 of the air quality) have been combined with deposition rates from other project emission sources to derive total project deposition rates of COPCs.***

  In order to determine the maximum predicted deposition rates for certain COPCs resulting from combustion sources, the maximum predicted deposition results for each source were pro-rated based on the respective speciation profile for that source (either PM_{10} or $PM_{2.5}$) for each individual COPC modelled. The results from all combustion sources' COPCs were then summed together at each receptor, in order to determine the maximum predicted deposition rate for each COPC. Only one of the COPCs, n-Hexane, existed in both $PM_{2.5}$ and PM_{10} fractions, and the greater PM_{10} n-Hexane value was used in order to be more conservative.

  Response to be provided by SNC for the bolded portion of the comment above.

- *The air quality report provides a background value for total deposition. It is unclear if, and how baseline deposition rates of COPCs have been derived, and subsequently used in the health risk assessment.*

  Response to be provided by SNC.

- *When determining background air quality concentrations, it is not clear whether the 98 %ile has been determined for each monitoring station, then the arithmetic average of all monitoring stations taken (per Section 10.1 of the BC Model Guidelines (BC MoE, 2008).*

  The 98th percentile was determined from the combined dataset from all monitoring stations for all years, as per a request from Metro Vancouver. This yields a more conservative estimate of the 98th percentile compared to the approach mentioned above from the BC Modelling Guidelines (BC MoE, 2008).

- *Has sufficient Project specific air quality monitoring data been collected to support the background concentrations used in the assessment?*

  Not at this point in time.

- *Table 5-25 indicates that all coal transfer points will use 'Enclosure, Wet Chemical Suppression'. Please confirm the design details that chemical suppressant is added to the water spray at all transfer points. In the design drawings and 'Water Management Plan Oct 15, 2013' only transfer point #3 prior to barge loading indicates use of chemical additives. If chemical suppression is added to the transfer points please provide details on the type of chemical used.*

  As indicated by FSD, chemical suppressants are to be added to the water spray at all transfer points. The wet chemical suppression products will be the following, or of a similar product composition from another vendor: GE DusTreat 9149 and DC9148 (a binding agent).

- *Table 5-25 indicates a control efficiency of 99% for the 'Load to Ship' source based on a 'Vent to Fabric Filter' technology. Please provide supporting rationale for modelling the ship loading with this control efficiency. The explanation in the body of the report that the design details are unknown requires additional clarification.*

  FSD has committed to using a "Vent to Fabric Filter" technology on the "Load to Ship Source" which provides a 99% control efficiency of emissions. Currently FSD is in discussions with Thor, the manufacturer of the ship loader, and Cleveland Cascade Chutes to provide a dust mitigation solution. They do not have the particulars of the design yet, however, they understand the standards they are designing the control technology to (ie. 99% control efficiency).

- *What is the basis for expanding the assessment scope beyond the coal transfer project to include only a portion of the agriculture product handling and not any of the other activities at the terminal?*

  The scope of the assessment was determined in consultation with the Port Metro Vancouver and Metro Vancouver. Agricultural handling activities were included to satisfy Metro Vancouver permitting requirements. The inclusion of agricultural products was meant to focus on the dust created by handling dry bulk. In order to account for the background air quality from an industrial environment with marine and rail operations, also in consultation with the Port Metro Vancouver and Metro Vancouver, Levelton has added the Second Narrows (T06) Metro Vancouver ambient air quality monitoring station to the background analysis which is located in Burrard Inlet amongst industrial activities.

  - *The agriculture product handling appears to exclude two significant sources of emissions that operate within the facility footprint, specifically marine vessels at berth and the rail locomotives that transport/switch agricultural product.*

Please see the response provided above.

- *What is the basis for not including the container handling and break bulk operations at the facility? In particular container and break bulk operations are non road equipment intensive.*

Please see the response provided above and below.

The scope of the assessment was to look at new bulk commodities handled or proposed at the terminal. The basis of the assessment was undertaken primarily to look at the impact of dust in relation to the handling of dry bulk. Containers, steel and project cargo operate independently, as a separate business unit from bulk commodities, in different areas of the terminal and have done so for over 50 years. The proximity of the agri bulk facility to the proposed coal facility, their recent addition to FSDs commodity portfolio, further supported the rationale to look at these two commodities together.

If there are any additional comments or questions please contact the undersigned.

