

RESOLUTION NO. R-18-26

A RESOLUTION AUTHORIZING THE EXECUTION OF AN INTERLOCAL GOVERNMENTAL AGREEMENT WITH WASHINGTON STATE UNIVERSITY REGARDING THE CAPITAL AND OPERATING COSTS OF THE PULLMAN WASTEWATER TREATMENT PLANT.

WHEREAS, the City Council for the City of Pullman has before it an instrument entitled, "Agreement Relating to Proration of Capital and Operating Costs of the Pullman Wastewater Treatment Plant"; and,

WHEREAS, Washington State University has approved said interlocal governmental agreement; and,

WHEREAS, the City Council of the City of Pullman deems it to be in the best interests of the City of Pullman to enter into said interlocal governmental agreement; now, therefore,

IT IS HEREBY RESOLVED by the City Council of the City of Pullman that the Mayor and Finance Director be and they are hereby authorized and directed to execute said interlocal governmental agreement; and, having executed the same, to submit one executed original to Washington State University and to file one executed original in the manner authorized by law.

IT IS FURTHER RESOLVED that the Mayor and Finance Director are each hereby authorized and directed to take such further action as may be appropriate in order to effect the purpose of this Resolution and the Agreement authorized thereby.

ADOPTED by the City Council of the City of Pullman at a regular meeting held on the 9th day of June 2026.

DATED this 9th day of June 2026.

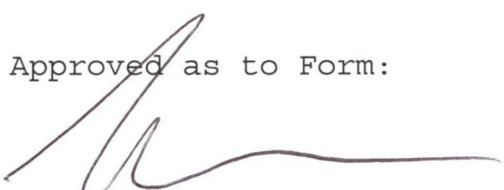



Mayor Francis A. Benjamin

ATTEST:


City Clerk Dee Stiles-Elliott

Approved as to Form:


City Attorney Thaddeus J. O'Sullivan

AGREEMENT RELATING TO PRORATION OF CAPITAL AND OPERATING COSTS OF THE PULLMAN WASTEWATER TREATMENT PLANT

This Agreement is by and between the city of Pullman, a municipal corporation of the state of Washington (“CITY”), and Washington State University, an institution of higher education and an agency of the state of Washington (“UNIVERSITY”).

RECITALS:

1. This Agreement is entered into pursuant to the Interlocal Cooperation Act (RCW 39.34).
2. The City Council of the CITY by resolution has approved and authorized the terms of this Agreement and has authorized the Mayor and Finance Director to sign the Agreement.
3. The Board of Regents of the UNIVERSITY has authorized the Executive Vice President for Finance and Operations to sign the Agreement.
4. The CITY has provided wastewater sewer lines and wastewater treatment at the Pullman wastewater treatment plant for the UNIVERSITY for approximately one hundred (100) years on a cost-sharing basis.
5. The UNIVERSITY, by a cooperative agreement dated April 25, 2001, has provided thirty-six point four percent (36.4%) of the local costs for capital improvements and thirty-six point four percent (36.4%) of the local costs for maintenance and operation costs of the wastewater treatment plant.
6. In 2019, the CITY, in cooperation with the UNIVERSITY, entered into an agreement with J-U-B Engineers, Inc. to complete a study to determine the percentage contribution of wastewater flow and loading from UNIVERSITY to apportion capital, and operations and maintenance costs for the CITY’s wastewater treatment plant. The flow and loading data for the study was impacted by the COVID-19 pandemic. Ultimately, data collection for the study was mutually delayed by both parties until the fall of 2024 and the spring of 2025. The study results were prepared and presented to CITY and UNIVERSITY staff on May 29, 2025. Thereafter, the 2025 Study Report, titled “City of Pullman Analysis of WSU Sewer Flow and Loads” (Attachment A) was finalized and completed on September 9, 2025.

7. The April 25, 2001, cooperative agreement provides for the negotiation of a new, revised cooperative agreement as required. Considering the results of the 2025 study, it is hereby mutually agreed between the CITY and the UNIVERSITY that it is appropriate to negotiate a new revised cooperative agreement relating to the proration of capital and operating costs of the Pullman Wastewater Treatment Plant.

TERMS OF AGREEMENT:

Now, therefore, in consideration of mutual benefits derived from the cooperative funding of a single wastewater treatment plant and system, it is agreed as follows:

I. PURPOSE

This Agreement is entered into for the purpose of:

- A. Prorating between the CITY and the UNIVERSITY the costs of maintenance and operation related to the CITY's wastewater treatment plant;
- B. Prorating between the CITY and the UNIVERSITY the cost of future capital improvements and additions to the wastewater treatment plant and certain sewer lines serving the UNIVERSITY;
- C. Determining the responsibilities of and relationship between each party during the construction of improvements and the continued operation of the wastewater treatment plant; and
- D. Allocating the assets and liabilities of the system in the event of termination.

II. DURATION, REVIEW, AND TERMINATION

- A. The duration of this Agreement shall be from July 1, 2025 to June 30, 2045. Prior to the expiration of this Agreement, the CITY and the UNIVERSITY will meet to examine then existing conditions affecting the operation of the wastewater treatment plant and system and negotiate a new, revised cooperative agreement in the event the parties desire to continue their agreement.
- B. A review of the maintenance and operation and capital improvement fee prorations between the UNIVERSITY and the CITY shall be made at any time either one of the parties makes written demand on the other, although no more than once in any three-year (36-month) period. Such review will consider

relative growth of the parties, special operation and maintenance problems that may have developed, and any other factors or considerations that affect the apportionment of the costs. At the written request of either party, review may be made by an independent engineer or engineering firm acceptable to both the CITY and the UNIVERSITY. In the event such a review does proceed, the charge will be borne by the parties according to the existing apportionment at the place and time of the review. In the event a modification to the proportional shares is deemed appropriate, recommendations will be made to the governing bodies of the parties. In the event the parties are unable to agree on the modification to the proportional shares by direct negotiation, they agree to participate, in good faith, in mediation. The mediator shall be chosen by agreement of the parties, the cost of which will be shared evenly. The parties agree that mediation shall precede any action in a judicial or quasi-judicial tribunal. If the parties fail to resolve the dispute in mediation, they agree to submit to binding arbitration pursuant to RCW 7.04.

- C. Either party may terminate upon written request with no less than one year notice.

III. RESPONSIBILITIES OF THE CITY

- A. The CITY has full responsibility for undertaking any analysis or study, design of improvements and additions, coordination with consulting firms, and the supervision, inspection, and administration of construction of improvements to the wastewater treatment plant and the sewer collection system. The CITY may, at its option, consult with the UNIVERSITY regarding any of the above matters.
- B. The CITY has full responsibility for the operation of the wastewater treatment plant, including the retention of competent operating staff and any necessary materials, equipment, and supplies. The CITY may, at its option, consult with the UNIVERSITY regarding such operations.
- C. The CITY will hold the UNIVERSITY harmless from claims or liability for damages to property or persons incurred during the construction of improvements and additions to said plant. The CITY also will hold the UNIVERSITY harmless from claims or liability for damages to property or persons incurred during operation of said plant except for claims arising out of the UNIVERSITY's negligent or willful acts or omissions, including violations of any federal, state, or local law, rule, regulation, or permit for the discharge of waste water that is or is considered to be harmful, detrimental, or injurious to the public health, safety, and welfare caused by the disposal of industrial wastes by the UNIVERSITY.

- D. The wastewater treatment plant and sewer collection system together with all additions and improvements, except for the sewer collection system located within the campus boundary of the UNIVERSITY, shall be the property of the CITY.
- E. The CITY may bill the UNIVERSITY not more often than once per month for their proportion of capital improvements and operations and maintenance costs incurred by the CITY. Notwithstanding, the CITY agrees to bill all costs so incurred not later than twelve (12) days following the UNIVERSITY's fiscal year on June 30 for the twelve-month (12-month) fiscal year period preceding the billing.

IV. RESPONSIBILITIES OF THE UNIVERSITY

- A. The UNIVERSITY shall within sixty (60) days of billing by the CITY remit its share of the costs to meet obligations incurred for the costs of approved construction and operation and maintenance costs incurred in the management of the wastewater treatment plant and sewer collection system in accordance with the terms of this Agreement. Any billing not paid within sixty (60) days shall be considered delinquent and accrue interest at the rate of twelve percent (12%) per annum from the date of the CITY's billing.
- B. In the event the CITY has obtained financing to make any improvements or pay any cost authorized by law, the UNIVERSITY agrees that its payment with respect to its share of the cost of the financing shall utilize the prorated sum in effect at the time the financing occurred.
- C. The UNIVERSITY agrees to consult with the CITY in good faith when requested regarding improvements and maintenance and operation of the wastewater treatment plant.

V. CAPITAL IMPROVEMENTS

- A. The 1998 General Sewer Plan determined that the cost of capital improvements at the wastewater treatment plant should be based mainly on peak design flow but also should include a load factor component. The 2025 Study Report estimated that the peak flow and load contribution from the UNIVERSITY amounted to twenty-eight percent (28.0%) of the peak flow and total load treated at the wastewater treatment plant. Therefore, the UNIVERSITY agrees to provide twenty-eight percent (28.0%) and the CITY agrees to provide seventy-two percent (72.0%) of the costs for capital improvements and additions to the wastewater treatment plant. Costs for capital improvements

may include costs incurred for design and construction engineering and architectural services, property acquisition, contract work, force account work, CITY personnel salaries and benefits, and related incidental items as deemed by the CITY to be reasonably necessary for the capital improvement.

- B. Since the UNIVERSITY is on a biennial budget system for capital improvements, the CITY will endeavor to inform the UNIVERSITY of planned capital improvements prior to July 1 of even numbered years to facilitate the UNIVERSITY's capital budget planning. It is acknowledged that emergency conditions may arise which may prevent the CITY from giving the UNIVERSITY such prior notification.
- C. It is agreed that any improvements to sewer lines serving the UNIVERSITY shall have the costs prorated in accordance with the estimated percentage of flows that the UNIVERSITY contributes, or may contribute in the future, to the sewer line relative to the respective non-UNIVERSITY flows and any other seven (7) factors deemed appropriate by the CITY and the UNIVERSITY. The CITY and the UNIVERSITY will meet to establish proration of such costs for each particular sewer line improvement proposed. In the event the CITY and UNIVERSITY are unable to agree on said proration by direct negotiation, they agree to participate, in good faith, in a mediation. The mediator shall be chosen by agreement of the parties, the cost of which will be shared evenly. The parties agree that mediation shall precede any action in a judicial or quasi-judicial tribunal. If the parties fail to resolve the dispute in mediation, they agree to submit to binding arbitration pursuant to RCW 7.04.

VI. OPERATION AND MAINTENANCE

- A. It is mutually agreed that the average flow and average load estimated in the 2025 Study Report are the appropriate bases for the apportionment of maintenance and operation costs. The noted analysis estimated the related UNIVERSITY contribution to be twenty-eight percent (28.0%) and the related CITY contribution to be seventy-two percent (72.0%). Therefore, the UNIVERSITY agrees to provide twenty-eight percent (28.0%) of the maintenance and operation costs of the wastewater treatment plant and the CITY agrees to provide seventy-two percent (72.0%) of such costs.

VII. ADMINISTRATION

- A. No new separate legal or administrative entity is created to administer this Agreement.

- B. This Agreement supersedes all previous agreements between the CITY and the UNIVERSITY regarding the wastewater treatment plant, its operation, capital improvements, engineering studies, or any other items related thereto. This Agreement does not alter, modify, or supersede any conduct regulated by federal, state, or local law, rule, regulation, or permit.
- C. All real and personal property and all modifications, improvements, additions, or repairs made to the system, except for the sewer collection system located within the campus boundary of the UNIVERSITY, shall remain the property of the CITY upon termination of the Agreement. The CITY agrees to assume and pay all liabilities of the system upon termination except for claims arising out of the UNIVERSITY's negligent or willful acts or omissions as described in Paragraph III.C and any UNIVERSITY portion of any financial liability existing at termination that initially was financed for a period of more than one year.

VIII. NOTICES

- A. All notices, requests, approvals, consents, or communications which may be required under this Agreement shall be given as follows:

Notice to the UNIVERSITY:

Executive Vice President for Finance and Operations
Washington State University
P.O. Box 641045
Pullman, WA 99164-1045

Notice to the CITY:

City Administrator
City of Pullman
190 SE Crestview Street Bldg. A
Pullman, WA 99163

IX. EFFECTIVE DATE AND FILING REQUIREMENTS

- A. This Agreement shall be effective upon the filing of the fully executed agreement with the Whitman County Auditor.
- B. Interpretation. As a further condition of this Agreement, the CITY and the UNIVERSITY acknowledge that this Agreement shall be deemed and construed to have been prepared mutually by each party and it shall be expressly agreed that any uncertainty or ambiguity existing therein shall not be construed against any party. In the event that any party shall take an action, whether judicial or

otherwise, to enforce or interpret any of the terms of the Agreement, the prevailing party shall be entitled to recover from the other party all expenses which it may reasonably incur in taking such action, including attorneys' fees and costs, whether incurred in a court of law or otherwise.

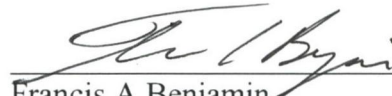
WASHINGTON STATE UNIVERSITY



Leslie Brunelli
Executive Vice President for Finance and
Operations

Date: 06/02/2026

CITY OF PULLMAN



Francis A Benjamin
Mayor

Date: 6/17/2026

ATTEST:



Dee Stiles-Elliott
City Clerk

Date: 6/17/2026

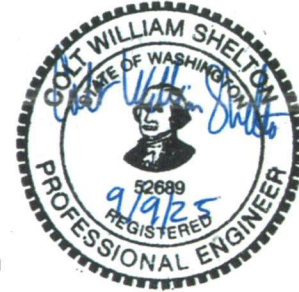
APPROVED AS TO FORM:



Assistant Attorney General
Date: 6/1/2026



City Attorney
Date: 6/9/2026



Technical Memorandum

DATE: September 9, 2025

TO: Sean Wells, P.E., Public Works Director, City of Pullman
Clayton Forsmann, P.E., Deputy Director of Public Works, City of Pullman

FROM: Colt Shelton, P.E.
David Watkins, P.E.

SUBJECT: City of Pullman Analysis of WSU Sewer Flow and Loads

I. INTRODUCTION

This technical memorandum summarizes the results of a flow and loading study at the points of connection between the Washington State University (WSU) system and the City of Pullman (City) system. A previous study to determine WSU flow and loads was developed in 2020 and 2021 by J-U-B Engineers, Inc. (J-U-B), but COVID-19 interrupted the flow monitoring, and 2021 loading data was below typical values. The draft Tech Memo from the 2020/2021 study is included as **Appendix A**. The conclusion of the 2020/2021 draft Tech Memo was the need for this current study. The purpose of this study is to determine the contribution of flow and loads from WSU to the City.

Sewer flows for this study were measured by J-U-B during the “dry” period Fall 2024 (DW) and the “wet” period Spring 2025 (WW) for Basin C. Flows were measured by the WSU permanent flow meters for Basins B and D, augmented with some literature values for WSU buildings not connected to Basin B flow meter. Basin A flows were determined by using typical literature values on a per unit basis multiplied by the number of units. The City and WSU provided data for water meter records and occupancy percentages to estimate flow from Basin A. City staff completed 24-hour composite sampling for constituent loading for all basins during the flow monitoring periods. **Figure 1** delineates the four WSU flow basins (A, B, C, and D).

Two periods of sampling were selected, dry and wet weather, and each period had at least one week where students were not on campus. The DW was selected to capture WSU’s start of semester (August 19th, 2024), and the WW period was selected to capture WSU’s spring break (March 10-14th, 2025), both in an attempt to observe the students’

contribution to wastewater flow and loads. During the 2024-2025 school year there were ~15,400¹ students attending WSU on the Pullman campus.

¹ WSU Data and Information Website (<https://data.wsu.edu/system-data/institutional-dashboards/student/total-student-enrollment/>) Total Student Enrollment, Pullman Campus, Spring 2025.

Legend

● Monitoring Location

WSU Boundary

Basins

Basin

A

B

C

D

Utility Service

● CITY OF PULLMAN

● WSU

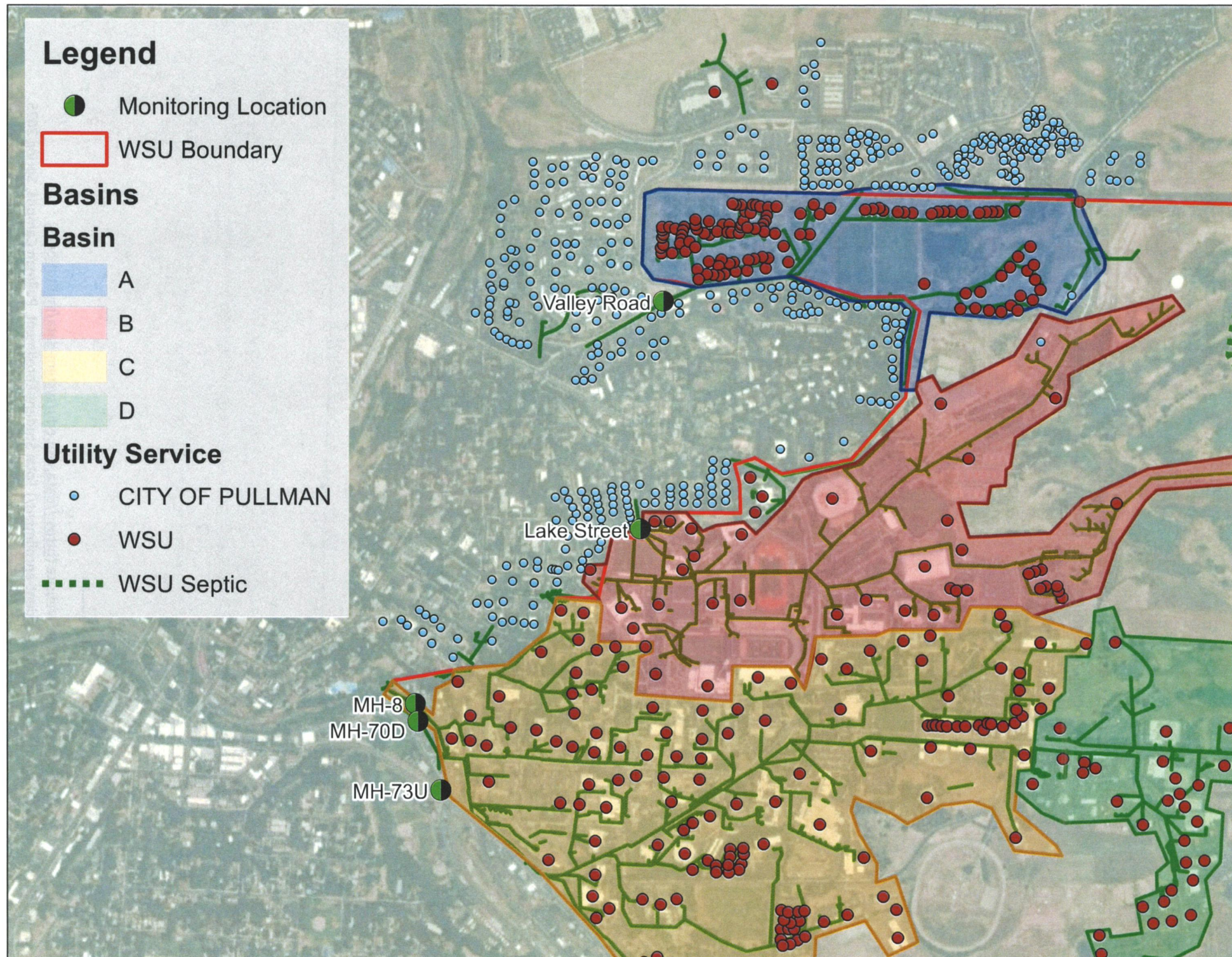
WSU Septic

MH-8
MH-70D

MH-73U

Valley Road

Lake Street



II. DRY WEATHER MONITORING

The agreed-upon DW monitoring period was August 5-25, 2024. Wastewater systems generally experience lower, more concentrated flow during late summer. Only minor precipitation events occurred during this period, which did not appear to cause measurable infiltration or inflow.

