SEWER PUMP STATION CONDITION ASSESSMENT REPORT

Prepared for the City of Mercer Island

January 2024

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Prepared by:

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City of Mercer Island

Sewer Pump Station Condition Assessment

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Note: This Sewer Pump Station Condition Assessment Report was completed under the direct supervision of the following Licensed Professional Engineers registered in the State of Washington.

Sincerely,

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Introduction

Purpose

The purpose of this Sewer Pump Station Condition Assessment Report (Report) is to provide the City of Mercer Island (City) with an objective decision-making tool to determine upgrades for its wastewater pump stations (PS) and to utilize said tools to assess the condition of five of the City's wastewater PSs and possibly additional PSs in the future. This Report will present recommended improvements and estimated costs for these five pump stations.

Background

City staff evaluated the condition of all the City's PSs and prepared the 2015 *Pump Station Condition and Accessibility Assessment*. The assessments and system checks rated and established a remaining useful life expectancy for each major PS component. The criticality of each PS also was rated by City staff based on the consequence of failure. According to the City's 2018 *General Sewer Plan* (GSP):

> The condition assessment identified that all pump stations, except the recently constructed PS 4 and PS 14, will require rehabilitation or replacement in the next 25 years. Further, pumps in fourteen PSs are projected to reach the end of their useful life in the next five years (short-term period). It is recommended that the City implement a PS Renewal Program to systematically [repair and replace] (R&R) ageing pump stations. PS 21 appears to be in the worst condition and may serve as a suitable pilot project for the program.

The evaluation presented in this Report builds on the City's 2015 condition assessment and is an objective analysis that provides criteria to rank the existing facilities. In addition, a numerical scoring system has been added to allow the comparison of all pump station replacement/rehabilitation priorities relative to one another.

Objectives

The objectives of this project entail the following items:

1. Develop specific, measurable criteria for the evaluation of PS components.
2. Develop a weighted scoring system to compare PS conditions and identified deficiencies.
3. Assess the current (baseline) condition of PSs through data logger analysis, documentation review, operations staff interviews, and PS field observations and testing.

4. Evaluate and rank each PS based on the developed scoring system.
5. Recommend improvements and policies that will minimize life-cycle costs and meet asset management goals.
6. Prioritize and develop a timeline of PS rehabilitation and repairs, and determine component conditions that imply near-term failure (i.e., within 5 years).
7. Update the City's Cityworks database to improve recording of PS characteristics, operating performance, and conditions of existing equipment.
8. Estimate costs of recommended improvements for a capital improvement plan (CIP).

Scope

The scope of this project includes the following items:

1. Review record drawings, historical data, available supervisory control and data acquisition (SCADA) operational data, and other available data for the five PSs, including the City's 2015 *Pump Station Condition and Accessibility Assessment*.
2. Visit each station with City staff to collect field information and observe the existing condition of the PS components.
3. Interview operations staff to confirm findings and to learn of special operational concerns and undocumented history of repairs and improvements for each PS and force main.
4. Document physical and operational information for assessment and evaluation of the PSs, including pump conditions, structural conditions, site access, and telemetry systems.
5. Install pressure data loggers for 2 weeks on the pump discharges to record operational data. These loggers will allow characterization of pressures in the PS force mains as shown in **Appendix A**.
6. Install HOBO data loggers in the pump station electrical panels for 20 months to record operational data. These loggers will allow characterization of the station's operational data as shown in **Appendix B**.
7. Develop a scoring system for the stations that determines the priority ranking of PS improvements.
8. Prepare a report summarizing the findings and recommendations.