Yours truly,

Levelton Consultants Ltd.



Per: Chris Koscher, B.Sc. (Hons.), EP

From: Ross Wilson
To: Wagenaar, Audrey
Cc: "Kennedy, Tara"; Nikl, Lee; Zis, Thalia; Purewal, Mandeep
Subject: RE: Follow up Questions - Fraser Surrey Docks Human Health Risk Assessment
Date: July 25, 2014 11:46:47 AM

Audrey

Our apologies but in Table I-2D, there is a miscalculation of the ILCR estimates for acetaldehyde, benzene, 1,3-butadiene and hexachorobenzene (DPM is not affected by this error). The values provided in the risk assessment report are approximately 4-times lower than should have been estimated. This error resulted due to the incorrect estimation of amortized exposure concentration for the cancer endpoint. Revised values are provided below for the risk estimates affected by this change.

Revised ILCR Estimates for Substances Provided in Table I-2D

COPC	Amortized Exposure Concentration for Cancer Endpoint (µg/m^3)	Incremental Lifetime Cancer Risk
Acetaldehyde	9.3E-04	5.4E-10
Benzene	2.6E-04	8.5E-10
1,3-Butadiene	2.2E-05	1.3E-10
Hexachlorobenzene	4.6E-10	2.1E-13

We stress that this correction does not affect the overall conclusions (i.e., even when benzene and 1,3-butadiene are summed with these revised estimates, the ILCR estimates remain less than 1 x 10^{-9} and, thus, are more than 10,000 lower than the Health Canada acceptable ILCR of 1 x 10^{-9}). Nevertheless, we will ensure that these corrections are formally documented.

Worked Example for Benzene

With respect to your request for sample calculation, as requested we provide the worked examples for HQ and ILCR estimates from benzene for industrial receptor.

Non-Cancer Risk for Industrial Exposures to Benzene

For non-cancer risk, the HQ from benzene was estimated from a Project Case air concentration of 0.00749 µg/m^3 occurring at the industrial location (this value is provided in the Levelton (2014) AQA report). Assuming an industrial receptor breathes this air at a rate of 10 hours per day, 5 days per week for 48 weeks per year, an amortized air concentration for estimation of non-cancer risk was then estimated to be 0.00206 µg/m^3 (i.e., 0.00749 µg/m^3 x 10 h/24 h x 5 d/7 d x 48 wk/52 wk = 0.00206 µg/m^3).

HQ values were then according to the following formula:

HQ = Estimated Exposure (0.00206 µg/m^3) = 6.9E-05
Tolerable Concentration (30 µg/m^3)

And thus, an HQ value of 6.9E-05 was estimated for the industrial receptor exposed to benzene at an annual average air concentration of 0.00749 µg/m^3 (rounding within the model provided a slightly lower value of 6.7E-05).

Cancer Risk for Industrial Exposure to Benzene

For cancer risk, the ILCR from benzene was estimated from a Project Case air concentration of 0.00749 µg/m^3 occurring at the industrial location (this value is provided in the Levelton (2014) AQA report). Assuming an industrial receptor breathes this air at a rate of 10 hours per day, 5 days per week for 48 weeks per year for 10 years, an amortized air concentration for estimation of cancer risk was then estimated to be 0.000257 µg/m^3 (i.e., 0.00749 µg/m^3 x 10 h/24 h x 5 d/7 d x 48 wk/52 wk x 10 y/80 y = 0.000257 µg/m^3).

ILCR values were then according to the following formula:

ILCR = Estimated Daily Exposure (2.57E-04 µg/m^3) x Cancer Potency Factor (3.3E-06 [µg/m^3]$^{-1}$) = 8.5E-10

And thus, an ILCR of 8.5E-10 was estimated for the industrial receptor exposed to benzene at an annual average air concentration of 0.00749 µg/m^3 for 10 years.

Please do not hesitate to contact me if you have any additional comments or questions.