The DW period captured the conclusion of summer break and the beginning of WSU's 2024-2025 school year, allowing the monitoring period to be broken into observations with students and without students. WSU's Week of Welcome occurred the week of August 12, 2024, and the school year officially began the following Monday, August 19, 2024. Based on the assumption that many students arrived one week prior to the first day of instruction, the DW period was divided into "without students" and "with students". The without students period was through August 12, 2024 and the with students period began on August 13, 2024. The average flowrates and shape of the flowrate versus time curve obtained from the continuous flow monitors in Basin C support this assumption. Graphs showing flows from the DW monitoring period for each basin are shown in **Appendix B**. The graphs show smoothed daily data because most meters only measure daily values. Basin C flow data was recorded at 5-minute increments, but daily averages were used given it was the only basin with such fine resolution.

Loading samples were collected for the following items:

- Biochemical oxygen demand (BOD)
- Total suspended solids (TSS)

The City of Pullman completed the 24-hr composite sampling for each Basin and transported the samples to Anatek Labs in Moscow, ID for sample analysis. The loading summary completed by Anatek Labs is shown in **Figure 3** and **Figure 4**. A description of the flow monitoring events for each basin is provided below.

BASIN A

Flows for Basin A were estimated using a combination of the August 2024 water meter readings and literature values from the Wastewater Engineering Treatment and Resource Recovery (Metcalf and Eddy, 5th Edition, 2014, Table 3-16) textbook, as was done for monitoring completed in 2019 and 2020. During the flow monitoring period, the City sampled the Basin A effluent three separate times from the same downstream manhole and provided results for BOD and TSS.

BASIN B

Data for Basin B was calculated using the Lake Street permanent meter station, occupancy and water meter usage for the WSU Streit-Perham dorms, and the Marriot Residence Inn water usage. Flow data for Lake Street provides total accumulated flow past the meter.

Average daily flowrates in Lake Street were calculated from daily total volume, provided for July and August 1-25, 2024. Flow data for the Marriot Residence Inn was provided by the City for monthly usage in August of 2024. Flow data for the dorms was provided for September of 2023. Total flow in Basin B was calculated by adding the flows from the Lake Street meter with the flows from the Streit-Perham dormitory and subtracting the flows from the Marriot Residence Inn. Dorm flowrate was determined from provided occupancy and the flowrate per bed from the 2023 data (2024 flow meter data was not available). The Marriott average daily flowrate was estimated from monthly total flow meter volumes for August 2024. During the monitoring period, seven loading samples were collected for the same constituents listed in Basin A, above.

BASIN C

Flow monitors were installed in three (3) manholes to determine the contribution from WSU to the City system for Basin C. DW monitoring occurred in MH-73U, MH-70D, and MH-8 from August 5 to August 26, 2024. To do this, one monitor was installed upstream of the connection point between the WSU and City system in MH-73U, one monitor was installed downstream of the connection point between the WSU and City System in MH-70D, and one monitor was installed in a manhole collecting flows directly from WSU, MH-8. WSU flow contribution to the City system was calculated by subtracting the flow measured in MH-70D from MH-73U, and then adding MH-8. The flow monitors recorded “flashy” data throughout the monitoring period, likely the result of regular, rapid flushing of large wastewater volumes upstream (such as from a car wash or brewery washdowns). The peaks did not always align between the upstream and downstream manholes MH-73U and MH-70D, causing the subtraction at the 5-minute interval reading of the meters to contain negative values. To mitigate errors, data was averaged over a longer daily period, and outlier points were removed.

During the monitoring period, eight loading samples were collected for the same constituents listed under Basin A above. Load sampling equipment had several malfunctions, reducing the number of samples available. After the monitoring period, City Staff called to discuss the loss of loading samples for Basin C and determined the eight loading samples were sufficient for the monitoring period to develop average loading values.

BASIN D

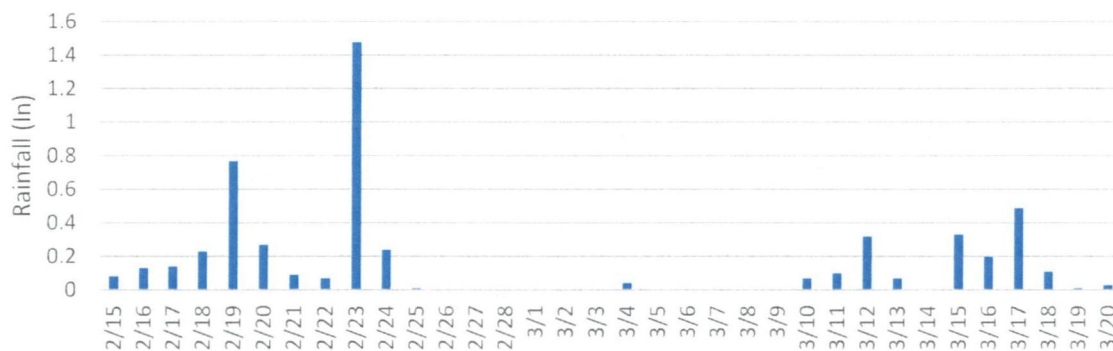
Basin D data consists solely of the flows measured from Grimes Way permanent meter station. Data for Grimes Way was provided for July and August 1-25, 2024. During the dry weather period, the City completed six loading sampling events for Basin D.

III. WET WEATHER MONITORING

The WW monitoring period was February 24, 2025 to March 17, 2025, the period with students was from February 24 to March 7 and without students from March 8 to March 16. The agreed upon dates were set to attempt to capture higher, more dilute flow typically occurring during late winter and early spring months, as a result of greater precipitation and increased infiltration and inflow.

On February 23, 2025 the Pullman, Moscow area experienced a large (1.5 inch) rain event. The flow monitors were installed the following morning and captured the decrease (“tail end” of the event) in sewer flows from 2/24 to about 2/27 following the storm. **Figure 2** below shows the precipitation events during the WW monitoring period. Review of the monitoring data indicates only storms prior to 2/24/2025 appear to have a significant impact on the flows.

Figure 2. Precipitation Events in February and March



WW analytical sampling was completed by the City for Basins A, B, C, and D in the same manholes as the DW monitoring and were analyzed by Anatek Labs in Moscow, Idaho. The loading samples were compared with sampling data from the spring of 2020 to understand loading trends and patterns. Graphs showing flows from the WW monitoring period for each basin are shown in **Appendix C**. The loading summary is shown in **Figure 5** and **Figure 6**. A description of the flow monitoring events for each basin is provided below.

BASIN A

Flow data for Basin A was provided for February and March 2025 water meter readings from the City and the total count of dwelling units for WSU-owned apartments. This data includes flows from February 1 to March 31, 2025. The data provided was the total count of dwelling units and the typical percentage occupied. To determine the flows for Basin A, JUB used literature values with the specific occupancy counts for dwelling units WSU provided. The flows from the City water meter readings of apartments were used to compare with the literature values to confirm that the literature values were

representative. During the flow monitoring period, the City sampled the Basin A effluent three separate times from the downstream manhole and provided results for BOD and TSS.

BASIN B

Data for Basin B was calculated as in the DW monitoring period using the flow data from the Lake Street permanent meter station, occupancy and water meter usage for the WSU Streit-Perham dorms, and the Marriot Residence Inn water usage. Flow data for the Lake Street monitor was for all of February and March 1-20, 2025. Flow data for the Marriot Residence Inn was also for February and March 2025. Flow data for the dorms was from September 2023 with bed counts from the DW monitoring period. WSU confirmed occupancy from the DW monitoring period was the same as the WW period. During the monitoring period, seven loading samples were collected for the same constituents listed in Basin A, above.

BASIN C

WW monitoring was completed for a three-week period from February 24 to March 17, 2025. Flow rates were determined as in the DW monitoring period for the monitors installed in the same three (3) manholes (upstream MH-73U, downstream MH-70D, and one collecting flows directly from WSU, MH-8). Loading rates were calculated using the sample data provided from the City sample monitors installed during the same time period as the J-U-B flow monitors. Sample locations were in MH-8 and the WSU outfall manhole on College Ave before it joins with the City. During the monitoring period, eight samples were collected for the same constituents listed under Basin A above.

BASIN D

Basin D data consists solely of the flows measured from Grimes Way permanent meter station. Data for Grimes Way was provided for February and March 1-20, 2025. During the monitoring period, six loading samples were collected for the same constituents listed in Basin A, above.

IV. WASTEWATER TREATMENT PLANT

The City also provided wastewater treatment plant (WWTP) influent BOD, TSS, and flow data from July to September 2024 and February to March 19, 2025. WWTP data represents all flow collected in the City's system, including the contributions by WSU. Graphs showing flows from the DW and WW monitoring periods are shown in **Appendix B** and **Appendix C**, respectively. The City sent the influent BOD and TSS samples to Anatek Labs in Moscow, ID as well during both monitoring periods to remove differences from using multiple labs.

V. FLOW ANALYSIS

Table 1 summarizes flows experienced in the City's sewer system, as recorded at the WWTP and of WSU's outfalls. WSU flowrates represent the summation of the average daily flows observed in Basins A, B, C, and D. The City percentage reported represents the portion of the wastewater produced by City sources *other than* WSU. The weighted average is calculated using the following assumptions:

- The impact to sewer flows from the 1.5" rain event on February 23 were observed in the flow monitoring data from Feb 23 to Feb 27, 2025. The days with elevated flows were removed from the data set to develop the WW average flow used in the calculations.
- 3 months (assumed Feb, Mar, Apr) of WW with students
- 6 months (assumes Aug, Sep, Oct, Nov, Dec, Jan) of DW with students
- 3 months (assumes May, Jun, Jul) of DW without students
- WW without students represents the specific conditions of Spring Break at the WSU campus and was not used to develop the weighted average flow.

Table 1 – Average Flowrate

Period	Total Flow	City		WSU	
	<i>gpm</i>	<i>gpm</i>	<i>% Flow</i>	<i>gpm</i>	<i>% Flow</i>
WW ¹ with students	2,179	1,678	77.0%	502	23.0%
WW ¹ without students	1,823	1,515	83.1%	307	16.9%
DW ² without students	1,500	1,036	69.1%	464	30.9%
DW ² with students	1,679	1,193	71.1%	486	28.9%
Weighted Average³	1,759	1,275	72.0%	484	28.0%

¹ Wet weather monitoring period, where WWW is wet weather with students

² Dry weather monitoring period, where DWO is dry weather without students and DWW is dry weather with students

³ Weighted Average = $(3*WWW + 3*DWO + 6*DWW)/12$

The WSU flow rates did not vary significantly during the two periods when students were present. WW with student flows were slightly higher which is likely related to the increase in I/I from wet weather during the monitoring period. The WW without students flow rates show less flow than during the DW period. The potential source of the DW difference is many students return to campus for sports, Greek life, or other activities prior to one week before the start of the semester. Additionally, students may spend the summer in Pullman for summer classes. The DW without students period was likely influenced by the additional flow from those early returning students. Additionally, the difference of flow (24 gpm) between the DW without students and with students period is smaller than the difference in the WW period. This seems to indicate a higher percentage of students were on campus in the DW without students period than during WW without students period. The WW monitoring indicates many students left and is likely close to the low flow WSU experiences. Thanksgiving Break and possibly the semester breaks may see similar low flows in the WSU system.

Based on the flow monitoring periods, WSU produced approximately 28.0% of the total City flow.

The percentage of WSU flow is lower than the current agreement between the City and WSU which shows about 36.4% of the flow was WSU's. WSU student population appears to have peaked at about 21,000² students in 2018/2019 academic year and is currently less than 15,400³. This is a 26.7% drop in enrollment. If the weighted average flow in **Table 1** for WSU of 485 gpm is increased by 26.7% the percentage of flow belonging to WSU would be 34.9%. This appears to align with the new lower enrollment number for WSU and the increasing population of the City of Pullman.

VI. BOD AND TSS ANALYSIS

During the DW monitoring period, for Basin A and C there is only one sample from the period without students. In Basin B there are not any samples for the DW period without students. Therefore, data from the 2021 DW monitoring period was used to augment the data in Basin B only for the DW without students period. The current sampling data for Basin B indicate similar trends found in the previous sample results and seems to indicate the 2021 DW data average is a reasonable representation of the current conditions.

During the WW monitoring period there was an even distribution of loading data from all basins. However, to understand trends 2020 WW data was also reviewed to determine if loading characteristics have changed. The 2020 data was influenced by COVID but the overall average and trends are similar to the current WW data. **Appendix D** shows the concentrations for all the monitoring events plotted by Basin to allow comparison.

BOD and TSS concentrations (in milligrams per liter, mg/L) in Basins A, B, and C appear to be near the average of the City System during the WW monitoring period. Basin D is largely an industrial basin and has much lower strength waste than the City or other parts of the WSU system. The WW data seems to show a slight influence of infiltration and inflow (I/I) on domestic waste strength with reductions of less than 50 mg/L for both BOD and TSS. Typically, WW concentrations will be lower (more dilute) than DW concentrations due to the presence of I/I in the system. The sampling shows a trend of higher strength when more students are present and lower strength when less students are present, which is expected. .

Basin B DW flow period 2024 did not have without students loading sample so the average of the without student period from the 2021 DW was used as an estimate.

Basin C is the largest flow-producing basin and generally has more flow than the other basins combined. Therefore, total loading trend towards the Basin C data. However, each Basin's concentration of the waste follows normal patterns of increase strength when

² WSU Data and Information Website (<https://data.wsu.edu/system-data/institutional-dashboards/student/total-student-enrollment/>) Total Student Enrollment, Pullman Campus, Fall 2018/2019.

³ WSU Data and Information Website (<https://data.wsu.edu/system-data/institutional-dashboards/student/total-student-enrollment/>) Total Student Enrollment, Pullman Campus, Spring 2025

students are on campus and decreased strength when they are not. This is also observed in **Figure 3** and **Figure 4**.

Basins A exhibits consistently higher BOD and TSS concentrations than Basins B, C, and D during DW when students are not present. During the DW period Basins A had BOD and TSS concentrations at or above the WWTP influent. Basins B, C, and D were consistently below the WWTP concentrations when students were not present and increase to near WWTP values when students were present for Basins B and C. The low values in Basin D were expected and are repeated in all loading data collected and match the non-residential nature of Basin D.

During the WW period Basins A, B, and C concentrations appear to match concentrations observed at the WWTP. Basin B appears to have a slightly higher strength waster than the WWTP when students were present. Basin D is again a low strength flow.

The quantities of BOD and TSS during the monitoring periods are presented in **Table 2**. The weighted average is computed using the same method and assumptions as the flow data. The data shows lower quantities of BOD and TSS during the periods without students, which is expected. Overall, WSU contributed 22% of BOD and approximately 24% of TSS (weighted average). As previously discussed, WSU supplies approximately 28.0% of the City's total flow, implying WSU's wastewater was sampled as slightly more dilute than wastewater from other sources in the City.