Investigation and Approach

General Description of Existing System

The City is responsible for the collection and conveyance of sewage within its service area to King County Department of Natural Resources and Parks (KCDNR) interceptors, except the private Shorewood collection system. The City's sewage system was constructed in the 1950s and 1960s and includes several sewer drainage basins. Sewage flows by gravity from each of the sewer basins to the City's lake line or hydraulic grade maintenance holes. The system utilizes a series of strategically placed PSs to convey the flow around the perimeter of Mercer Island before discharging into one of two KCDNR facilities located on the north and south ends of the island. From the KCDNR interceptors, all sewage flows to the South Treatment Plant in the City of Renton for treatment. The City's system is shown in **Figure 1** (attached to this Report), which was prepared by Carollo Engineers as part of the City's 2018 GSP.

History of Stations

The information provided in this section was obtained primarily from the City's 2018 GSP and the *Sewer System Lake Line Access Evaluation and Lake Line Program Development* prepared by Tetra Tech and Carollo Engineers in 2019.

The City operates 18 sewer PSs, consisting of 15 wet well/dry well PSs, 2 submersible PSs, and 1 flush station. PSs 1 through 7 were constructed in 1956, PSs 9 through 13 were constructed in the early 1960s, and the remaining PSs (14 through 25) were constructed in the mid-1960s. PS 14 was rebuilt recently, and PS 4 was relocated and reconstructed as part of the sewer lake line replacement project along the northwest side of the island. PS 11 currently is being rebuilt as part of a King County project. All pumps in the PSs were replaced in the 1990s with Cornell pumps as part of system-wide improvements.

Pump Station 19

PS 19 is on an upland site at 7697 W Mercer Way. The station sits adjacent to 7701 W Mercer Way and a residential property's backyard, and along the Lake Washington shoreline. The walking path to reach the PS crosses several frontage properties, and there is no vehicle access. PS 19 consists of three (3) 6NHTA Cornell pumps (vertically mounted centrifugal pumps) of 10 horsepower (HP) each running on a 100 amperes (A) electrical service. This PS has a 50 kilowatt (kW) above-grade diesel generator located on W Mercer Way. The pump station is on public right-of-way (ROW). Primary land access to the PS is through parking at the driveway of 7641 W Mercer Way and walking a pathway near the lake shoreline. Use of this pathway requires written approval from the homeowners. This PS has a dock on public ROW that enables water access by barge. This PS receives wastewater from PS 18 and sewer basins 15, 16, 16A, 17, 18, 18A, and 19, which convey sewer flow to the lake line. This PS does not directly receive any gravity sewer flow.

Pump Station 20

PS 20 is on an upland site located at 8790 85th Avenue SE. The PS sits at a street end (near the southern tip of Mercer Island) and along the Lake Washington shoreline. The PS consists of three 6NHTA Cornell pumps (vertically mounted centrifugal pumps) of 10 HP running each on a 100 A electrical service. There is a 50 kW below-grade diesel generator on site. The 85th Avenue SE public ROW covers both the PS and site access. This PS receives wastewater from PS 19, as well as sewer basins 20 and 20A, which convey sewer flow to the lake line. This PS also receives gravity sewer flow from sewer basin 21.

Pump Station 21

PS 21 is accessible through the driveway at 7964 E Mercer Way and is located at 8000 Avalon Drive. The PS is surrounded on three sides by Lake Washington and covered by wooden decking for the residential property at 8002 Avalon Place. PS 21 consists of three 6NHTA Cornell pumps (vertically mounted centrifugal pumps) of 10 HP each. There is a below-grade sand filter for odor control. A 50 kW diesel generator is located upland from the pump station in a below-grade vault.

PS 21 is included in an easement for 8000 E Mercer Way. A multiple use easement and access easement cover the length of road from 7936 E Mercer Way to 7964 E Mercer Way. For current access by land, crews approach the site by a private road that ends at a residential driveway. Crews park at the bottom of the road within the residential driveway and then walk to the site across the backyard. The easement also allows water access from the square dock over the station that belongs to the residential property at 8002 Avalon Place. This PS receives wastewater from PS 20 and sewer basin 23, which convey sewer flow to the lake line. This PS does not directly receive any gravity sewer flow.