Ross Wilson, M.Sc., DABT
(604) 221-6565

From: Wagenaar, Audrey [mailto:Audrey_Wagenaar@golder.com]
Sent: July 24, 2014 4:22 PM
To: rosswilson@telus.net
Cc: Kennedy, Tara (Tara.Kennedy@snclavalin.com); Nikl, Lee; Zis, Thalia
Subject: Follow up Questions - Fraser Surrey Docks Human Health Risk Assessment

Hi Ross,

Tara suggested that we contact you if we had questions on the Fraser Surrey Docks risk assessment while she is away on vacation. We've started our review and identified a couple of minor points for clarification as outlined below:

- While checking Table I-2D – "Chronic Inhalation Risk Estimates for the Industrial Receptor, Gaseous COPCs", we noticed that concentrations of gaseous COPCs do not appear to be

presented in the report. It was therefore not possible to check the amortized air concentrations presented in Appendix I for the industrial receptor (e.g., benzene in Table I-2D). In addition, it is unclear from this table how the exposure concentration amortized for the assessment of carcinogens was calculated.

- Would SNC be able to provide i) the air concentrations for gaseous COPCs from which amortized exposure concentrations were calculated, and ii) a sample calculation (e.g., for benzene) for the industrial receptor, to support the Project HQs and ILCRs reported in Table I-2D.

Please let me know if you have any questions.

Cheers,
Audrey

Audrey Wagenaar (M.Sc., DABT, PChem.) | Associate, Senior Environmental Scientist | **Golder Associates Ltd.**
500 - 4260 Still Creek Drive, Burnaby, British Columbia, Canada V5C 6C6
T: +1 (604) 296 4200 | **D:** +1 (604) 297 2036 | **F:** +1 (604) 298 5253 | **E:** Audrey_Wagenaar@golder.com | **www.golder.com**

Work Safe, Home Safe

This email transmission is confidential and may contain proprietary information for the exclusive use of the intended recipient. Any use, distribution or copying of this transmission, other than by the intended recipient, is strictly prohibited. If you are not the intended recipient, please notify the sender and delete all copies. Electronic media is susceptible to unauthorized modification, deterioration, and incompatibility. Accordingly, the electronic media version of any work product may not be relied upon.

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

Please consider the environment before printing this email.

APPENDIX E

Summary of Minor Discrepancies in HHRA

1.0 DETAILED COMMENTS

1.1 Problem Formulation

Table 3-3 - SO_2 (1-hr, 24-hr and annual), PM10 (24-hr) and TPM (24-hr) Concentrations including background

There appear to be rounding errors associated with values for the maximum receptor along the rail corridor+background and the maximum receptor along the barge corridor+background as the values incorporating background concentrations are less than the background concentration. This rounding error does not affect the overall conclusions of the report, as concentrations are well below the environmental quality criteria for these receptors.

Table 3-10 – Exposure Characteristics for Industrial Workers

Exposure characteristics for residential receptors are provided in Table 3-10; however information for the industrial worker is not included in this table.

1.2 Exposure Assessment

Cumulative Scenario Assessment (Page 59; Section 4.1.2.3 and Page 61, Section 4.1.3.3).

There appear to be a couple of typographical errors indicating that metals and PAHs for which background soil concentrations were higher than in the coal analysis were not included in the assessment of cumulative risks. This does not affect the overall outcome of the study as risk estimates have been provided for the cumulative case in Section 6.0.

Transcription Error – Table 4-2 Relative Absorption Factor for Mercury

Text indicates a value of 0.1 was utilized as a relative absorption factor for mercury but Table 4-2 indicates a value of 1.0. It appears that the value of 0.1 was used in the HHRA but this is not completely clear.

1.3 Toxicity Assessment

Lack of Use of a Surrogate for Acenaphthalene

Toxicity reference values are lacking for several polycyclic aromatic hydrocarbons, particularly for the non-carcinogenic endpoints. SNC-Lavalin has elected to use oral toxicity reference value for pyrene as a surrogate for the assessment of non-carcinogenic PAHs with three or greater rings. It is not clear why this approach or a similar surrogate approach (i.e., acenaphthene) was not utilized for acenaphthalene, rather than not assessing it.

1.4 Risk Characterization

Summary of PM2.5 Concentrations (pages 90 and 91)

The concentrations for the maximum concentrations plus background at a residential receptors presented on the top of page 90 are not quite the same as those presented in Table 3-2. The text indicates 14.0 ug/m^3 for the 24-hr and 4.9 ug/m^3 for the annual averaging periods while Table 3-2 presents values of 16.5 ug/m^3 and 4.7 ug/m^3 for the 24-hr and annual averaging periods, respectively. Both sets of values are lower than the selected air quality criteria (25 ug/m^3 [24-hr] and 8 ug/m^3 [annual, with a planning goal of 6 ug/m^3]), so the apparent transcription error does not affect the conclusions of the assessment.