Table 2 – Average BOD and TSS Loading

Period	BOD					TSS				
	Total Load	City		WSU		Total Load	City		WSU	
	<i>lb/d</i>	<i>lb/d</i>	% BOD	<i>lb/d</i>	% BOD	<i>lb/d</i>	<i>lb/d</i>	% TSS	<i>lb/d</i>	% TSS
WW¹ with students	6,043	4,548	75.3%	1,495	24.7%	5,803	4,240	73.1%	1,563	26.9%
WW¹ without students	4,247	3,710	87.3%	538	12.7%	4,143	3,510	84.7%	633	15.3%
DW² without students	3,978	3,340	84.0%	638	16.0%	3,550	2,954	83.2%	596	16.8%
DW² with students	4,534	3,469	76.5%	1,065	23.5%	5,116	3,737	73.0%	1,379	27.0%
Weighted Average³	4,772	3,707	78%	1,066	22%	4,896	3,667	76%	1,229	24%

¹ Wet weather monitoring period

² Dry weather monitoring period, Basin B without Students estimated from 2021 data

³ Weighted Average = (3*WWW + 3*DWO + 6*DWW)/12

Figure 3 – Average BOD Concentration Dry Weather

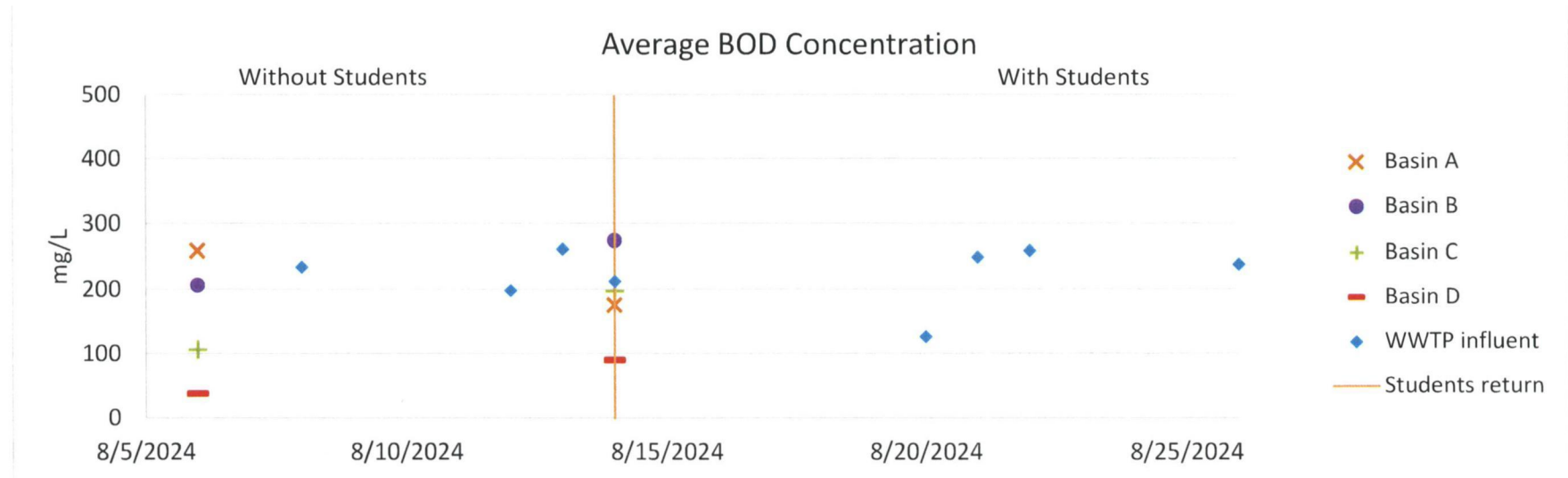


Figure 4 – Average TSS Concentration Dry Weather

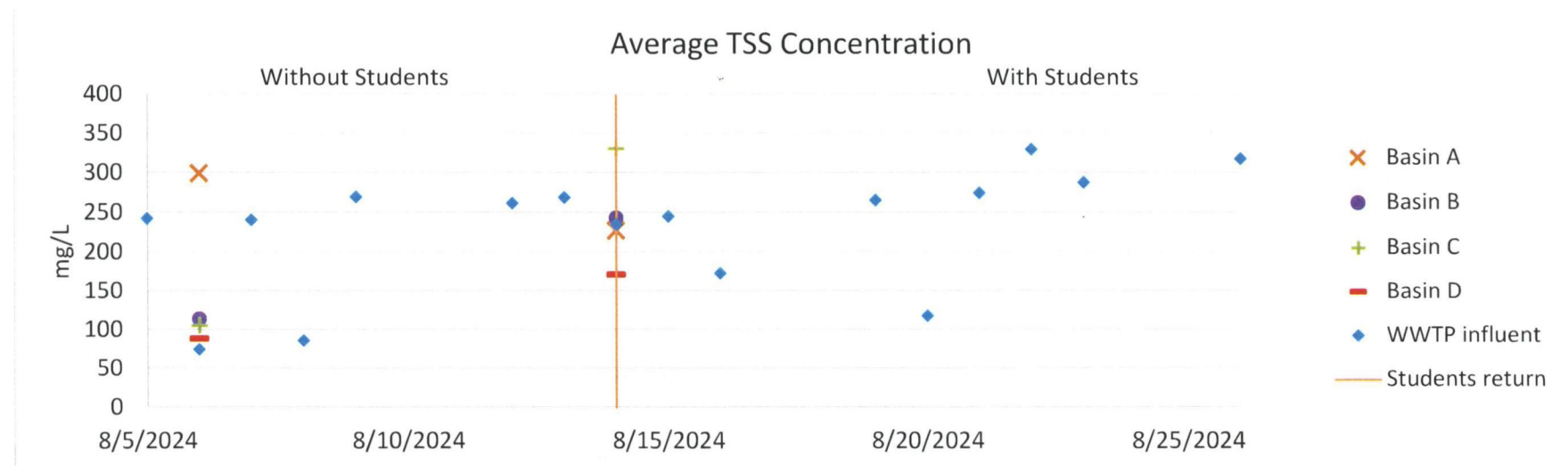


Figure 5 – Average BOD Concentration Wet Weather

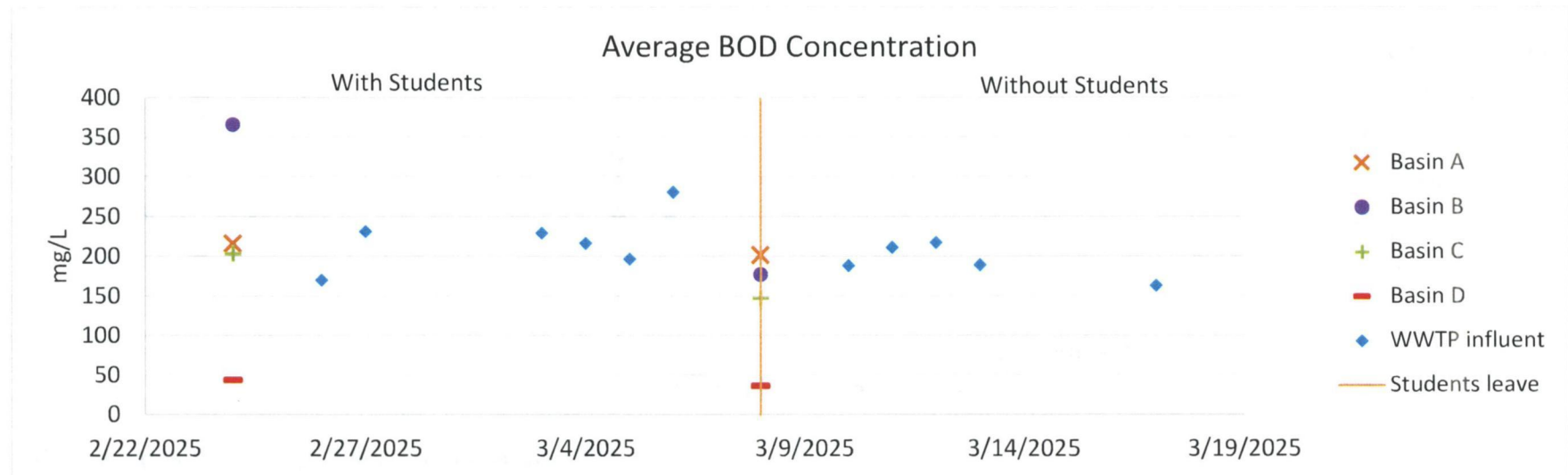
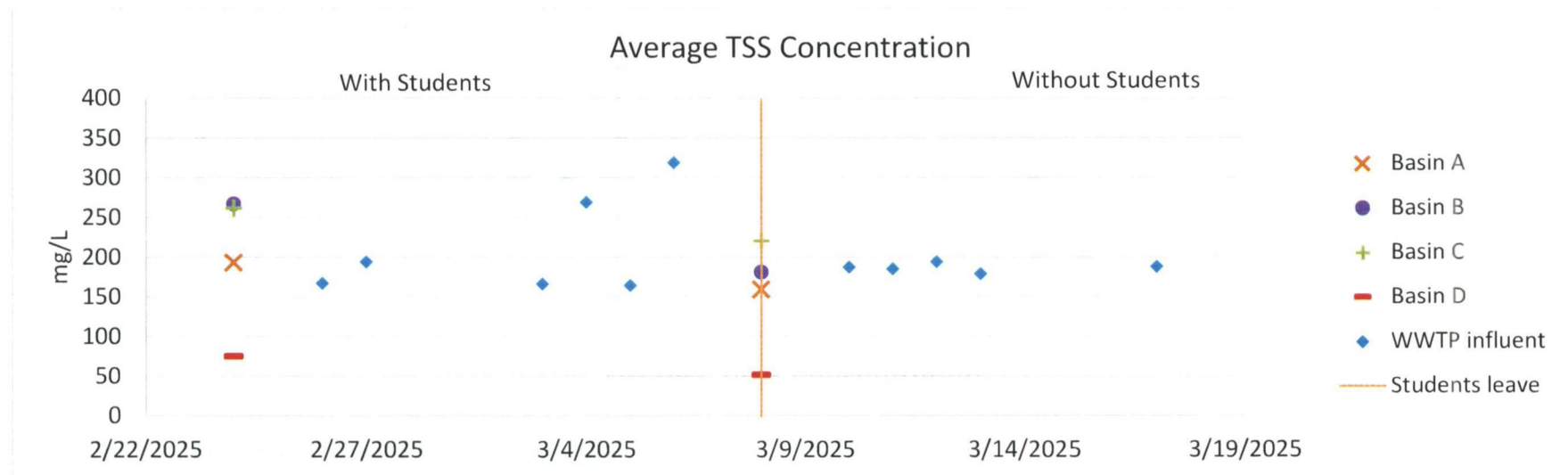


Figure 6 – Average TSS Concentration Wet Weather



VII. RECOMMENDATIONS

Some municipalities split costs for Capital Improvement and Maintenance/Operation based on a combination of the percentage of flow and the percentage of loading (wastewater strength). Those agreements are designed to address users with waste streams different from typical residential strength or different from the wastewater treatment plant average. The consideration of loading is generally through a surcharge for high strength waste, the threshold of which is typically set based on long-term City averages. The loading data gathered during this project indicates WSU loading was generally equivalent in strength to the City's wastewater. It is recommended to continue with a flow-based agreement.

J-U-B met with City staff and WSU staff on 5/29/25 to review the data gathered from the monitoring periods and a decision was reached to proceed with drafting an agreement that is based on the weighted average flow split summarized in Table 3.

Table 3. Percent Flow Between City and WSU

2024-2025 Flow Splits	CITY %	WSU %
Flow Percentages	72.0%	28.0%

APPENDIX A – DRAFT March 10, 2022 City of Pullman Analysis of WSU Flow and Loads

Appendix A includes the full DRAFT Technical Memo for the Flow Monitoring done from 2020 to 2021. The draft figures, tables, and graphs presented are for the 2020 and 2021 flow monitoring.



J-U-B ENGINEERS, INC.

J-U-B COMPANIES



THE
LANGDON
GROUP



GATEWAY
MAPPING
INC.

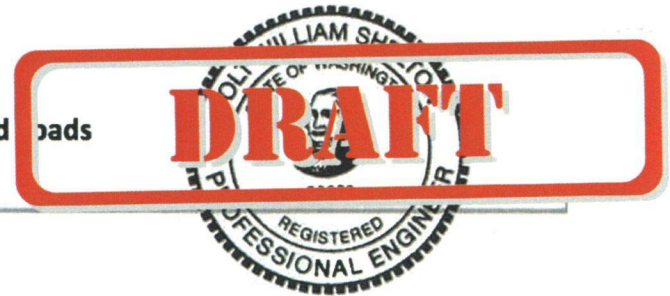
Technical Memorandum

DATE: March 10, 2022

TO: Shawn Kohtz, P.E., Public Works Director, City of Pullman
Clayton Forsmann, P.E., Deputy Director of Public Works, City of Pullman

FROM: Colt Shelton, P.E.
David Watkins, P.E.

SUBJECT: City of Pullman Analysis of WSU Flow and Loads



I. INTRODUCTION

This technical memorandum summarizes the results of a flow and loading study at the point of connection between the Washington State University (WSU) system and the City of Pullman (City) system. The purpose of this study is to determine the contribution of flow and loads from WSU to the City. Flows were measured by J-U-B Engineers, Inc. (JUB) during the “wet” period and the “dry” period of the year for Basin C. In addition, the City and WSU provided flow data for Basins A, B, and D, as well as constituent loading data from all basins. **Figure 1** delineates the four WSU flow basins (A, B, C, and D).

II. SOCIETAL EVENTS

During the wet weather flow monitoring period, unprecedented events occurred that could, and likely did, affect the results of the study. The following events occurred during the wet weather monitoring period:

- February 24, 2020 – Flow Monitors installed.
- February 28, 2020 – Recleaning of WSU line complete.
- February 29, 2020 – Washington State Governor Jay Inslee issues state of emergency for all counties in Washington for COVID-19 pandemic.
- March 11, 2020 – WSU announces transition to online classes after spring break.
- March 14, 2020 – WSU spring break starts March 16, 2020 – Flow Monitors removed after discussion with City about WSU transition to online classes.
- March 22, 2020 – WSU spring break ends.
- March 23, 2020 – WSU transitions fully to online classes.
- March 25, 2020 – Washington State Governor Jay Inslee issues mandatory stay-at-home order for the entire state to help slow the spread of COVID-19.

Legend

● Monitoring Location

□ WSU Boundary

Basins

Basin

A

B

C

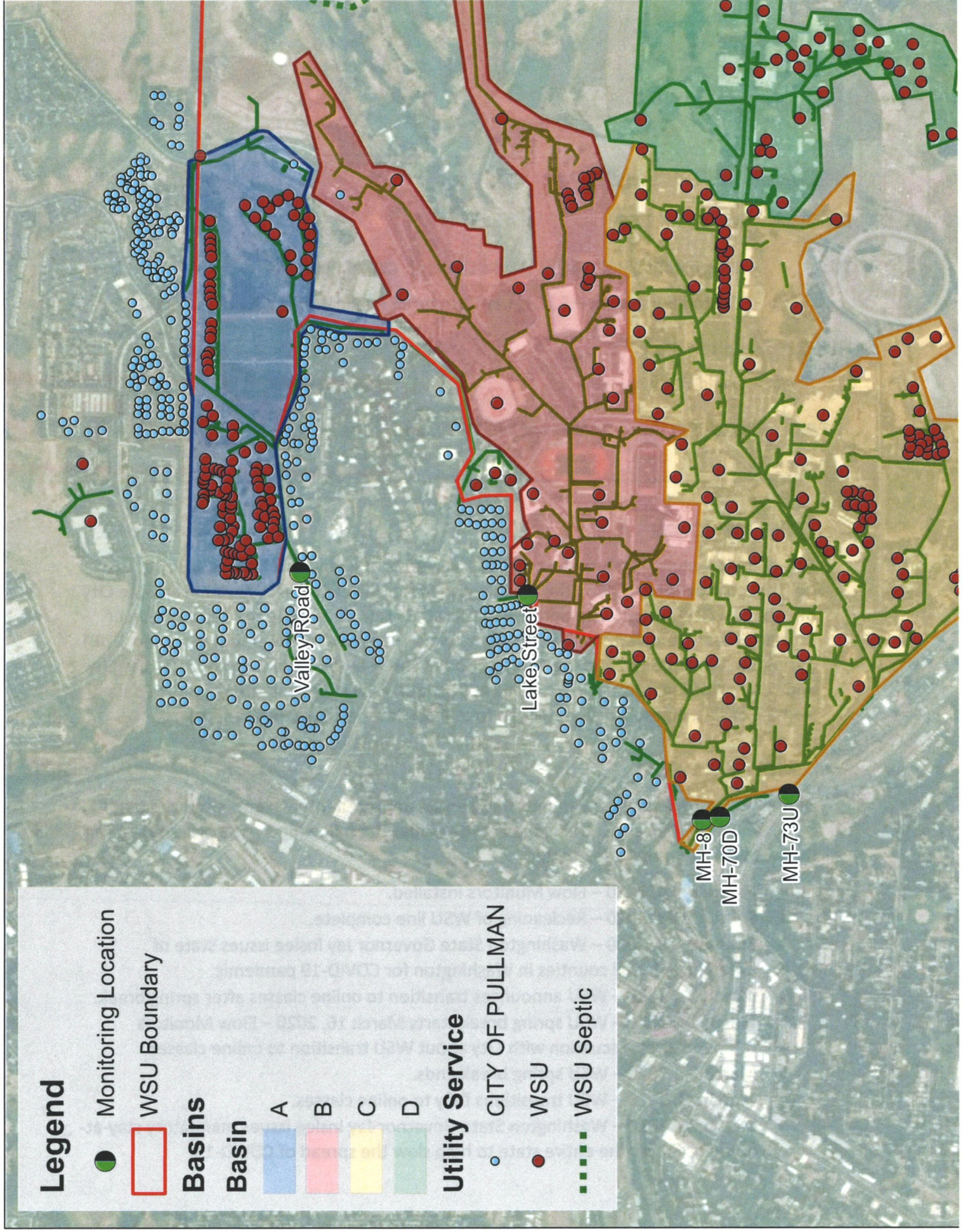
D

Utility Service

● CITY OF PULLMAN

● WSU

--- WSU Septic



The wet weather flow monitoring period was initially selected to capture WSU's spring break, in attempt to observe the students' contribution to wastewater flow and loads. As nearly 20,000 students attend WSU on the Pullman campus, this was expected to be significant. Unfortunately, due to the COVID-19 events outlined above, the effect of students leaving campus was not apparent in the study results. Additionally, because COVID-19 events coincide with the majority of the wet weather period, it was assumed that the entire wet weather flow and loading analysis period reflects suspect data and was not used in the final analysis for the flow splits. Students did not return to campus until the 2021-2022 school year and the dry weather period was paused until July of 2021 to capture the new normal conditions.

III. WET WEATHER MONITORING

The wet weather monitoring period was February 24, 2020 to March 16, 2020. JUB selected the dates in attempt to capture higher, more dilute flow that typically occurs during late winter and early spring months, as a result of greater precipitation and increased infiltration and inflow. Unfortunately, no significant precipitation events occurred during the monitoring period.

Due to the occurrence of COVID-19, fewer constituent sampling events were reported during the wet weather period than anticipated. Consequently, in the absence of available wet weather data and upheaval of typical flow and loading patterns, the data was not used in the analysis. Wet weather analytical sampling was completed for Basins B, C, and D and was reviewed and confirmed to contain data representing abnormal characteristics and patterns. Loading samples were collected for the following items:

- pH
- Biochemical oxygen demand (BOD)
- Total suspended solids (TSS)
- Total phosphorus (Total P)
- Total Kjeldahl nitrogen (TKN)

A description of the flow monitoring events for each basin is provided below even though the wet weather data was not used. Graphs showing flows from the wet weather monitoring period for each basin are shown in the **Appendix A**. The loading summary is shown on **Figure 1**.