Pump Station 22

PS 22 is located at an upland site at 6226 E Mercer Way on a grassy slope. It consists of three 4NNT Cornell pumps (vertically mounted centrifugal pumps) of 7.5 HP each running on a 100 A electrical service. There is a 25 kW below-grade diesel generator on site. Access to the site and PS are provided within an easement. This PS receives wastewater from PS 23 and sewer basins 32, 31, 30, 29, 28, 27B and 27A, which convey sewer flow to the lake line. This PS does not directly receive any gravity sewer flow.

Pump Station 23

PS 23 is at an upland site located at 5406 96th Avenue SE. The PS is in an open grassy space. It consists of three 4NNT Cornell pumps (vertically mounted centrifugal pumps) of 7.5 HP each running on a 100 A electrical service. There is a 40 kW below-grade diesel generator on site. An easement covers both the PS and the site access. This PS receives wastewater from PS 24, as well as sewer basins 63, 77, 36, 35, and 34, which convey sewer flow to the lake line. This PS also receives gravity sewer flow from sewer basin 33.

Data Collection

Field Data Collection

RH2 Engineering, Inc., (RH2) conducted site visits at the stations with City and PumpTech, LLC, (Pump Tech) staff to collect field information, take site photographs, and observe the existing conditions of the structural, mechanical, and electrical systems. Before conducting the site visits, RH2 reviewed available record drawings for each PS.

PumpTech was subcontracted to perform field test on the pumps and motors and to provide the results to RH2 for incorporation into the pump station ranking procedure. Data was collected with only one pump operating at a time during the site visits. The results are included in **Appendix C**. PumpTech performed the following tasks:

- Recorded flow rates during testing periods. Average flow rates were derived from pump tests (either pump down, with a temporary strap-on flow meter, or with a temporary insertion flow meter) at the stations. The flow rates were used to correlate operational performance with other test data.
- Determined suction and discharge pressure readings (static and operating) and vertical locations of pressure gauges above the dry well floor.
- Recorded voltage, current, and megger readings. Voltage and current readings were measured across each pair of legs to calculate average values for each motor tested. Megger readings indicate the amount of resistance from motor windings and the degree of deterioration of the motor insulation.
- Determined voltage imbalances and current imbalances. The imbalances are used to assess deficiencies in the electrical components.
- Performed lateral vibration tests and provided results for all pump locations. Lateral vibration readings were used to assess the stability of the pump/motor assembly.
- Provided comments about the existing conditions of the pumps, motors, valves, and piping. PumpTech comments were used to compare with RH2 site visit observations to provide a better understanding of the existing operating characteristics of the PS components.

RH2 incorporated the field data into the PS inventory database and ranking matrix calculations. Refer to the **Ranking Matrix** section of this Report for details regarding the pump, motor, and force main condition assessments.

HOBO data loggers were installed for 20 months to record operational data, including run time data which was converted to hourly flow data. The loggers tabulated the pump run times and cycles on an hourly basis. This Report uses this data to assess: 1) the adequacy of the pump capacity; 2) active wet well capacity to check pump cycling frequency; and 3) and emergency response time following the triggering of the high wet well alarm.

Records Data Collection

Hard copies of all record drawings for each PS were obtained from the City in digital format for field and office use. The SCADA settings for the City's sewer PSs are summarized in **Table 1**.

Table 1

Wastewater PS SCADA Settings (2022)

(Based on Information from City Operations)

PS No.	Overflow Elevation (ft) [Based on Record Drawings]	High Alarm and Lag Pump On Level (ft)*	Lead Pump On Level (ft)	Pump Off Level (ft)
19	15.75	7.00 to 7.50	6.00	2.00
20	15.75	7.00 to 7.50	6.00	2.50
21	15.75	7.00 to 7.50	6.00	2.00
22	15.75	7.00 to 7.50	6.00	3.50
23	15.75	7.00 to 7.50	6.00	3.50

***Note:** A high alarm level of 7.50 feet was used for the evaluations prepared for this Report.

RH2 also performed interviews with operating personnel prior to and during the site visits to:

- Provide an opportunity to focus on specific issues at each PS;
- Learn of the replacement/repair history of each PS that is not available from City records. Replacement history includes replacement of pumps, motors, valves, piping, ventilation, and controls. Repair history includes repair of concrete surfaces, force main breaks, force main bypass blockage, and valve blockage;
- Learn of special operational issues at each PS. Issues include grease build up, rocks, rags and obstructions, excessive run times, power outages, and overflow history;
- Confirm deficiencies apparent from on-site visits and SCADA information; and.
- Learn about relationships between stations and overflow structures.

Some of the information collected from the interviews can be found in **Appendix D**.

Data Logger Data Collection

Charts developed from the data recorded by the pressure data loggers are provided in **Appendix A**.

The pump operational data from the data loggers was analyzed and used along with pump capacity testing (which were performed by PumpTech) to develop graphs of influent flow, pump starts and run time for each pump station. For these data analyses, it was assumed that any fill or pump interval less than 90 seconds was due to maintenance by City staff or erroneous readings due to a pump being offline (or similar). Charts were developed for the first month of data recorded for influent flow, pump starts, pump run time, and pumped flow, which are provided in **Appendix B**. Pumped flows were estimated for periods where multiple pumps were in operation since the pumping rates with more than one pump in operation were not evaluated as part of this project. It was assumed that only one pump was in operation during those periods.

It also should be noted that increased influent flow rates occurred at PSs 22 and 23 during the summer months in 2022 and 2023. According to City staff, this was caused by a defect in the City's sewer system near Lake Washington that was allowing inflow to enter the City's sewer system; this defect has been resolved for the time being.

Ranking Categories

As pumping equipment age and use increases, the condition of the equipment degrades, resulting in reduced efficiency and greater maintenance needs. Periodically, re-testing and re-evaluating each pump and motor is recommended as it provides details on the equipment's degradation over its useful life. This can assist with scheduling replacement and prioritizing maintenance and operations tasks. This information provides City staff the opportunity to troubleshoot and repair or replace the pump prior to failure, reducing the chance for emergency repairs or overflows.

RH2 has evaluated and assessed the PSs based on the following ranking categories:

- General Categories
- Station Overflow Vulnerability
- Wet Well Operation
- Wet Well Condition
- Dry Well Condition
- Pumps
- Motors
- Exterior Force Main
- Emergency Power and Bypass
- Controls and Electrical Power

Each category is ranked from 1 to 5, with 1 being the least preferred and 5 being the most preferred.

General Categories

Status of Health, Fire, and Life Safety Systems

The condition of the ventilation, intrusion and smoke alarms, and fire extinguishers is used to assess the potential for damage to a PS during an emergency. Poor ventilation or a lack of functioning alarms or a fire extinguisher also could endanger the City's operators. The status of these systems is based on RH2 site visit observations and discussions with City operators. The unweighted scores and associated descriptions are as follows:

- (5) Adequate ventilation, intrusion alarm, fire extinguisher, and smoke alarm.
- (4) One known missing item from adequate ventilation, intrusion alarm, fire extinguisher, and smoke alarm.

- (3) Two known missing items from adequate ventilation, intrusion alarm, fire extinguisher, and smoke alarm.
- (2) Three known missing items from adequate ventilation, intrusion alarm, fire extinguisher, and smoke alarm.
- (1) No or poor ventilation, intrusion alarm, fire extinguisher, and smoke alarm.

Exterior Concrete Condition

The top slab concrete and exposed exterior wall concrete were assessed during RH2 site visits. The average value is used to determine an overall unweighted score. The concrete items used the following comparison descriptions:

- (5) None to slight signs of cracking of concrete.
- (4) Slight to moderate signs of cracking of concrete.
- (3) Moderate signs of cracking, surface sloughing, spalling, etc.
- (2) Moderate to widespread signs of cracking of concrete.
- (1) Widespread signs of cracking, surface damage, etc.