Similarly, text on the top of page 91 indicates that the maximum predicted annual average PM2.5 concentration (Project emissions + background) for all the receptors assessed is 4.48 ug/m^3.

Acute Inhalation Risk Estimates – Maximum North Delta Residential Receptor (Table 6-2).

There are a couple of instances where the values presented in Table 6-2 do not match those presented in the supporting tables in Appendix I. These include (1) the baseline hazard quotient for ethylbenzene (2.2E-4 in Table 6-2 and 9.1E-5 in Table I-1A) and (2) the cumulative scenario hazard quotient for formaldehyde (8.8E-2 in Table 6-2 and 1.1E-1 in Table I-1E).

Chronic Inhalation Risk Estimates – Maximum North Delta Residential Receptor (Table 6-3).

Table 6-3 provides a Project case hazard quotient for hexachlorobenzene (8.4E-11) but there is no value provided in Appendix I (Table I-2B).

In addition, footnotes a and b in Table 6-3 indicate that hazard quotients for the chronic inhalation scenario where conducted using 1-hr TRVs(TCEQ ReV and OEHHA REL, respectively). This appears to be a transcription error as the chronic ReV and REL values should have been used.

Risk Estimates for Benzo(a)pyrene and Benzo(a)anthracene (Tables 6-5, 6-6 and 6-7, 6-12, 6-13, 6-14, 6-19 and 6-20)

The results in Tables 6-5, 6-6, 6-7, 6-12, 6-13, 6-14, 6-19 and 6-20 for benzo(a)pyrene and benzo(a)anthracene appear to be reversed relative to the supporting tables in Appendix I.

Transcription Errors – Table 6.6 and Table 6-9

The values in Table 6.6 for the baseline, project and cumulative hazard quotients for titanium, uranium vanadium and zinc do not match those presented in the supporting table (Tables I-4A, B and C). There appears to be a transcription error.

Acute Inhalation Risk Estimates – Maximum Rail Corridor Residential Receptor (Table 6-9).

There are a couple of instances where the values presented in Table 6-9 do not match those presented in the supporting tables in Appendix I. These include (1) the baseline hazard quotient for ethylbenzene (2.2E-4 in Table 6-9 and 9.1E-5 in Table I-1A), (2) the baseline hazard quotient for benzene (4.6E-3 in Table 6-9 and 3E-2 in Table I-1A), (3) the project hazard quotient for benzene (3.5E-5 in Table 6-9 and 3.2E-5 in Table I-1C) and (4) the cumulative scenario hazard quotient for benzene (4.6E-3 in Table 6-9 and 3E-2 in Table I-1E).

Transcription Errors – Table 6-13 (Project Case – Hazard Quotient [all routes])

There appear to be a number of rounding/transcription errors between Table 6-13 and the supporting table (Table I-6B) for several substances for the total HQ value in the Project case. In most cases, the values are slightly lower in Table I-6B; the most significant differences are for beryllium (4.0E-4 in Table 6-13 and 1.8E-3 in Table I-6B) and uranium (1.4E-3 in Table 6-13 and 2.4E-3 in Table I-6B). The other substances affected include: benzo(a)pyrene, arsenic, chromium VI, iron, mercury, molybdendum, selenium, and tin and in these cases, the transcription errors appear to be related to rounding differences. These transcription/rounding errors do not appear to affect the overall cumulative risk (hazard quotient [all routes]) estimates as these values are the same in Table 6-13 and the supporting appendix table (Table I-6C).

Acute Inhalation Risk Estimates – Maximum Industrial Receptor (Table 6-16).

There are a couple of instances where the values presented in Table 6-16 do not match those presented in the supporting tables in Appendix I. These include (1) the baseline hazard quotient for benzene (4.6E-3 in Table 6-16 but 3E-2 in Table I-1A and Table I-1G), (2) the baseline hazard quotient for ethylbenzene (2.2E-4 in Table 6-16 and Table I-1G but 9.1E-5 in Table I-1A), and (3) the project and cumulative scenario hazard quotients for benzene (project case – 4.3E-4 in Table 6-16 and 1.2E-3 in Table I-1G; cumulative case – 5.0E-3 in Table 6-15 and 3.1E-2 in Table I-1G).