BASIN A

Flow data for Basin A was provided from 2019 water meter readings from the City and total count of dwelling units for WSU owned apartments. This data includes flows from January to December of 2019 (pre-COVID). Data for Basin A was provided to JUB from WSU in the middle of April 2020. The data provided was the total count of dwelling units and the typical percent occupied. To determine the flows for Basin A, JUB used literature values for the specific dwelling units WSU provided and the historical flows from the City

water meter readings. Loading in Basin A was estimated using dry weather period data because loading samples were not collected in that basin due to early termination of the sampling program from COVID.

BASIN B

Data for Basin B was calculated using the flow data from the Lake Street permanent meter station, the WSU Streit Perham dorms, and the Marriot Residence Inn. Flow data for Lake Street was provided on a monthly usage rate for each month from 2017 to 2020. Flow data for the Marriot Residence Inn was provided on a monthly basis from 2015 to 2020. Flow data for the dorms was determined using bed counts and literature values. The total flow for Basin B was calculated by adding the flows from Lake Street with the flows from the dorms and subtracting the flows from the Marriot Residence Inn.

BASIN C

Wet weather monitoring was completed for a three-week period from February 24, 2020 to March 16, 2020. Flow monitors were installed in three (3) manholes to determine the contribution from WSU to the City system, referred to as Basin C. To do this, one monitor was installed upstream of the connection point between the WSU and City system in MH-73U, one monitor was installed downstream of the connection point between the WSU and City System in MH-70D, and one monitor was installed in a manhole collecting flows directly from WSU in MH-8. WSU flow contribution to the City system was calculated by subtracting the flow measured from MH-73U from MH-70D, then adding MH-8. Loading rates for each manhole were calculated using the sample data provided from the City sample monitors that were installed during the same time period as the JUB flow monitors. Sample locations were in MH-8 and the WSU outfall manhole on College Ave before it joins flows from the City.

During data collection, the flow monitor in MH-8 had to be reinstalled due to gravel buildup in the pipe that caused inaccurate readings. The pipe was cleaned out by the City and WSU. The reinstallation of the monitor occurred on February 28, 2020. Data for the time period from February 24 to February 28 is considered inaccurate.

BASIN D

Basin D data consists solely of the flows measured from Grimes Way permanent meter station. Data for Grimes Way was provided from May 2019 to March 2020.

IV. DRY WEATHER MONITORING

JUB defined a dry weather monitoring period from July 15, 2021 to September 2, 2021. Wastewater systems generally experience lower, more concentrated flow during late summer. Only minor precipitation events occurred during this period which did not appear to cause measurable infiltration or inflow.

The dry weather period captured the conclusion of summer break and the beginning of WSU's 2021-2022 school year, allowing the monitoring period to be broken into observations with students and without students. WSU's Week of Welcome occurred the week of August 14, 2021, and the school year officially began the following Monday, August 23, 2021. Based on the assumption many students arrived two weeks prior to the first day of instruction, the dry weather period was divided into "without students" and "with students" periods before and after August 9, 2021, respectively. The average flowrates and shape of the flowrate versus time curve obtained from the continuous flow monitors in Basin C support this assumption.

The return to school in August of 2021 appears to begin a return to normal for flows and loading at the WSU campus. The impacts of COVID on student preferences to live on and/or off campus and typical wastewater generation patterns still are being felt. Graphs showing flows from the dry weather monitoring period for each basin are shown in the **Appendix B**.

BASIN A

Basin A used water meter records from the 2019 data for July through September. Flows for Basin A were estimated using a combination of the 2019 water meter readings and literature values from Metcalf and Eddy (2014) as was done in the wet weather monitoring period. During the flow monitoring period, the City sampled the Basin A effluent three separate times from the same downstream manhole and provided results including pH, BOD, TSS, TKN, and total P.

BASIN B

Similar to the wet weather flow period, total flow in Basin B was calculated by adding the flows from Lake Street with the flows from the Streit Perham dormitory and subtracting the flows from the Marriot Residence Inn. Average daily flowrates in Lake Street were calculated from daily total volume, provided from July through September 2021. Dorm flowrate corresponded to a provided occupancy and a typical flowrate per bed given by Metcalf and Eddy (2014). The Marriott average daily flowrate was estimated from monthly total volumes, July through September 2021. During the monitoring period, 19 loading samples were collected for the same constituents listed in Basin A, above.

BASIN C

Dry weather monitoring occurred in MH-73U, MH-70D, and MH-8 from July 15, 2021 to September 2, 2021. As with wet weather monitoring, the total Basin C flowrate corresponded to MH-73U subtracted from MH-70D and added to MH-8. Unfortunately, the flow monitors recorded "flashy" data throughout the monitoring period, likely the result of regular, rapid flushing of large wastewater volumes upstream (such as from a car

wash, brewery washdowns, etc.). To mitigate error introduced, data was cleaned by removing any negatives from the individual MH datasets, as well as the total basin dataset, and removing any outlier points.

Several other events occurred that required data adjustments. During data collection, solids built up in MH-70D, requiring cleaning of the flowmeter to achieve accurate readings. Additionally, missing data was filled during a brief gap in recording in MH-8 at the end of the monitoring period. Finally, a few days of abnormally low flow, which may have resulted from monitor error or unusual events, were removed from analysis.

During the monitoring period, 13 samples were collected for the same constituents listed under Basin A above.

BASIN D

The WSU provided average hourly flowrates observed in Grimes Way meter station. Again, this represented the entirety of Basin D. During the dry weather period, the City sampled and provided results for 16 loading samples.

V. WASTEWATER TREATMENT PLANT

The City also provided wastewater treatment plant (WWTP) influent BOD, TSS, and flow data from January 2020 to October 2021. TKN and Total P data was not available at the WWTP. WWTP data represents all flow collected in the City's system, including the contributions by WSU. Graphs showing flows from the wet and dry weather monitoring periods are shown in **Appendix A** and **Appendix B**, respectively.

VI. Flow Analysis

Table 1 summarizes flows experienced in the City's system, as recorded at the WWTP and at the WSU outfalls. WSU total flowrates represent the summation of the average daily flows observed in Basins A, B, C, and D. Note that the City flowrate (in gallons per minute, gpm) captures wastewater generated by WSU *in addition* to all other sources in the City. However, the percentage reported represents the portion of the wastewater produced by City sources *other than* WSU.

Table 1 – Average Flowrate

Period	All City		WSU	
	<i>gpm</i>	<i>% Flow (City only)</i>	<i>gpm</i>	<i>% Flow</i>
WW ¹ with students	2,150	55.6%	955	44.4%
DW ² without students	1,415	58.2%	591	41.8%
DW ² with students	1,676	59.4%	681	40.6%
Weighted Average³	1,747	59.1%	742	40.9%

¹ Wet weather monitoring period – not used to determine weighted average

² Dry weather monitoring period

³ Weighted Average based on 9 months of with student population and 3 months of without student population

Although the flowrates varied during the different periods, the proportion of the City flow supplied by WSU remained relatively constant. During recorded periods, WSU produced approximately 41% - 44% of the total City flow. However, as noted above, wet weather data was considered unrepresentative because of COVID-19 and was not used in the analysis. Therefore, the dry weather with students and the without students were combined with a weighted average based on the number of months students were present at the WSU Pullman campus.

VII. BOD and TSS Analysis

Table 2 summarizes loads in pounds per day (lb/day) observed in the City's entire system, as recorded at the WWTP and at WSU. Again, note that City's lb/day value captures WSU contributions, while the City percentage does not. The wet weather sample data did not follow typical trends and confirmed the data did not represent normal characteristics. Dry weather data appears to continue to have some abnormalities making the data set suspect.

Table 2 – Average BOD and TSS Loading

Period	BOD				TSS			
	All City		WSU		All City		WSU	
	lb/d	% BOD (City only)	lb/d	% BOD	lb/d	% TSS (City only)	lb/d	% TSS
WW ¹ with students	7,315	65.5%	2,521	34.5%	6,373	72.8%	1,732	27.2%
DW ² without students	4,308	75.2%	1,069	24.8%	4,016	81.4%	748	18.6%
DW ² with students	6,195	74.5%	1,579	25.5%	5,102	77.7%	1,139	22.3%
Average	5,939	71.7%	1,723	28.3%	5,164	77.3%	1,206	22.7%

¹ Wet weather monitoring period

² Dry weather monitoring period

BOD concentrations during the wet weather and dry weather did not follow typical trends for influences from infiltration and inflow (I/I) on domestic waste. Typically, wet weather concentrations should be lower (more dilute) than dry weather concentrations due to the presence of I/I in the system. However, only Basin D followed this trend. Lack of wet weather samples in Basin A did not allow comparison of the different monitoring periods and may skew the data. Basins B maintained about equal concentrations during both monitoring periods, with slightly higher concentrations during wet weather. Basin C has wet weather concentrations about double the dry weather concentrations and dry weather concentrations are very low for domestic strength waste. Basin C is the largest flow producing basin and generally has more flow than the other basins combined. Therefore, the low dry weather concentrations cause the data set to be lower than expected and trend opposite normal patterns. This is also observed in **Figure 1** and **Figure 2**. All four basins maintain BOD and TSS concentrations (in milligrams per liter, mg/L) near

or below the WWTP influent, with Basins A and B exhibiting consistently higher BOD and TSS concentrations than Basins C and D.

Table 2 summarizes the quantities of BOD and TSS during the monitoring periods. The data shows lower quantities of BOD and TSS during “dry weather without students” than the other periods, which is expected. However, when students returned, BOD quantities remain far below the wet weather quantities. During dry weather, WSU contributed 25% of BOD and approximately 20% of TSS. However, as previously discussed, WSU supplies over 40% of the City’s total flow, implying that WSU’s wastewater was sampled as consistently more dilute than wastewater from other sources in the City and typical domestic waste.

Figure 1 – BOD Concentration

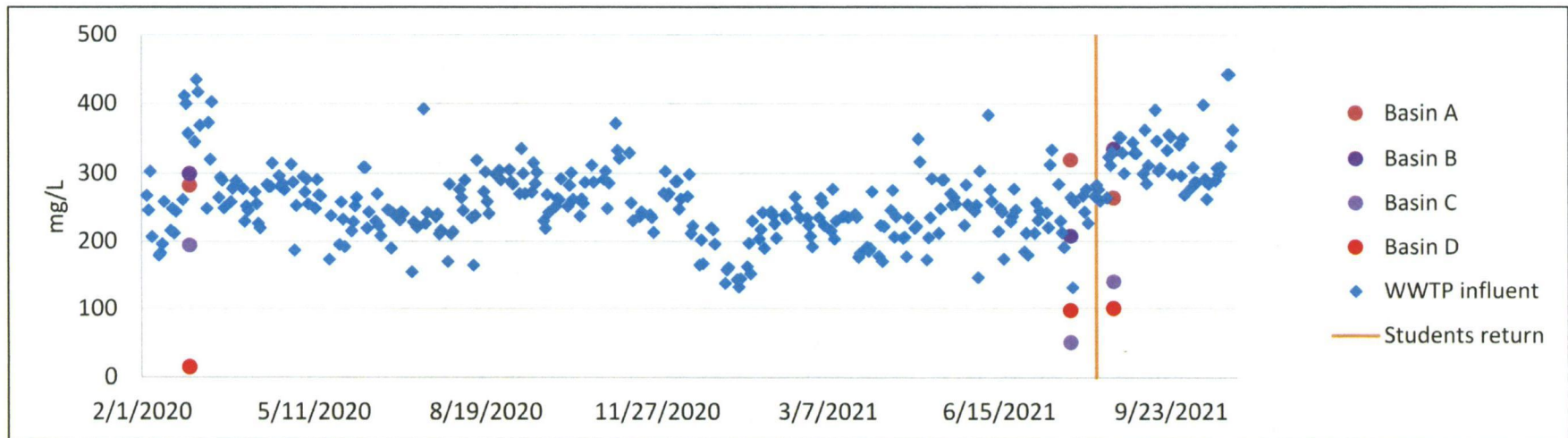
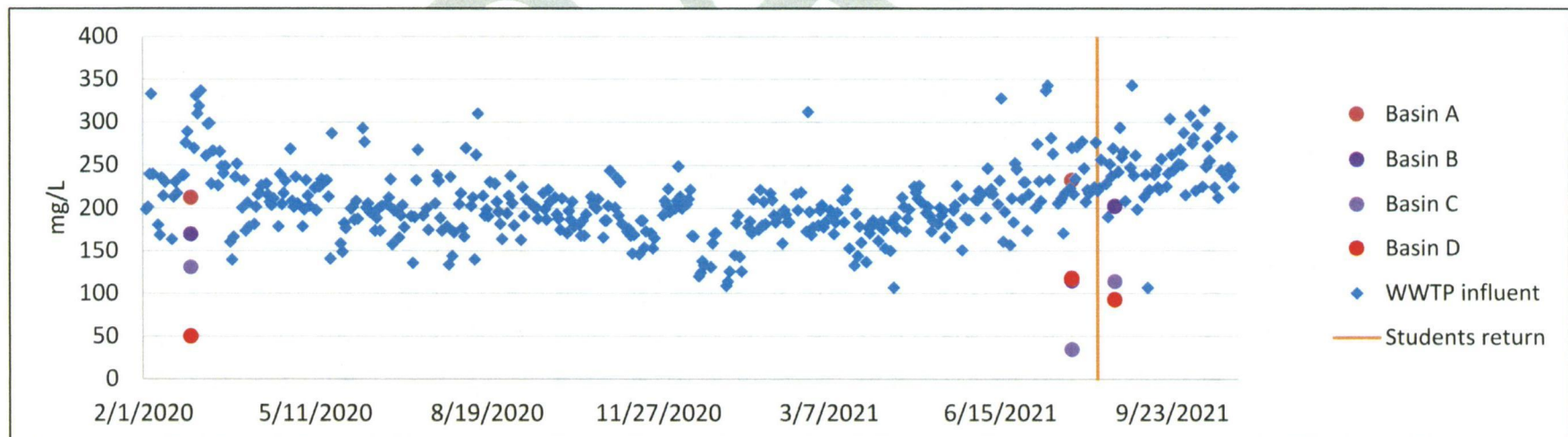


Figure 2 – TSS Concentration



VIII. Other Constituents

In addition to BOD and TSS, the City also provided nitrogen (in the form of TKN) and phosphorus (total P) sample results for Basins A, B, C, and D. Because these values were not reported for the WWTP, literature values served as a basis of comparison for 'typical' wastewater loading. Loads correspond to average concentrations obtained from Metcalf and Eddy (2014) and observed WWTP flowrates. **Table 3** summarizes TKN and total P.

Table 3 – WSU Loading of Other Constituents

Period	TKN (lb/d)		Tot. P (lb/d)	
	Literature value ¹	WSU	Literature value ¹	WSU
WW ² with students	516	387	91.8	54.0
DW ³ without students	319	83	56.8	23.4
DW ³ with students	368	253	65.4	33.7
¹ Calculated with observed flowrates and typical municipal wastewater concentrations of 45 mg/L TKN and 8 mg/L total P, as reported in Metcalf and Eddy (2014). ² Wet weather monitoring period – suspect data. ³ Dry weather monitoring period.				

Similar to BOD and TSS, WSU appears to produce relatively more dilute wastewater than a typical domestic source. This is most significant during the “dry weather without students” period, when WSU generated approximately 26% of expected TKN loading and 41% of expected total P. The results indicate wastewater characteristic are likely still being influenced by COVID and may not be representative of a return to more normal conditions in the coming years.

IX. Recommendations

J-U-B met with the City and WSU to review the data gathered from the monitoring periods and developed an approach for WSU to compensate the City for treatment of the wastewater generated. The current agreement between the City and WSU divides the cost between the following two categories based on past flow and loading:

Table 4 - Previous Agreement Between City and WSU

Current Agreement	CITY %	WSU %
Capital Improvements	63.6%	36.4%
Maintenance & Operation	63.6%	36.4%

During discussions between the City and WSU, they agreed the best approach going forward was to keep the same structure of the agreement and updated the values based

on the dry weather flow splits. Upon recovery from COVID, additional loading samples and/or flow monitoring could be completed to help determine if BOD loading should be included in the splits. (or).