Condition of City’s Dock(s) (If Applicable)

Those pump stations with docks were evaluated for signs of wear, including warps or cracks, rotting wood, loose boards, or rusted supports. The condition of the dock is based on RH2 site visit observations and discussions with City operators. The unweighted scores and associated descriptions are provided as follows:

- (5) None to slight signs of wear, or no dock needed.
- (4) Slight to moderate signs of wear.
- (3) Moderate signs of wear for dock.
- (2) Moderate to widespread signs of wear.
- (1) Widespread signs of wear for dock.

Type of Vehicle Access to Station

This category is used to assess the ability for maintenance and emergency vehicles to access and maneuver near a PS. Based on RH2 site visit observations, the unweighted scores and descriptions are as follows:

- (5) Easily accessible access road to station and parking lot, with dedicated parking available for maintenance vehicle(s).
- (4) Easily accessible access road to station and parking lot, but no dedicated parking available for maintenance vehicle(s).
- (3) Minor road or driveway with adequate turnaround (cul-de-sac or hammerhead).

- (2) Narrow road or driveway with inadequate turnaround restricted by dead-end or road shoulder/sidewalk.
- (1) Nearest road more than 100 feet from station.

Station Overflow Vulnerability

Response Time before Overflow

Response time is based on peak day average inflow and storage volume above high alarm to overflow. The peak day average inflow is calculated using the recorded data from the data logger data analysis. The peak day average inflows for PSs 20 and 21 were calculated to be greater than the peak day average inflow for PS 19. PSs 20 and 21 are downstream of PS 19, so the peak day average inflow for PS 19 was used for PSs 20 and 21. The storage volume is based on record drawings. The response time is equal to the storage volume divided by the peak day average inflow. The unweighted scores and associated descriptions are as follows:

- (5) Response time is greater than 3 hours.
- (4) Response time is greater than 1.5 hours and less than or equal to 3 hours.
- (3) Response time is greater than 1 hour and less than or equal to 1.5 hours.
- (2) Response time greater than 30 minutes and less than or equal to 1 hour.
- (1) Response time less than or equal to 30 minutes.

Number of Overflows in Past 5 Years

A PS with a greater number of overflows has a higher potential health risk if the overflowed sewage reaches a nearby water body. No distinction has been made in the analysis for the volume of sewage overflowed or if sewage overflowed to an emergency storage and/or a nearby water body. The number of overflows is based on discussions with operators. The unweighted scores and associated descriptions are as follows:

- (5) No known overflows.
- (4) One known overflow.
- (3) Two known overflows.
- (2) Three known overflows.
- (1) Four or more known overflows.

Wet Well Operation

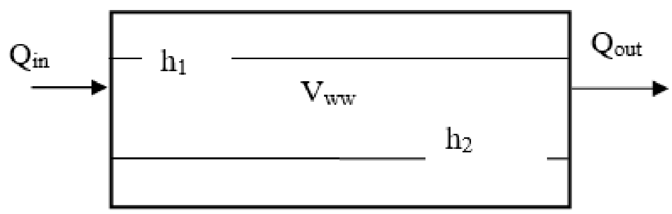
Wet Well Cycling Index (Current)

The wet well cycling index for current inflow conditions is calculated using the following approach.