Note also that the footnotes a and b to Table 6-16 indicate that two cases have been assessed for acrolein using different acute toxicity reference values; however only one case is presented in Table 6-16 and it is the HQ derived using the more conservative of the two acute toxicity reference values.

Rounding Errors – Table 6-17 (Baseline Hazard Quotient)

There appear to be a number of rounding errors between Table 6-17 and the supporting table (Table I-2A) for several substances for the baseline hazard quotient. In most cases, the values are slightly higher in Table I-2A. The substances affected include all the VOCs except acrolein and formaldehyde. These slight rounding errors do not appear to affect the overall cumulative risk estimates as these values are the same in Table 6-17 and the supporting appendix table (Table I-2A).

Error in Industrial Worker Carcinogenic Amortization – Table 6-18

An error was found in the amortization calculation for carcinogenic substances for the industrial worker. SNC-Lavalin have revised their calculations and provided an updated version of Table 6-18 which is appended in Appendix D. It has been confirmed that the updated calculations do not change the report conclusions.

Sensitivity Analysis – Section 7.1.1 – Typographical Errors – Hazard Quotients

While reviewing the sensitivity analysis and corresponding tables in Appendix VIII, it was noted that there is a discrepancy between the hazard quotients for benzo(a)anthracene, carcinogenic PAHs and uranium presented in Table 6-5 and Appendix Table VIII-A. The hazard quotient for benzo(a)anthracene is 7.3E-7 in Table 6-5 and 6.9E-6 in Appendix Table VIII-A. This may be the result of reversing values for benzo(a)pyrene and benzo(a)anthracene in several of the report tables as noted in an earlier comment The hazard quotient for carcinogenic PAHs is 2.5E-5 in Table 6-5 and 2.6E-5 in Appendix Table VIII-A. For uranium, the hazard quotient presented in Table 6-5 is 6.1E-4 and in Appendix VIII-A is 2.2E-4. .

Sensitivity Analysis – Section 7.1.1 – Typographical Errors – ILCR Values

The ILCR value for benzo(a)anthracene (1.3E-8) in Table 6-7 appears to be the value for benzo(a)pyrene based on the results presented in Appendix Table VIII-C.

Sensitivity Analysis – Section 7.1.1 – Transcription Errors – Mean Coal ILCR Concentrations

The ILCR value based on mean coal concentrations for benzo(a)anthracene (1.5E-10) in Section 7.1.1 does not match the value provided in Appendix Table VIII-C (1.4E-9).

Similarly, the ILCR value based on mean coal concentrations for benzo(b)fluorathene (1.0E-10) in Section 7.1.1 does not match the value provided in Appendix Table VIII-C (6.7E-10). It appears that there has been a transcription error in that the values from the ILCR (air inhalation) column rather than the ILCR (all routes) column in Table VIII-C have been provided in Section 7.1.1.

1.5 Appendices

Table I-5A Mislabelled

Table I-5A in Appendix I appears to be mislabelled as it refers to Maximum North Delta Residential Receptors however the data provided are for the Maximum Rail Corridor Residential Receptor as indicated in the text (page 110 and Table 6-12).

Appendix V - Typographical Error – Health Canada (2013) Oral TRV for Benzo(a)pyrene

There appears to be a transcription error with respect to the oral TRV for benzo(a)pyrene as the value in Table V-2 for Health Canada (2013) is listed as 1.6E-3 (µg/kg bw/day)$^{-1}$ while the value in the text above is 2.3 E-3 (µg/kg bw/day)$^{-1}$. The Health Canada (2010) value of 2.3 E-3 (µg/kg bw/day)$^{-1}$ which is more conservative than the Health Canada (2013) value has been used in the risk assessment so it does not affect the outcome of the risk assessment.

Appendix V - Typographical Error – Oral TRV for Vanadium

Table V-58 indicates that the oral TRV selected for vanadium is 0.07 µg/kg bw/day while the appendix text (Section V.3.25.2) and Table 5-3 in the main report indicate that a value of 15 µg/kg bw/day was selected.

Appendix VI – Summary Statistics for Coal and Soil Analyses

Although indicated in the text, summary statistics for the coal and soil do not appear to be included in Appendix VI.

o:\final\2013\1421\13-1421-0036\1314210036-008-r-rev0\appendix e.docx

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Corporation
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

Golder Associates