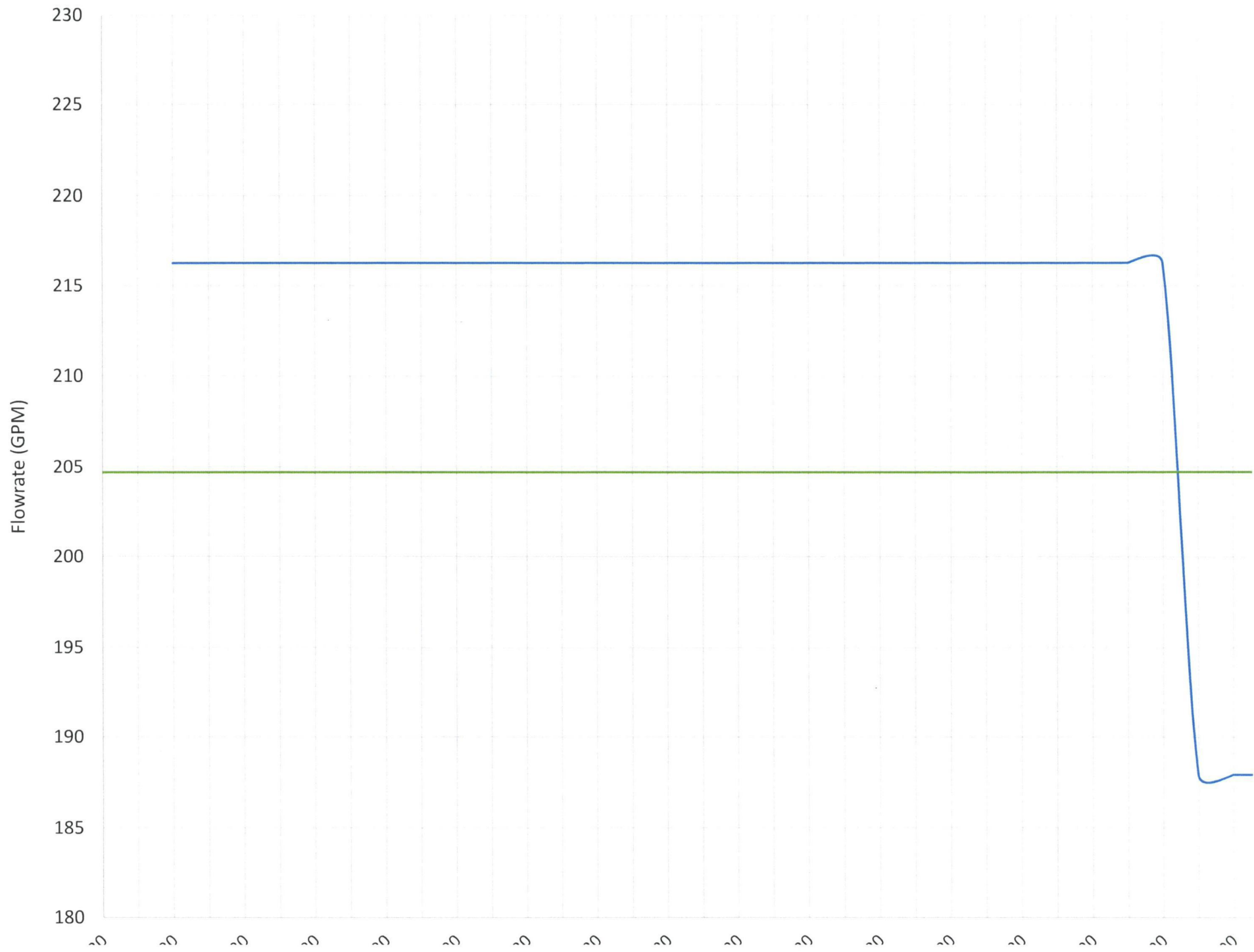
The outcome of the meeting is a new agreement between the City and WSU that the City will pass as Resolution XYZ. The agreement allows for WSU to be billed on 40.9 percentage of the City's flow meter at the WWTP year round, with an additional 40.9% contribution to capital improvement projects.

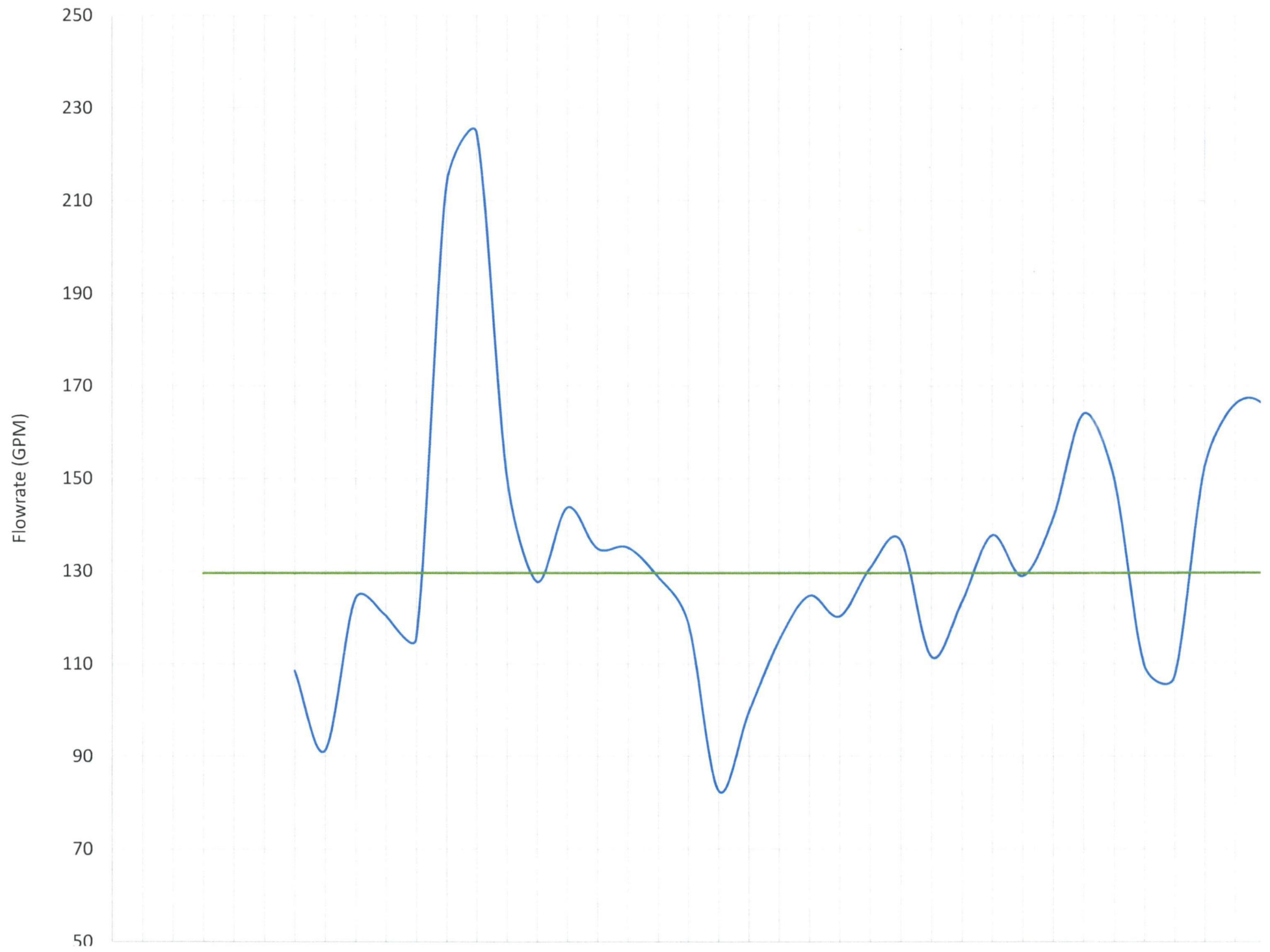
Table 5. Proposed Agreement Between City and WUS

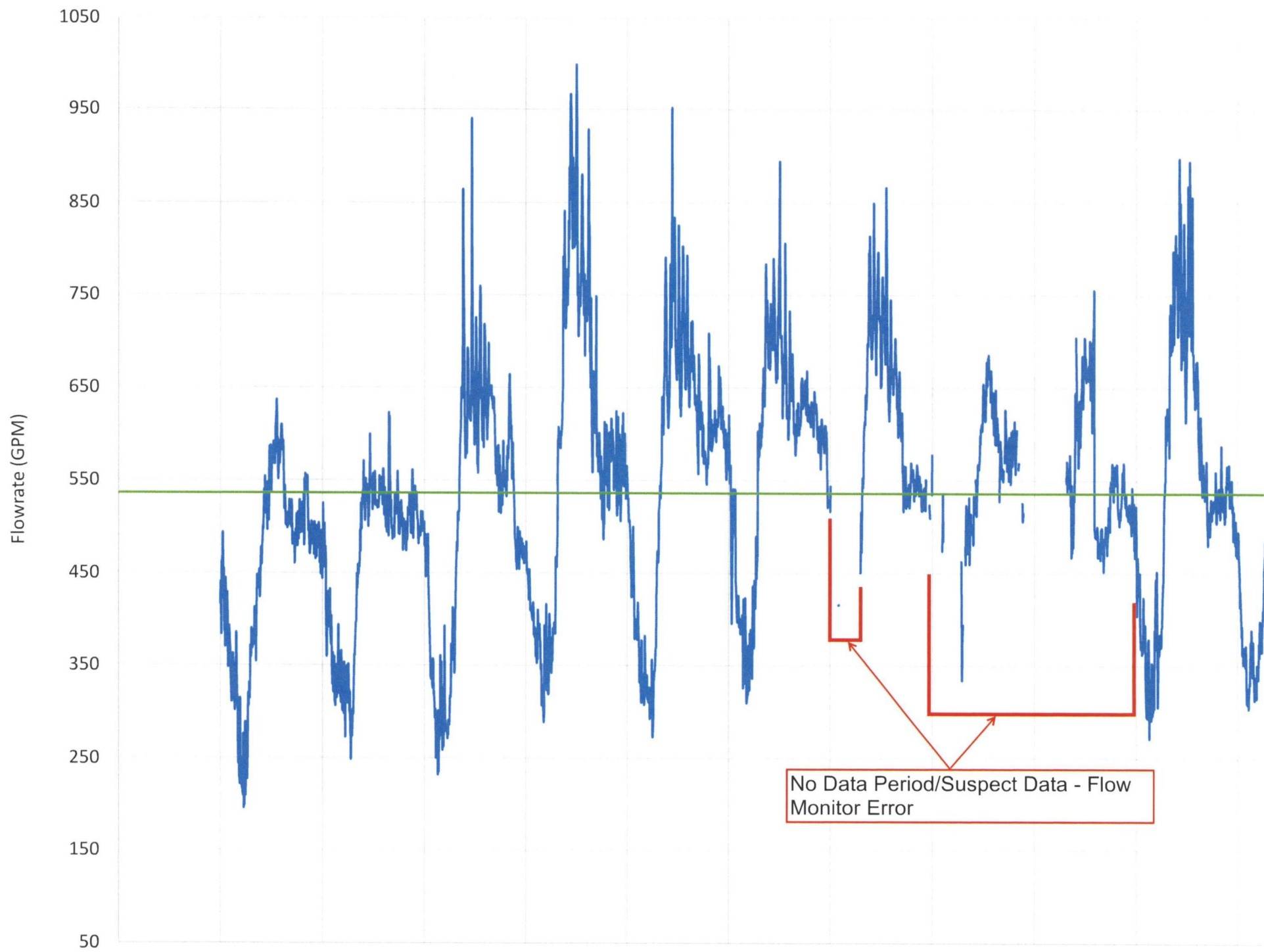
Proposed Agreement	CITY %	WSU %
Capital Improvements	59.1%	40.9%
Maintenance & Operation	59.1%	40.9%

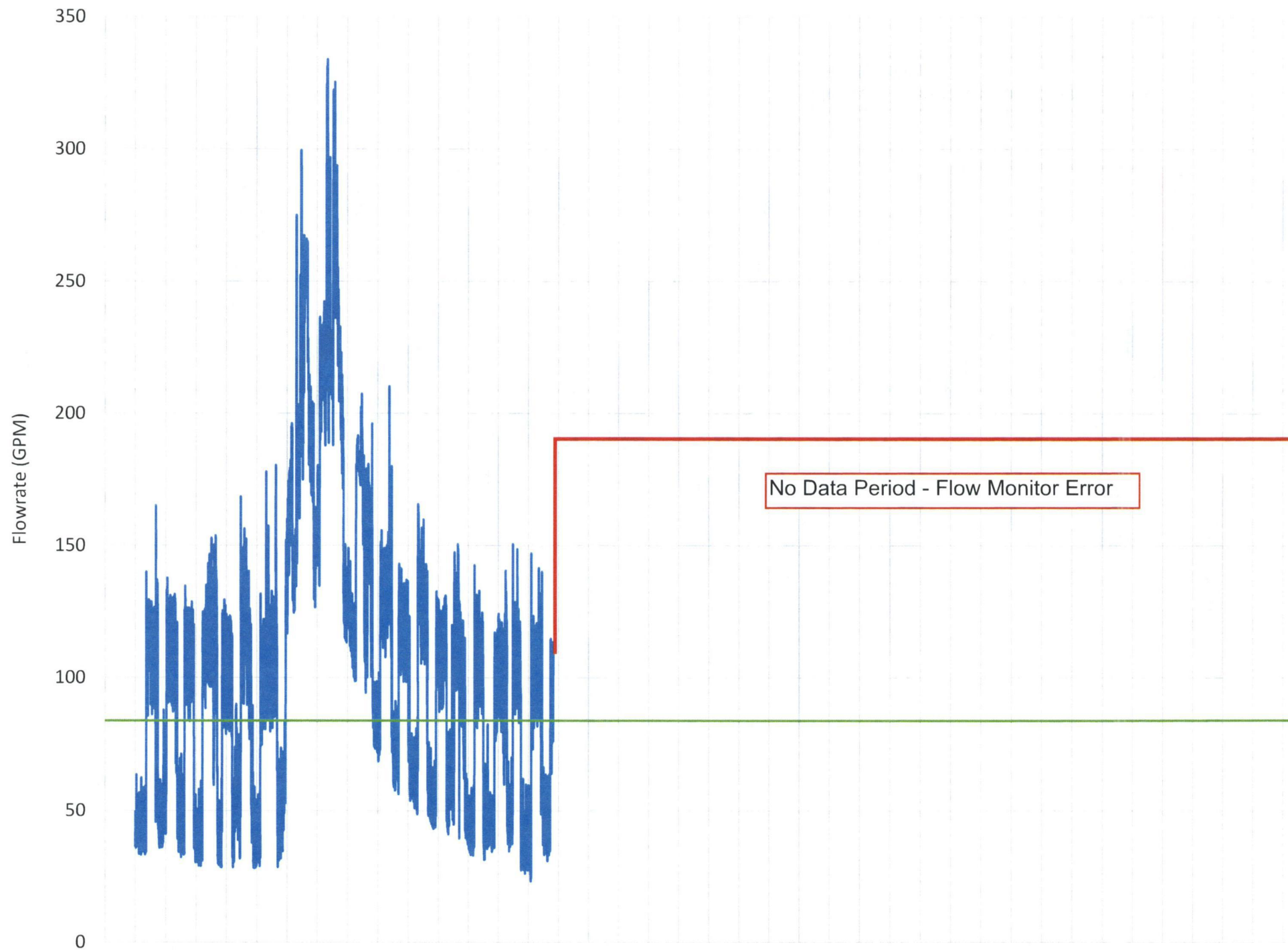
APPENDIX A – Wet Weather Flow Monitoring Graphs

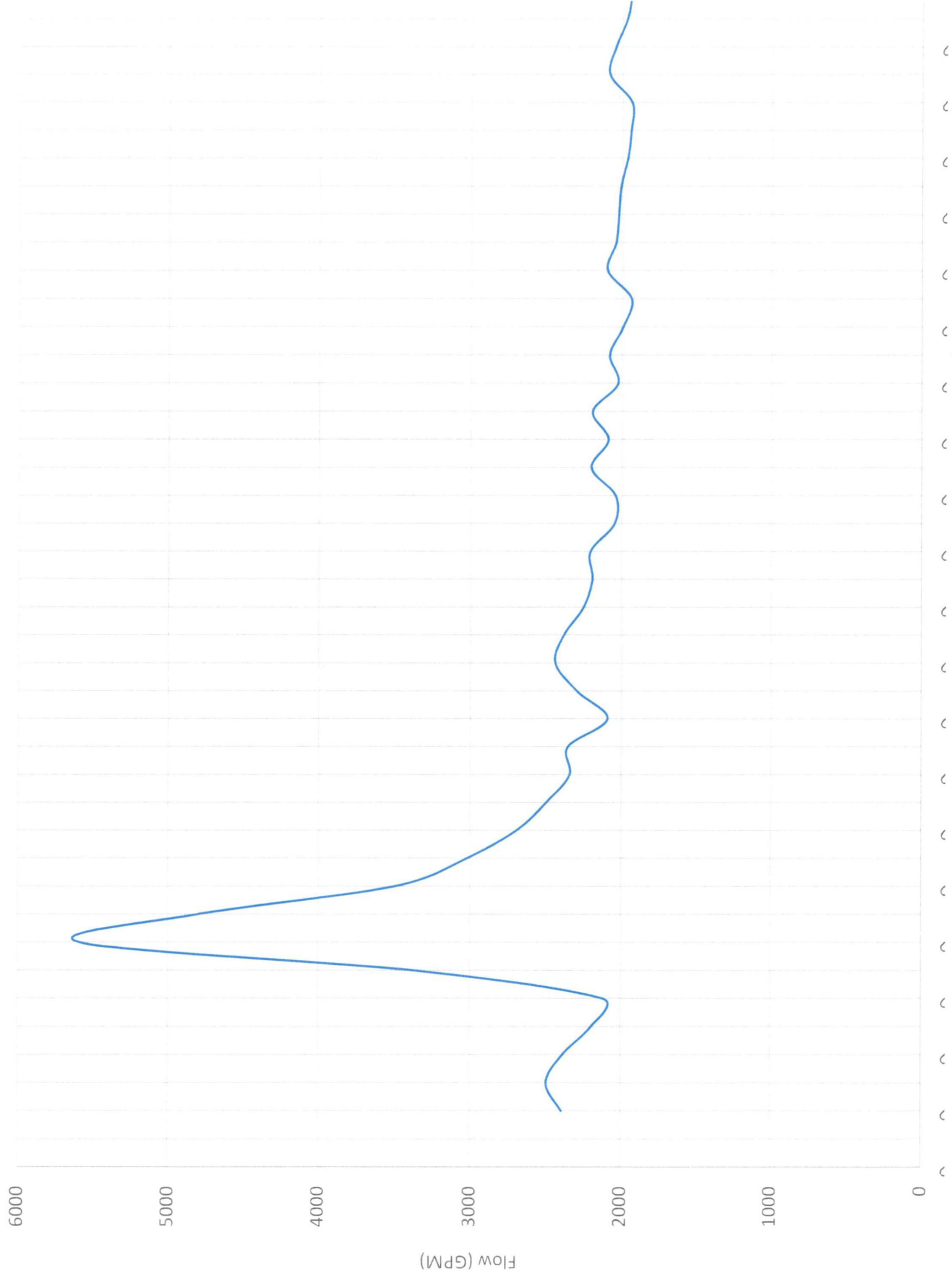
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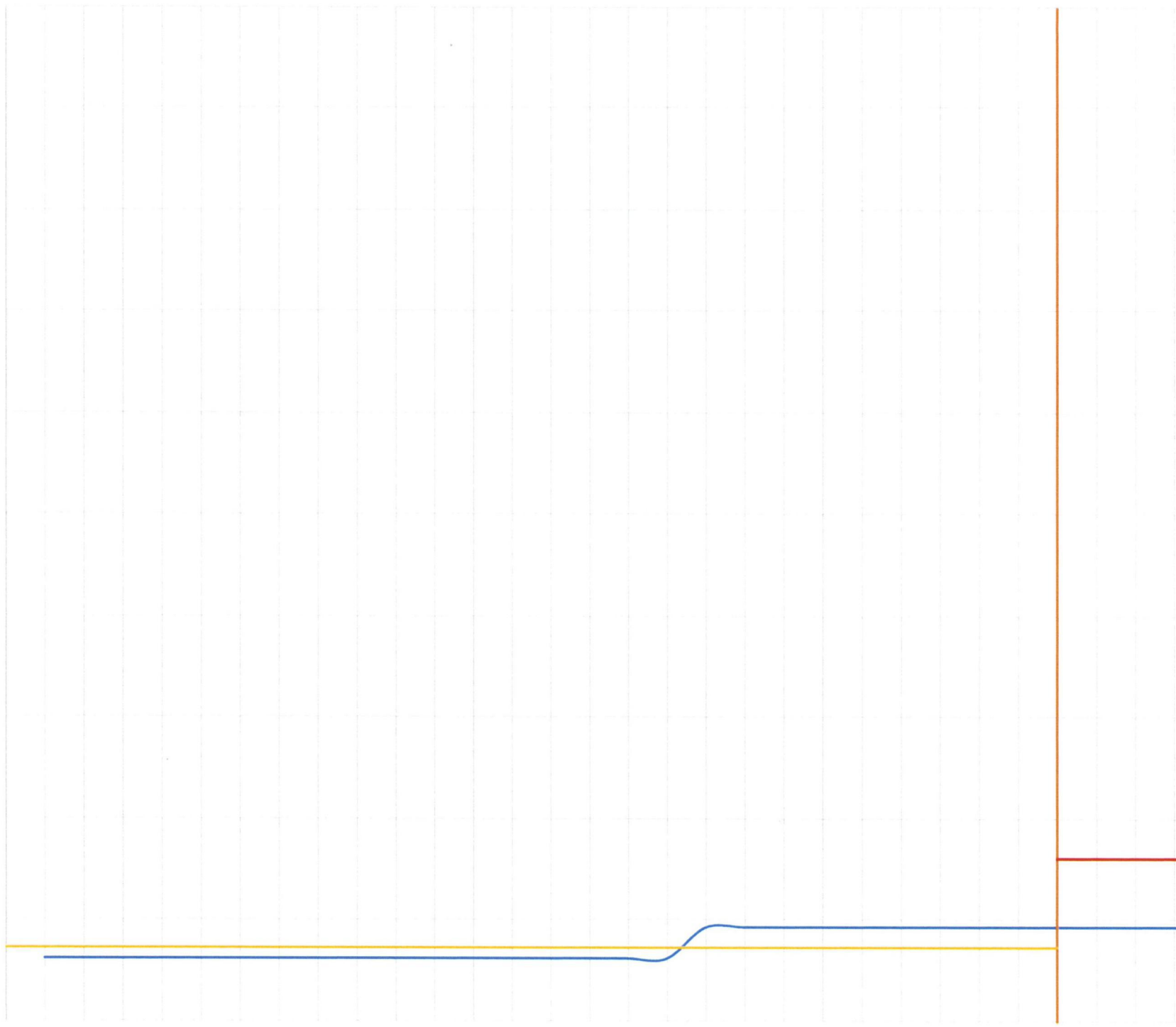