Approach

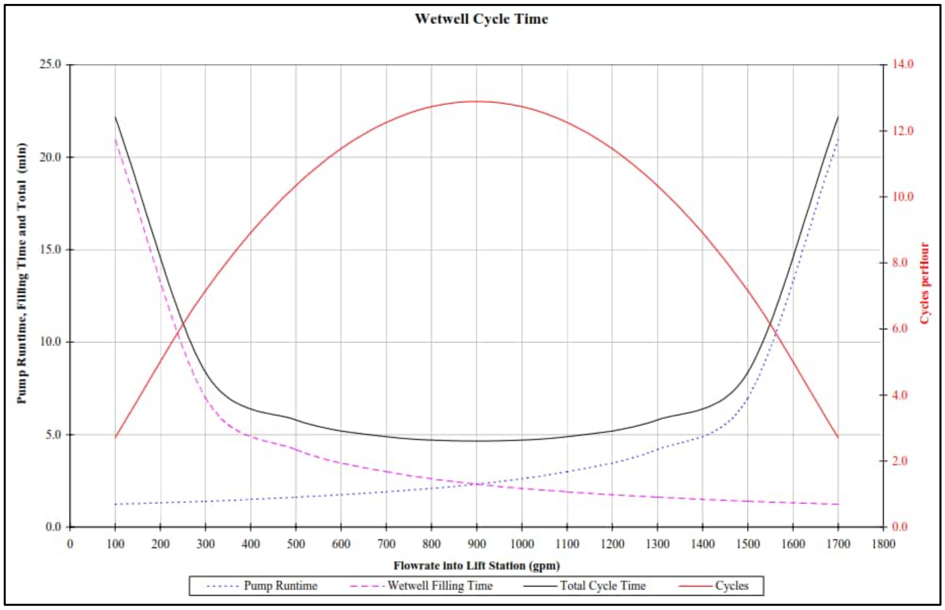
- Determine the pumping capacity for each pump from the pump tests. Determine the average pump capacities for each pump station.

- Determine the inflow to cause the maximum number of cycles. This inflow is considered to be theoretically equal to 0.5 times the average pump capacity.
- Determine the available active wet well volume per cycle from lead pump on and lead pump off wet well levels at that PS.
    - The influent lake line was ignored for the purposes of estimating the active wet well volume for these analyses.
    - These calculations also assumed the operational levels in the wet well were above the fillets (i.e., the sloped walls that form the hopper bottoms to the wet wells).
- Determine the maximum number of cycles per hour.
    - The cycles per hour are calculated by dividing 60 minutes by the time it takes for a single pump to complete a cycle. The time for a single pump cycle is calculated by dividing the available useable volume by the net flow rate. A single cycle is the sum of the time it takes to fill the wet well from the “pump off” to the “pump on” setpoint and the time it takes to pump out the useable volume while flow is still entering, back to the “pump off” setpoint . The following equation describes the variables involved in calculating wet well cycling time.



$$(Q_{in} - Q_{out}) \times \Delta t = (h_1 - h_2) \times A_{ww}$$

    - When the influent flow rate (Q_{in}) is equal to one half of the discharge rate from the wet well, the cycling is at a maximum. To illustrate this point, assume a wet well with a surface area (A_{ww}) equal to 56 square feet, a discharge rate (Q_{out}) of 1,800 gallons per minute (gpm), and 5 feet of useable vertical storage (h_1-h_2) in the wet well). The equation is solved for Δt. The following graph shows that peak cycling occurs when the influent flow is 900 gpm, exactly one half of the assumed discharge rate of 1,800 gpm.



- Determine the maximum allowable cycles per hour for the motor size. Based on industry standards, motors up to 25 HP are assumed to be able to reasonably provide up to 8 cycles per hour.
- Determine the maximum allowable cycles per hour for the PS. Take the total number of pumps at the PS and subtract one. This assumes one pump is out of service for these calculations. Multiply this number by the maximum allowable cycles per hour for the motor size.

The wet well cycling index is equal to the maximum number of cycles per hour divided by the maximum allowable cycles per hour for the pump station configuration and motor size. An index greater than 1.0 indicates that the motor is more likely to have a reduction in useful service life. This is due to the motor turning on/off (cycling) more frequently than other motors with an index less than 1.0. The unweighted scores and associated descriptions are as follows:

- (5) Wet well cycling index is less than or equal to 1.0.
- (4) Wet well cycling index is between 1.0 and 1.1.
- (3) Wet well cycling index is between 1.1 and 1.2.
- (2) Wet well cycling index is between 1.2 and 1.3.
- (1) Wet well cycling index greater than 1.3.