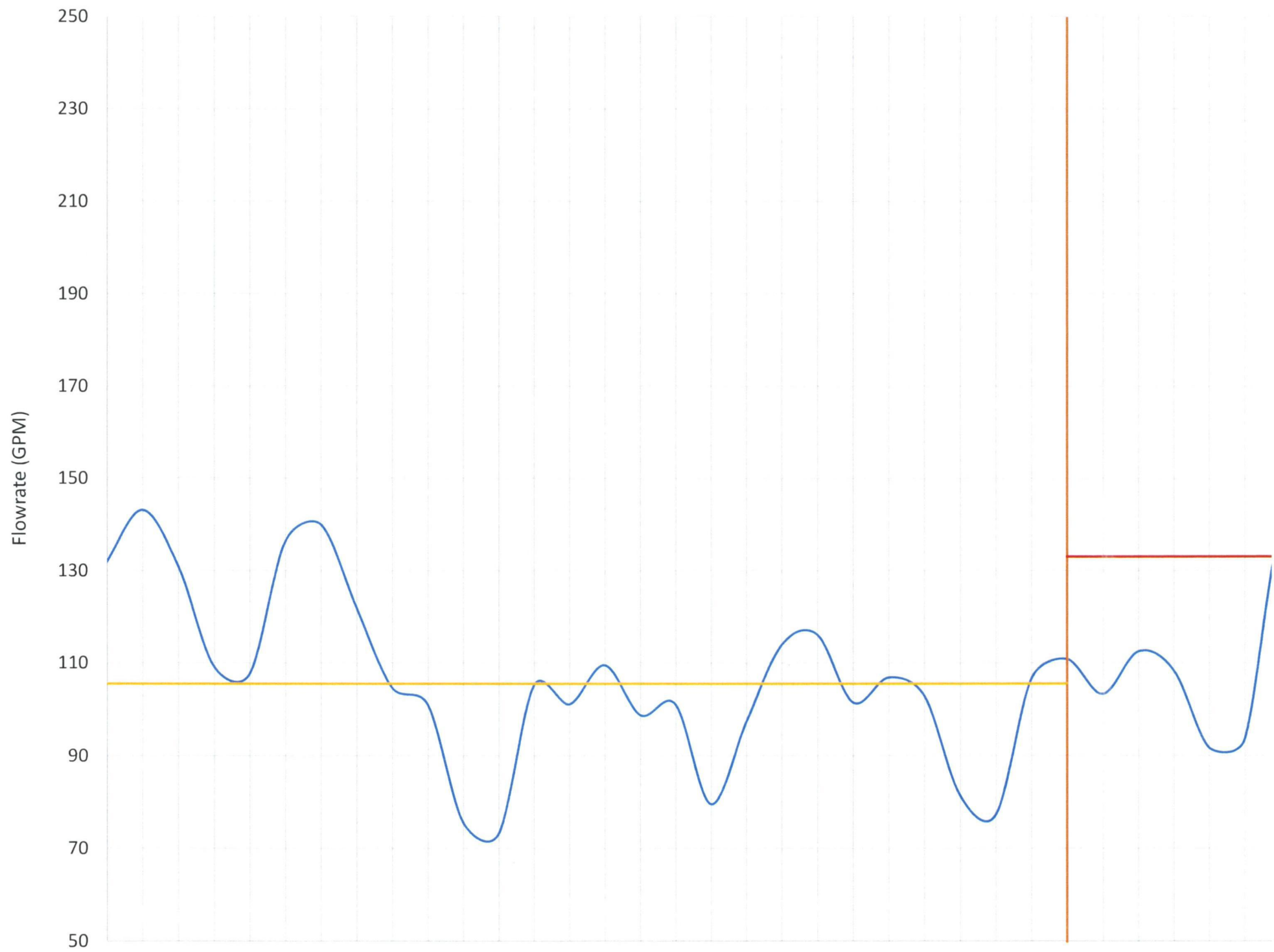
APPENDIX B – Dry Weather Flow Monitoring Graphs

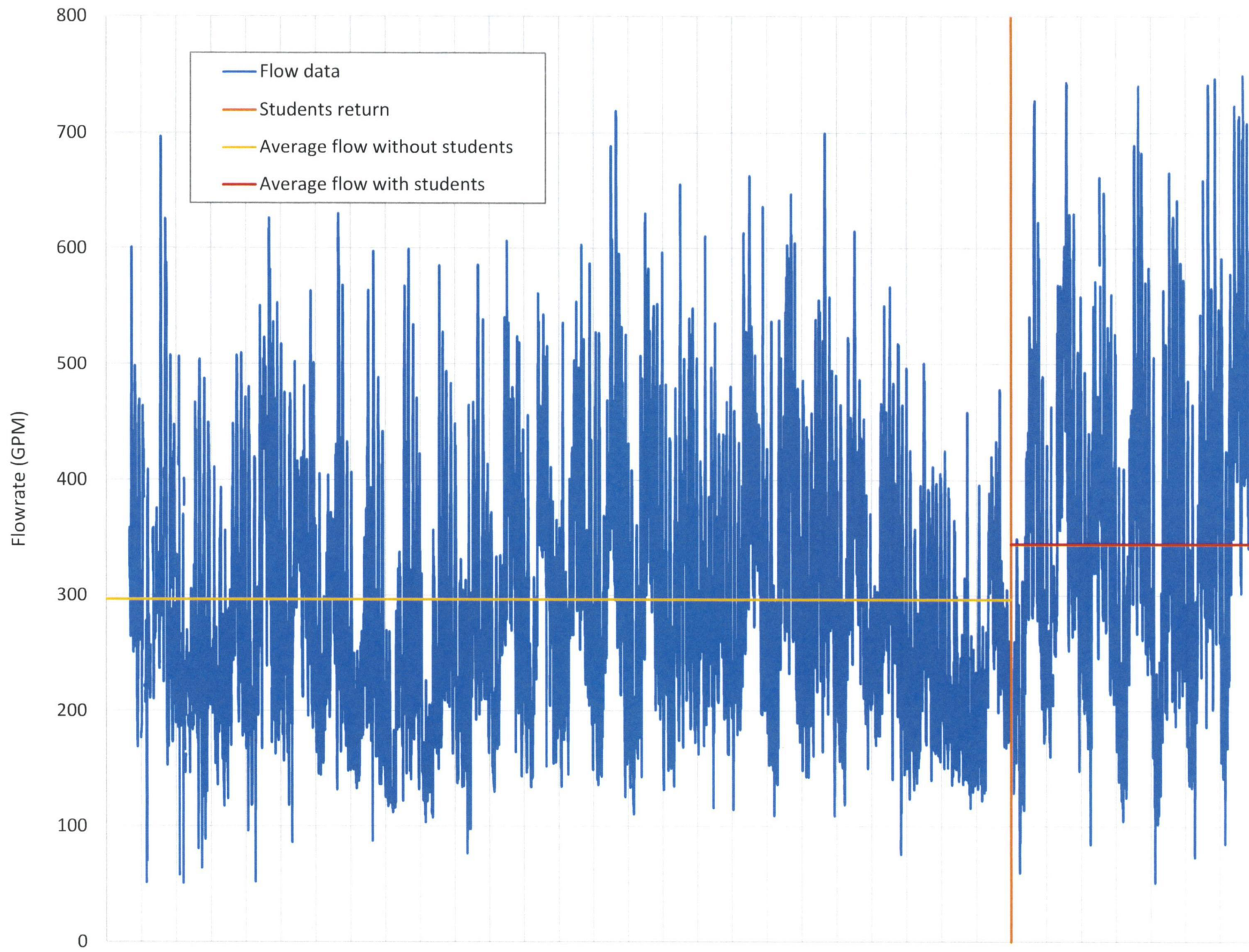
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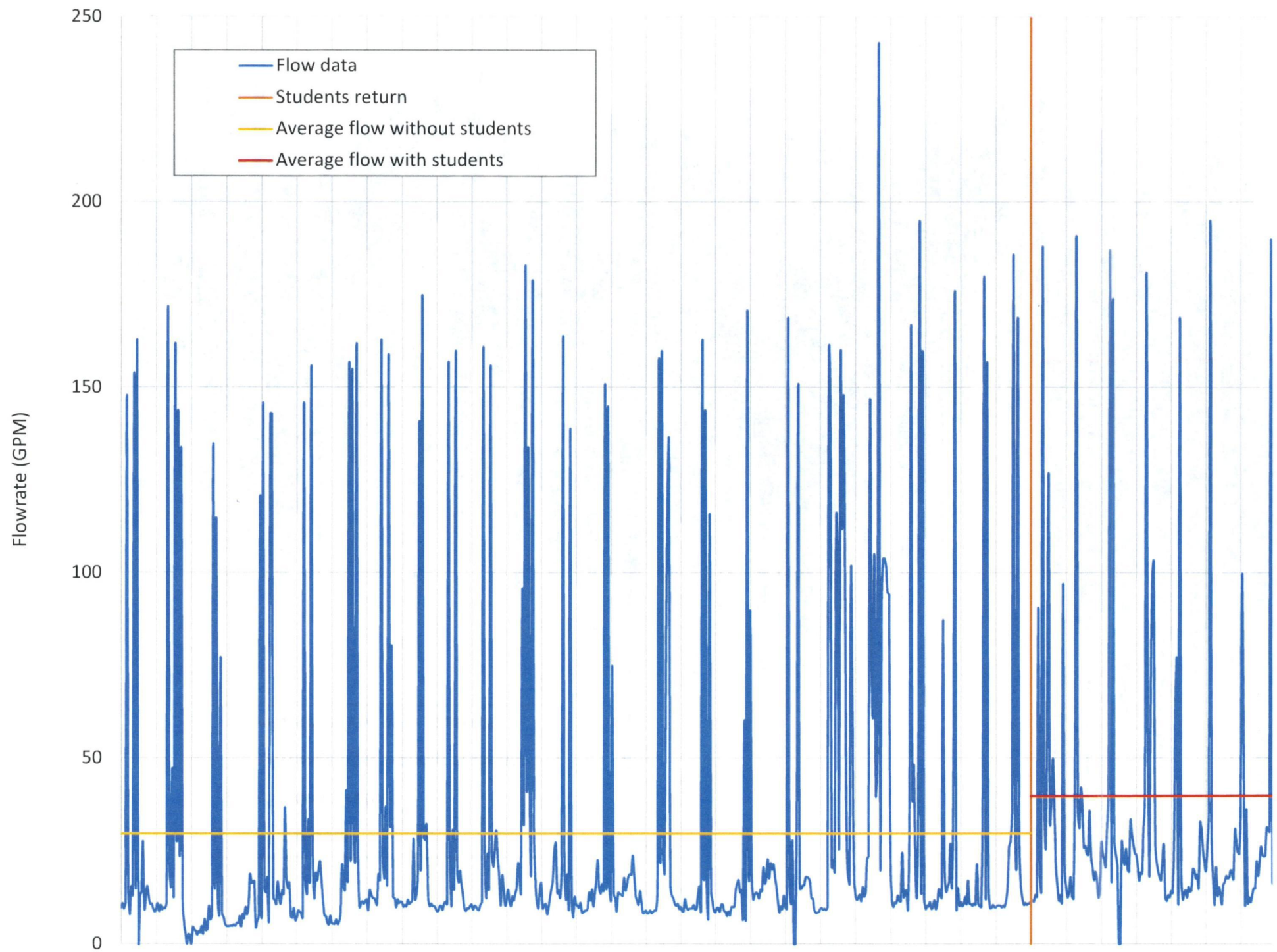
Flowrate (GPM)

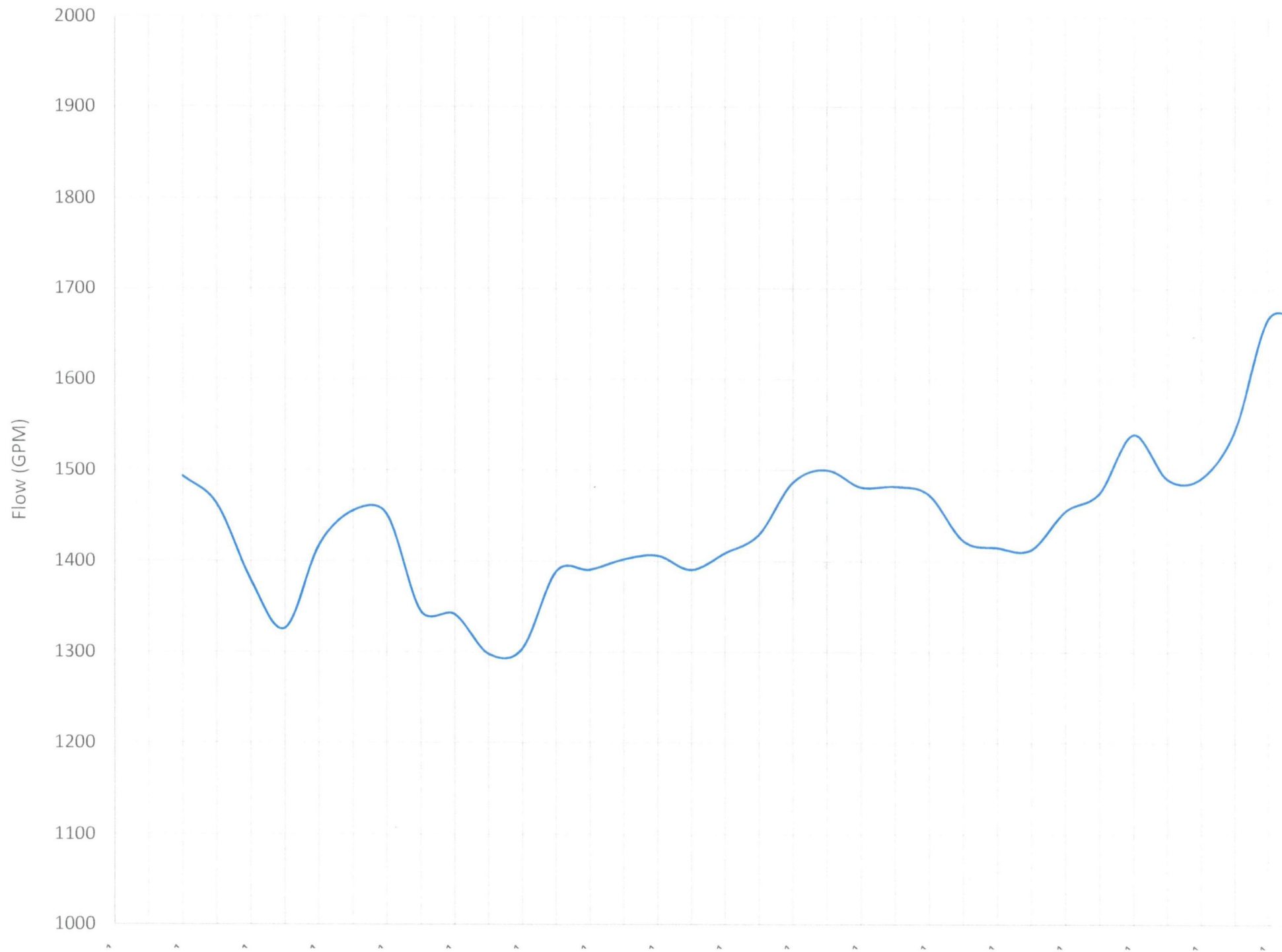
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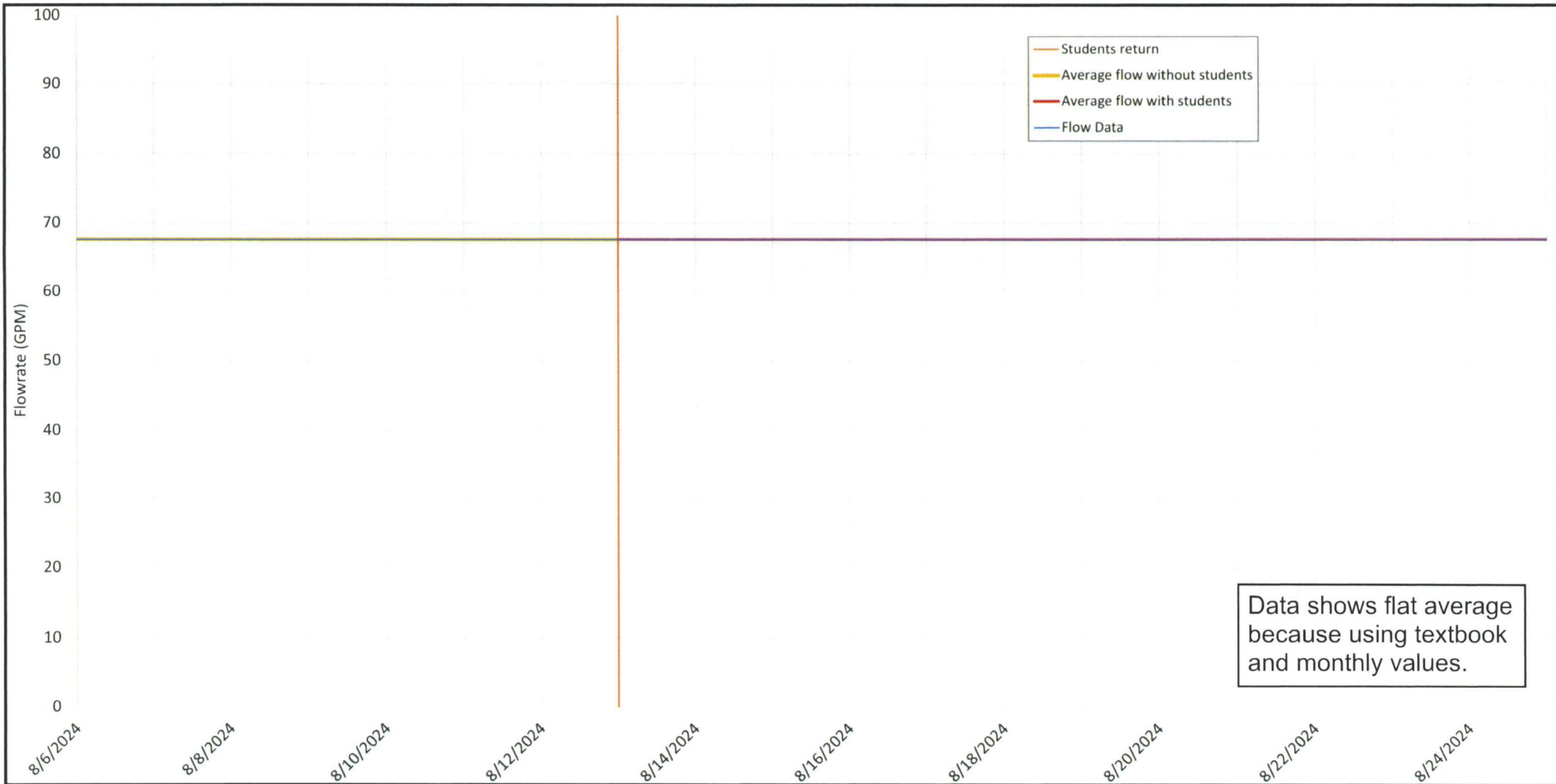