Wet Well Influent Pipe Surcharge Index

The surcharge index is equal to the lead pump on wet well level (feet above pressure transducer) subtracted by the lower influent pipe invert location above the pressure transducer in the wet well. This index is used to assess the extent of surcharging of the lowest influent pipe located inside the wet well during typical maximum wet well levels. The lead pump on wet well level is based on the settings in the City's SCADA system and adjusted per the record drawings. Per anecdotal information from the City, the pressure transducers are set at the top of the fillets in the wet wells. The lower influent pipe invert level is based on record drawings. The unweighted scores and associated descriptions are as follows:

- (5) Surcharge index is less than or equal to -0.5.
- (4) Surcharge index is between -0.5 and ≤ 0.0.
- (3) Surcharge index is between 0.0 and ≤ 0.5.
- (2) Surcharge index is between 0.5 and ≤ 1.0.
- (1) Surcharge index is greater than 1.0.

Apparent Severity of Wet Well Grease

Grease can coat the inside of the influent pipes and force mains, as well as accumulate on the wet well wall surfaces, which results in reduced volume and/or capacity of the system components. Excess grease can restrict flow through the force main, causing the pumps to work harder and discharge valves to malfunction. The level of severity is used to assess the extent of maintenance needed to clean the wet well, pumps, valves, and force main. This rating is based on discussions with operators. The unweighted scores and associated descriptions are as follows:

- (5) None to slight severity of wet well grease removal.
- (4) Slight severity of wet well grease removal.
- (3) Slight to moderate severity of wet well grease removal.
- (2) Moderate severity of wet well grease removal.
- (1) Moderate severity to chronic wet well grease removal.

Apparent Severity of Wet Well Rock/Grit/Obstruction

Rock and grit reduce the storage capacity in the wet well and emergency storage if the wet well is not cleaned routinely. Obstructions potentially create excessive wear or damage to pump impellors, have a higher power drain on motors under load, cause damage and sticking of discharge valves, and cause damage to the interior lining of force main. The level of severity is used to assess the extent of maintenance needed to clean the wet well and emergency storage structures, as well as service the pumps, motors, and valves. This rating is based on discussions with operators. The unweighted scores and associated descriptions are as follows:

- (5) None to slight severity of wet well rock/grit/obstruction removal.
- (4) Slight severity of wet well rock/grit/obstruction removal.
- (3) Slight to moderate of wet well rock/grit/obstruction removal.
- (2) Moderate severity of wet well rock/grit/obstruction removal.
- (1) Moderate severity to chronic wet well rock/grit/obstruction removal.

Wet Well Condition

Condition of Access Metals

The access maintenance hole lid and access ladder metal components were assessed during RH2 site visits. The average value is used to determine an overall unweighted score. The individual metal items, as well as the average value of the components, were used to determine the following comparison descriptions:

- (5) None to slight signs of corrosion of access metal components and/or minor discoloration of metals.
- (4) Slight to moderate signs of corrosion.
- (3) Moderate signs of corrosion.
- (2) Moderate to widespread signs of corrosion.
- (1) Widespread signs of corrosion, metal pitting/damage, metal strength in question, etc.

Condition of Concrete

The ceiling and wall concrete of the wet well were assessed during RH2 site visits. The average value is used to determine an overall unweighted score. The concrete items are based on the following comparison descriptions:

- (5) None to slight signs of concrete cracking, surface damage, surface sloughing, spalling, etc.
- (4) Slight to moderate signs.
- (3) Moderate signs of concrete cracking, surface damage, surface sloughing, spalling, etc.
- (2) Moderate to widespread signs.
- (1) Widespread signs of concrete cracking, surface damage, surface sloughing, spalling, etc.

Degree of Infiltration

The degree of infiltration is used to assess the extent of potential structural problems in the concrete walls of the wet well. This rating is based on RH2 site visit observations. The unweighted scores and associated descriptions are as follows:

- (5) No infiltration visible through any walls.
- (4) Little to minor infiltration.
- (3) Minor seepage through one or more walls.
- (2) Minor to excessive infiltration.
- (1) Excessive flow through one or more walls.