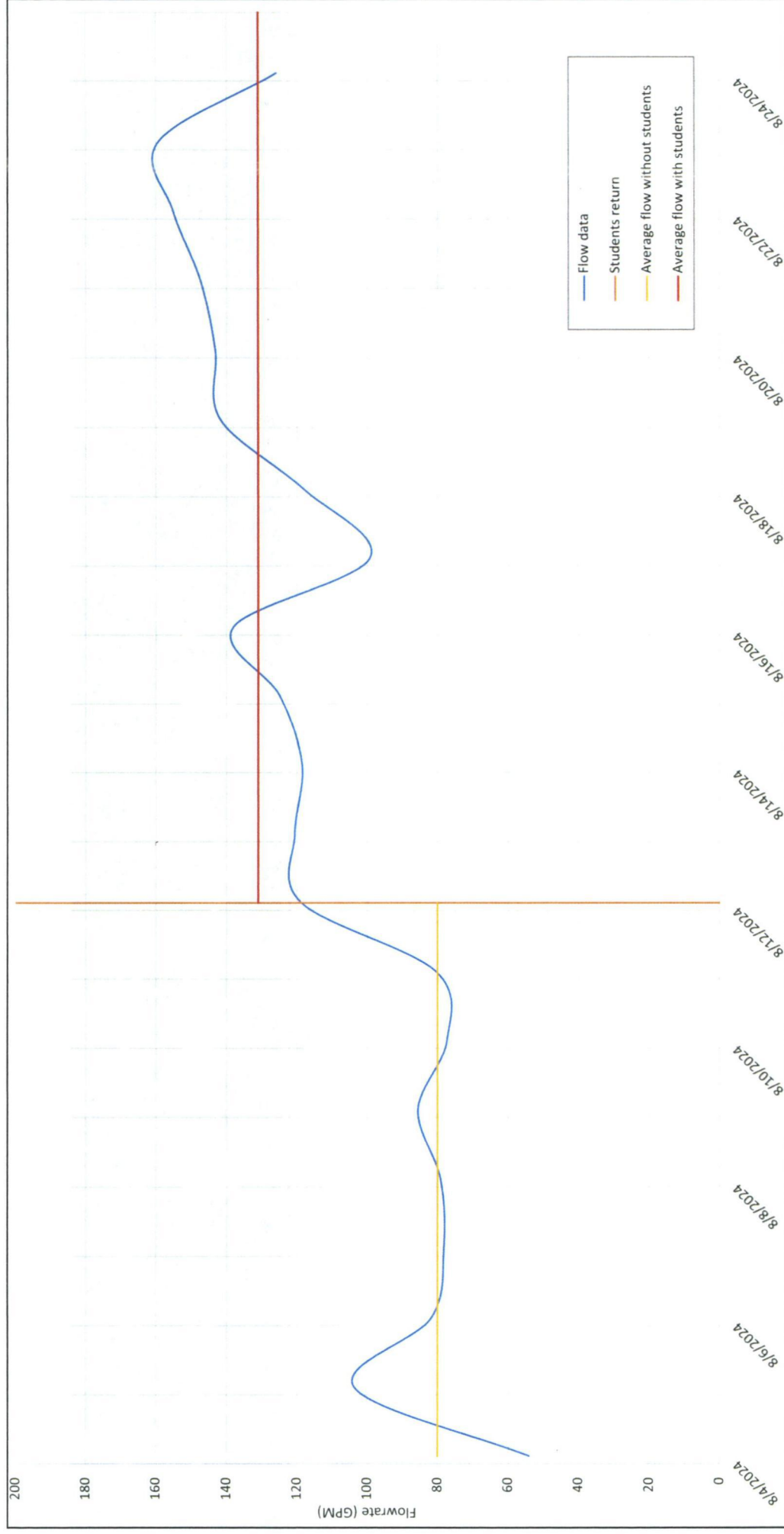


APPENDIX B – Dry Weather Flow Monitoring Graphs



Basin A - Dry Weather Flow

WSU Flow and Loads

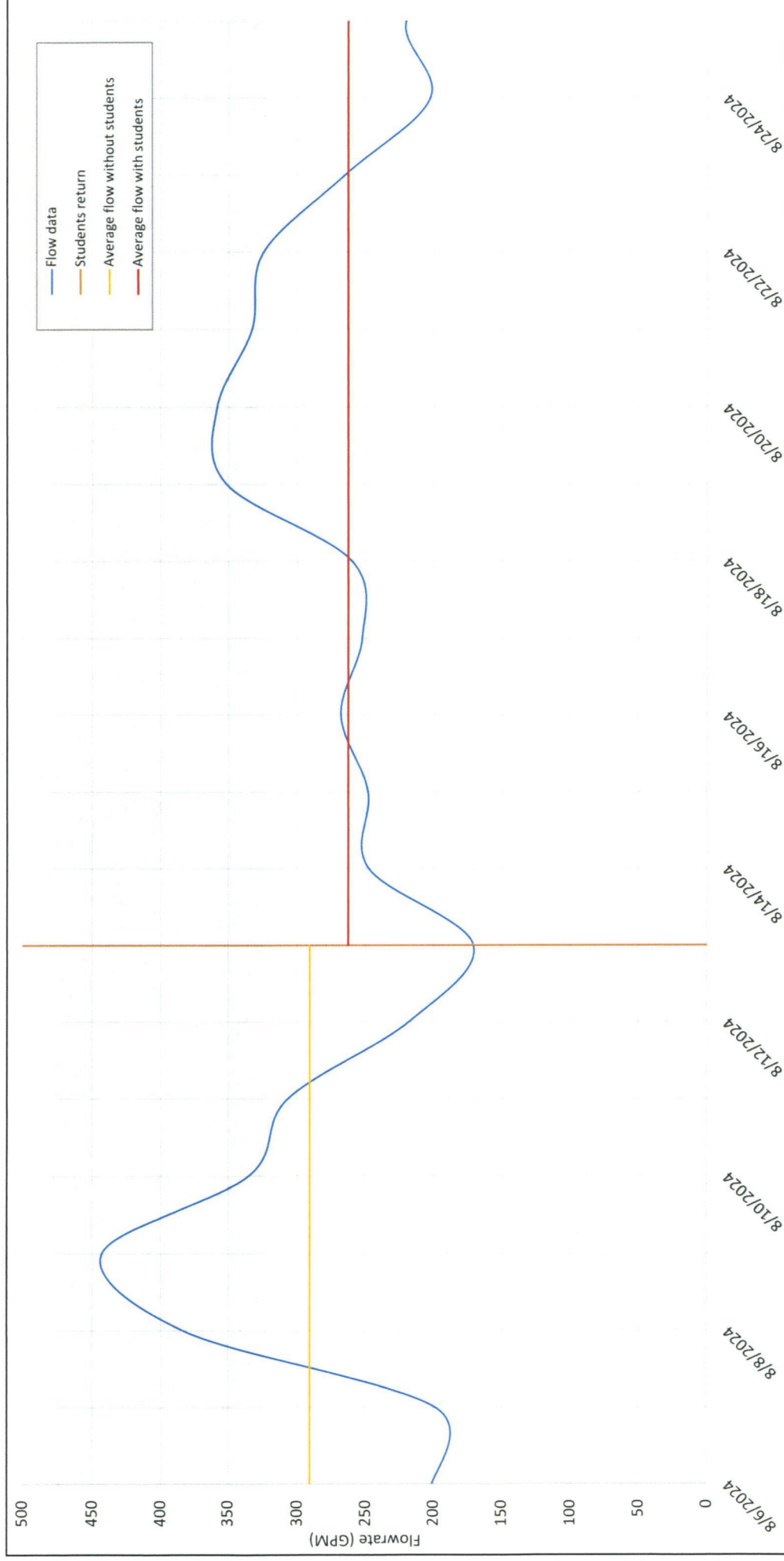


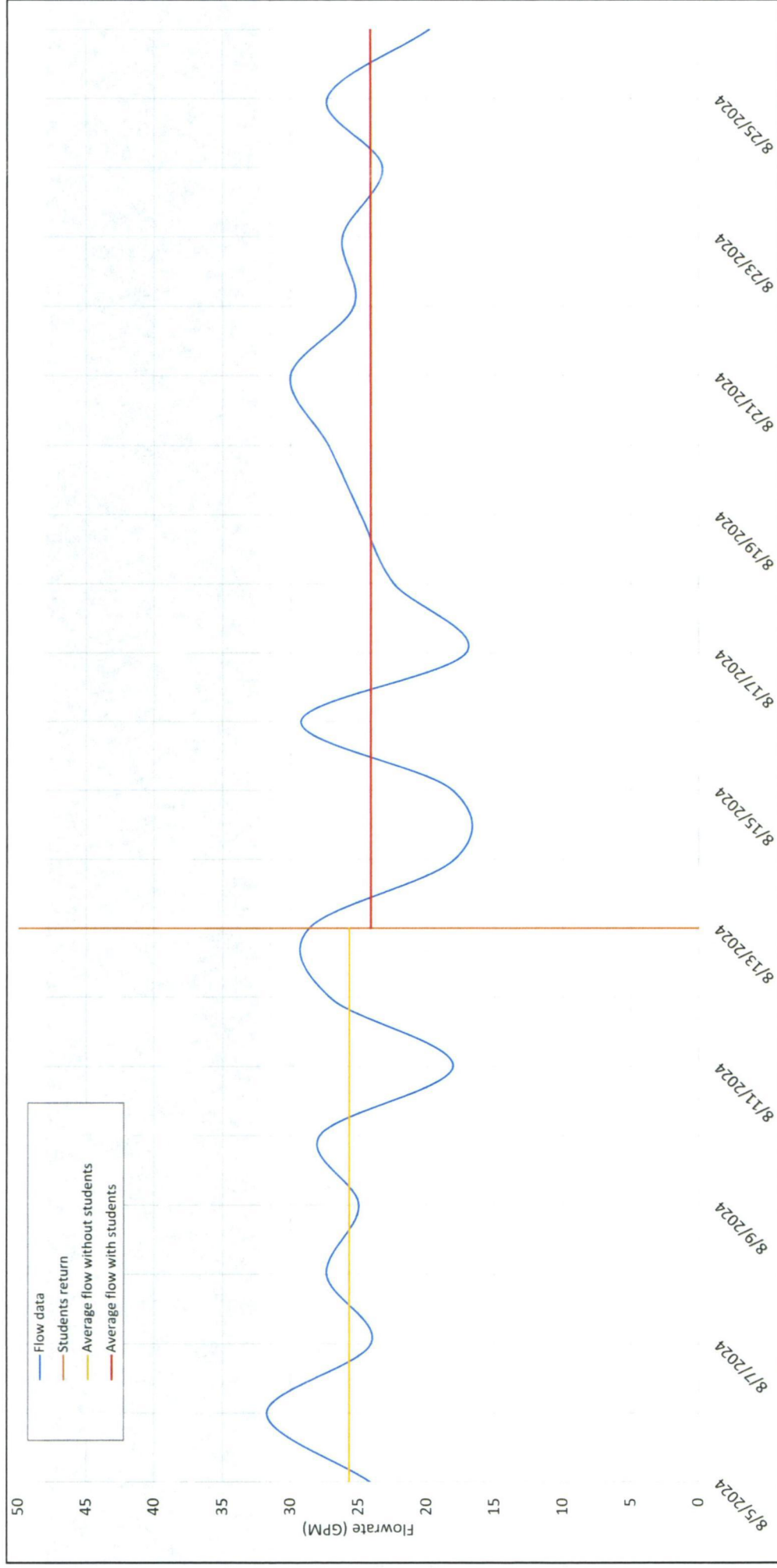
Basin B - Dry Weather Flow

WSU Flow and Loads

Basin C - Dry Weather Flow

WSU Flow and Loads

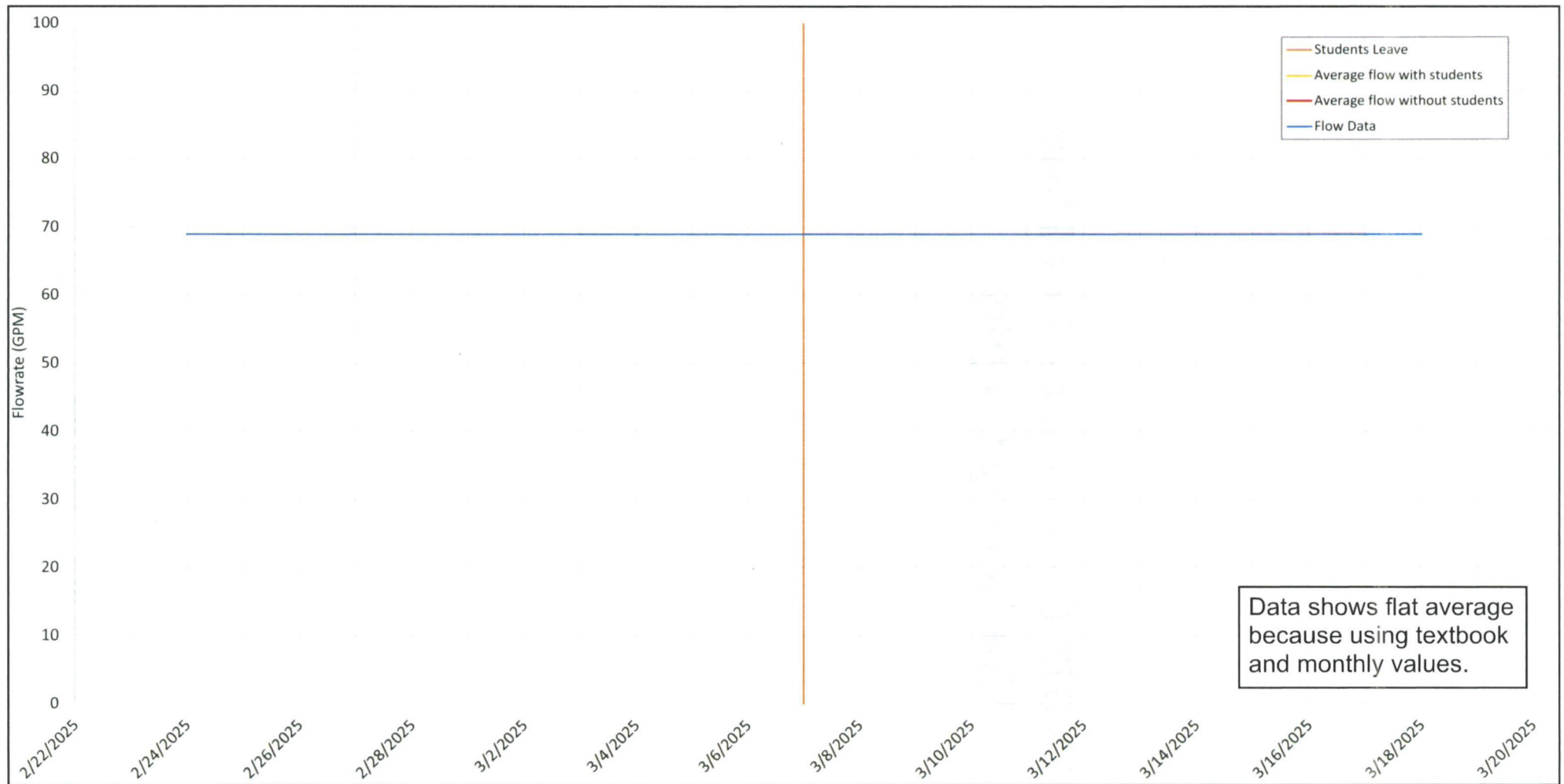




Basin D - Dry Weather Flow

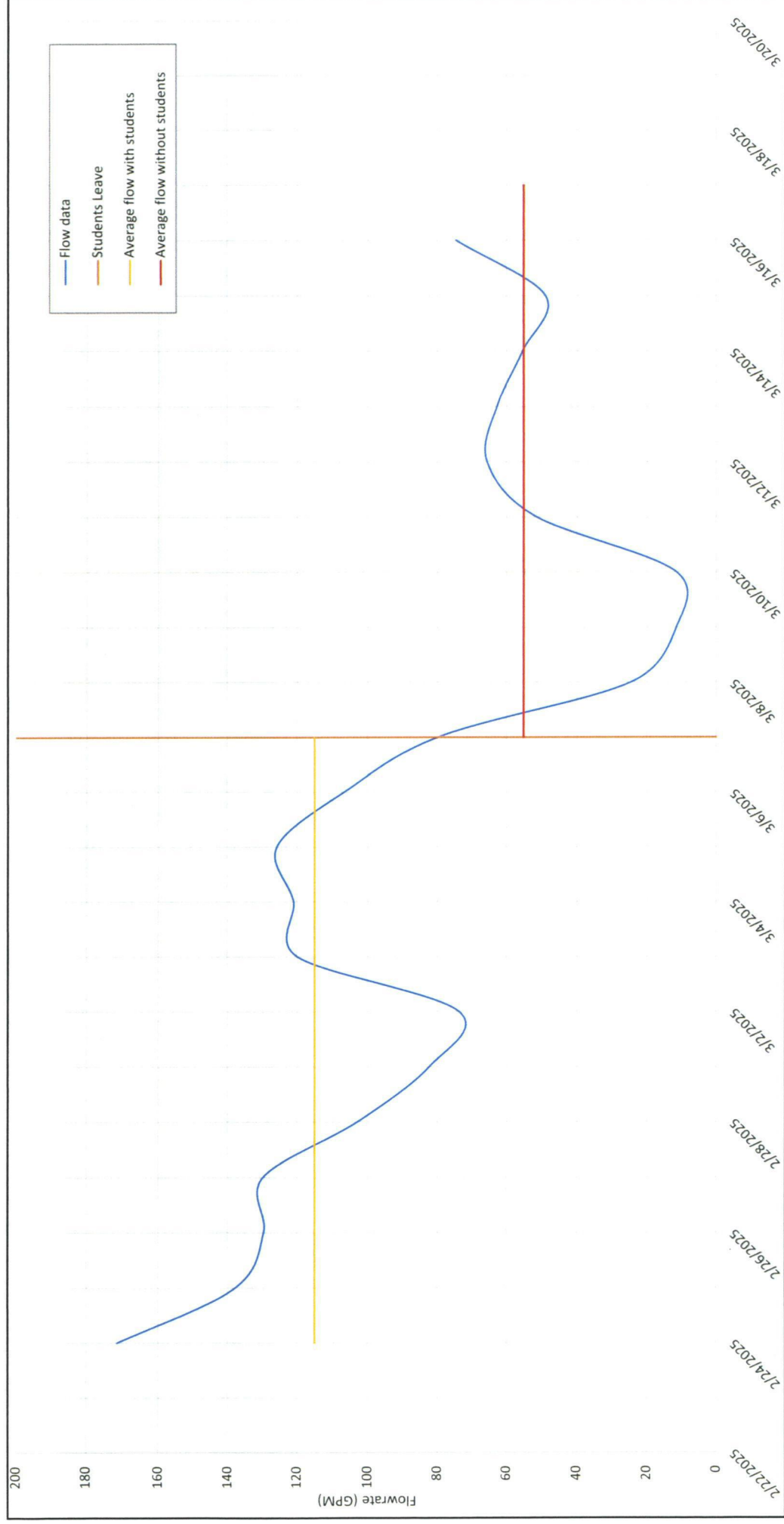
WSU Flow and Loads

APPENDIX C – Wet Weather Flow Monitoring Graphs



Basin A - Wet Weather Flow

WSU Flow and Loads

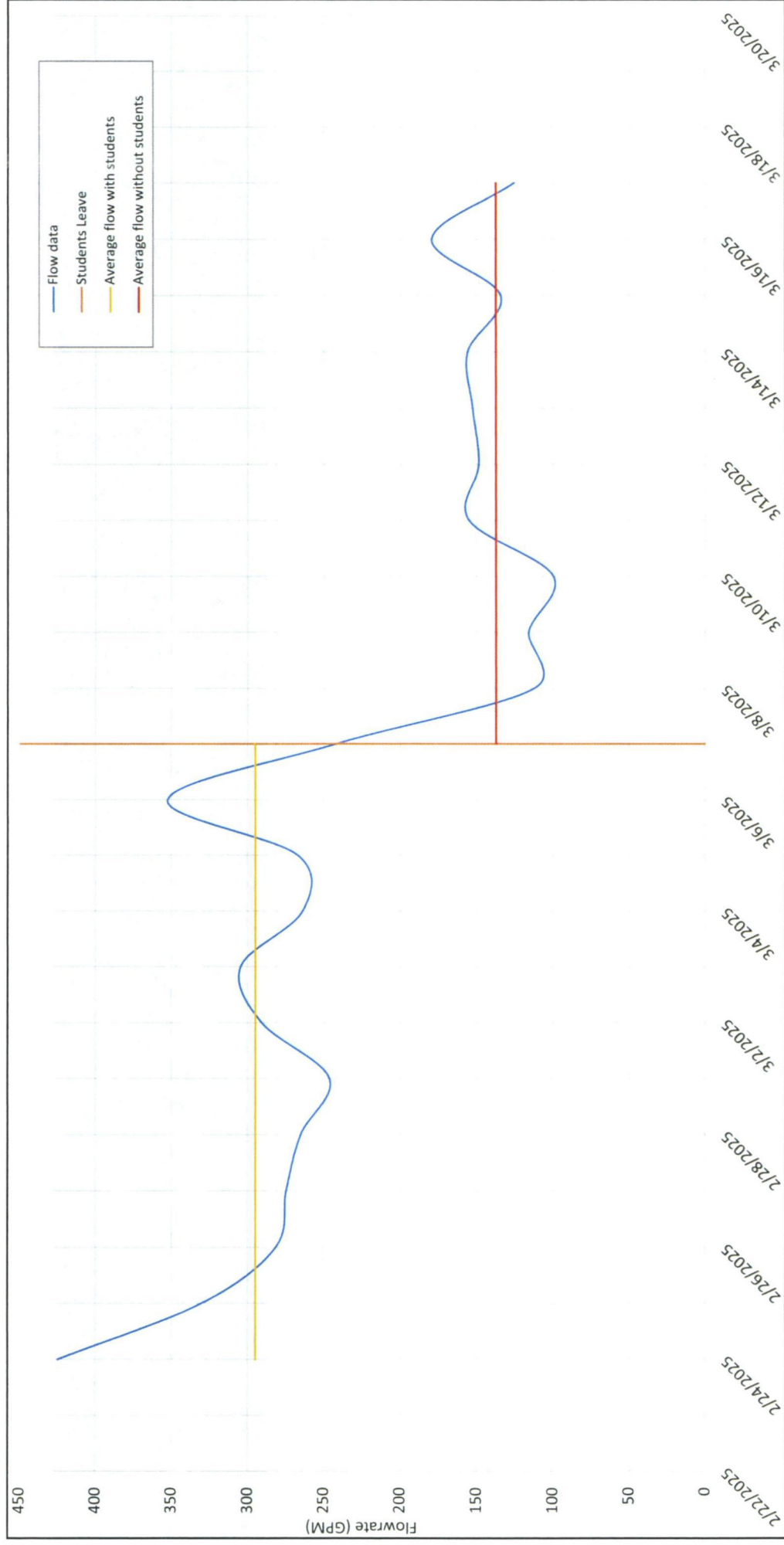


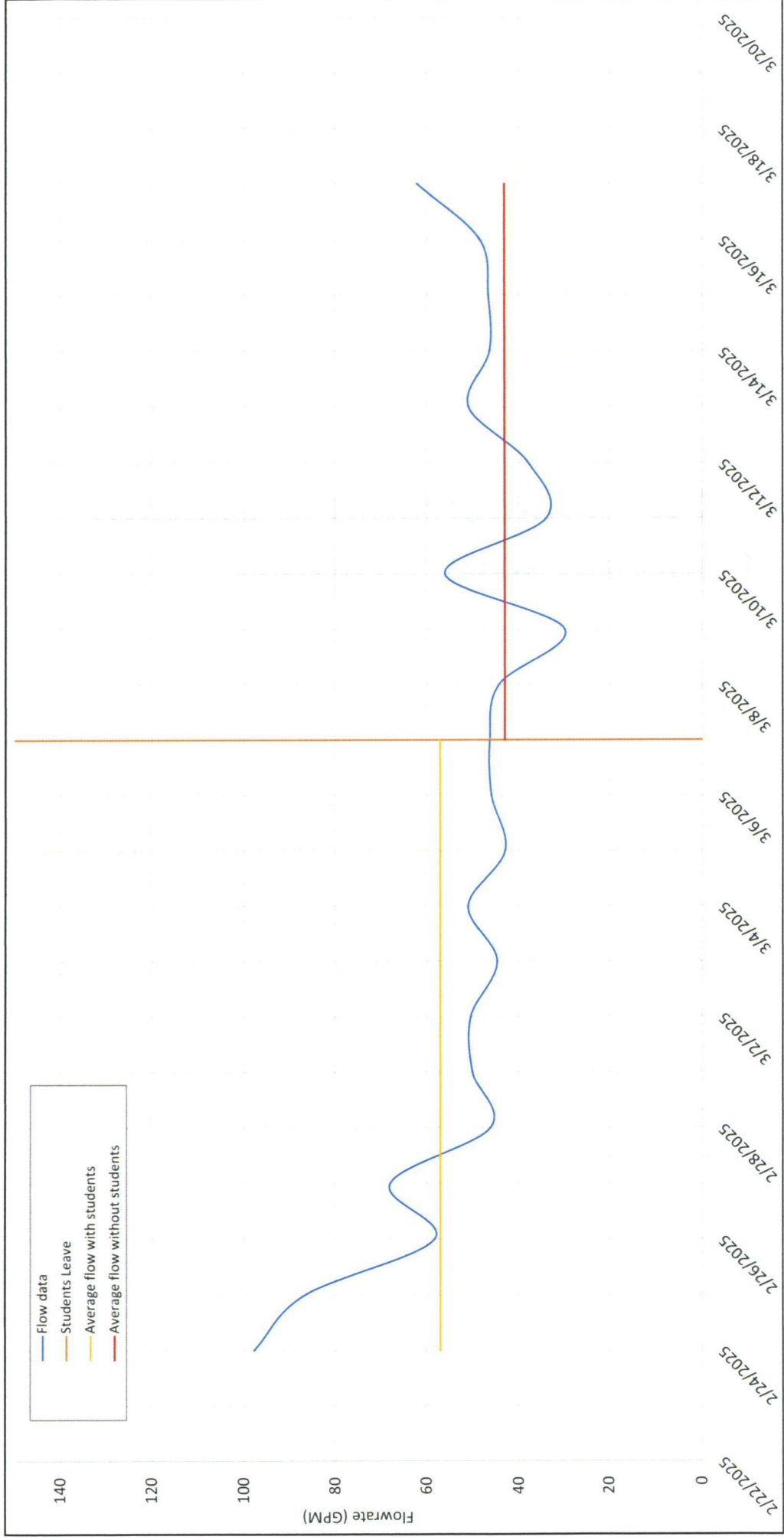
Basin B - Wet Weather Flow

WSU Flow and Loads

Basin C - Wet Weather Flow

WSU Flow and Loads



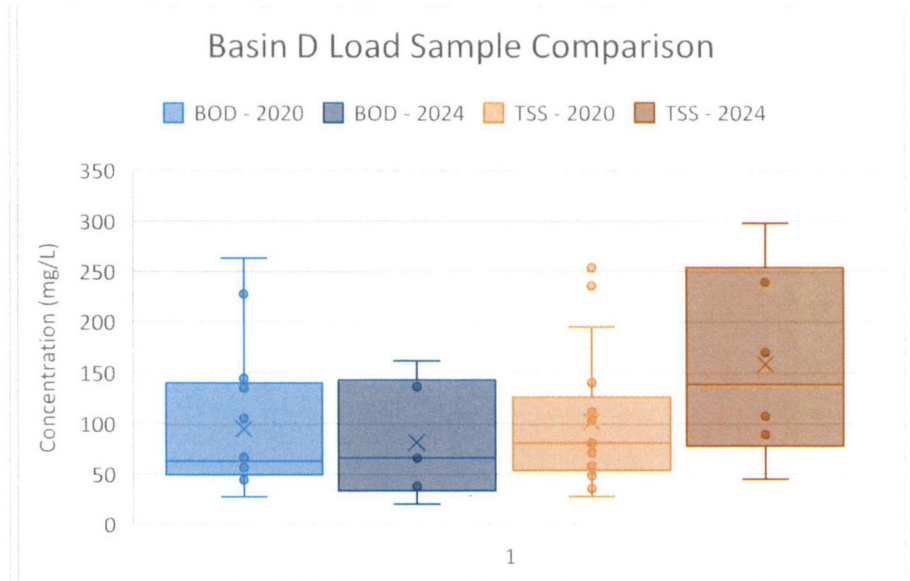
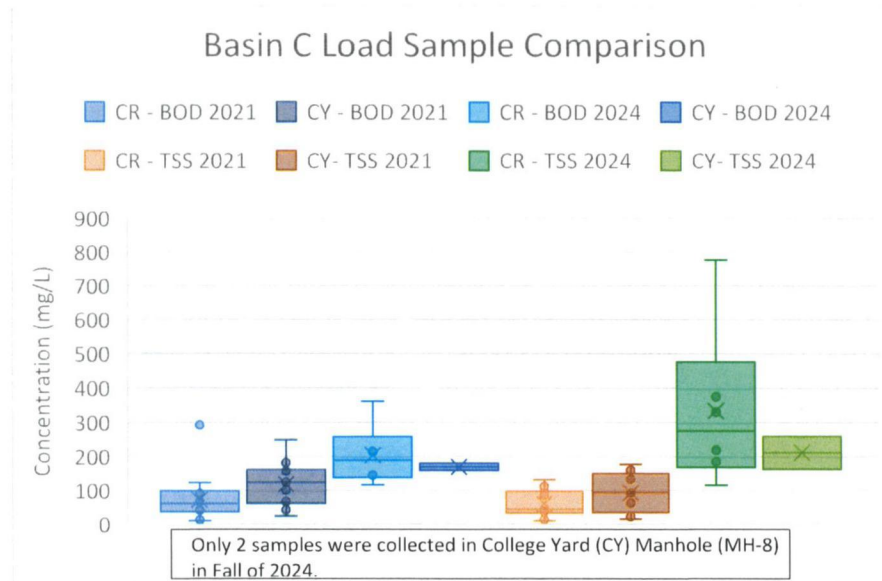
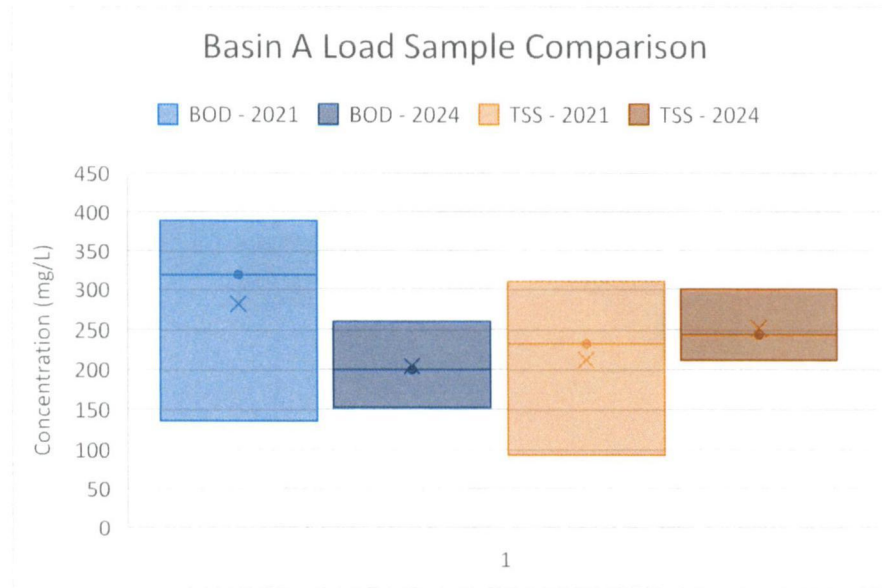


Basin D - Wet Weather Flow

WSU Flow and Loads

APPENDIX D – Comparison of Loading Concentration Graphs

Dry Weather Flow Monitoring Loading Sample Comparisons



Wet Weather Flow Monitoring Loading Sample Comparisons