Dry Well Condition

Condition of Access Metals

The following items were assessed during RH2 site visits:

- Access hatch.
- Platform grating metal components.
- Access ladders.

The individual metal items described, as well as the average value of the components, were used to create the following comparison descriptions and unweighted scores:

- (5) None to slight signs of corrosion of access metal components and/or minor discoloration of metals.
- (4) Slight to moderate signs of corrosion.
- (3) Moderate signs of corrosion.
- (2) Moderate to widespread signs of corrosion.
- (1) Widespread signs of corrosion, metal pitting/damage, metal strength in question, etc.

Condition of Concrete

The dry well ceilings, walls, and floors were assessed during RH2 site visits. The individual concrete items, as well as the average value of the components, were used to create the following comparison descriptions and unweighted scores:

- (5) None to slight signs of concrete cracking, surface damage, surface sloughing, spalling, etc.
- (4) Slight to moderate signs.
- (3) Moderate signs of concrete cracking, surface damage, surface sloughing, spalling, etc.
- (2) Moderate to widespread signs.
- (1) Widespread signs of concrete cracking, surface damage, surface sloughing, spalling, etc.

Degree and Status of Interior Lighting

The degree and status of the interior lighting in the dry well is used to assess if additional lighting would be needed to safely access the dry well based on RH2 site visit observations. The unweighted scores and associated descriptions are as follows:

- (5) Sufficient lighting for visual inspection and no need to replace lights.
- (4) Moderate to sufficient lighting or Slight to moderate need to replace lights.
- (3) Moderate lighting or need to replace lights.

- (2) Insufficient to moderate lighting or moderate to widespread need to replace lights.
- (1) Insufficient lighting for visual inspection; requires additional lighting or widespread need to replace lights.

Degree of Infiltration

The degree of infiltration is used to assess the extent of potential structural problems in concrete walls for a dry well chamber or vault. The degree of infiltration is based on RH2 site visit observations. The unweighted scores and associated descriptions are as follows:

- (5) Dry, no infiltration visible through any walls.
- (4) Dry to minor infiltration.
- (3) Minor seepage through one or more walls.
- (2) Minor to excessive infiltration.
- (1) Excessive flow through one or more walls.

Condition of Water Pumping System

Each of the PSs evaluated has a water pump system in the dry well. Each system has an intake in the lake and a pump that pumps the lake water into the PS dry well. Each system has a hose with a nozzle attached that allows the pumped lake water to be used in the dry well for cleaning purposes.

If the water pumping system in the dry well is having significant operational issues or experiencing significant signs of wear, including corrosion, leaks, stains, etc., the station's performance may deteriorate as a result. The condition of the water pumping system is used to assess if the system is functioning properly and is based on RH2 site visit observations and discussions with operators. The unweighted scores and associated descriptions are as follows:

- (5) None to slight signs of wear to water pumping system. No problems with water pumping system operation.
- (4) Slight to moderate signs of wear or problems with water pumping system operation.
- (3) Moderate signs of wear to water pumping system. Moderate problems with water pumping system operation.
- (2) Moderate to widespread signs of wear or problems with water pumping system operation.
- (1) Widespread signs of wear to water pumping system. Significant problems with water pumping system operation or system is inoperable.

Pumps

Pump Flow Capacity Ratio (Current)

The current discharge flow capacity ratio is used to assess the pumping capacity for a single pump and does not consider multiple pumps in operation. The ratio is based on current inflow and discharge conditions using the following approach.

Approach

- Determine the second highest inflow from a statistical analysis of the HOBO data logger data.
- Determine the pumping capacity for each pump using the pump tests.
- Determine the discharge flow capacity ratio. This ratio is equal to the peak inflow divided by the pump capacity determined previously.

A ratio greater than 1.0 indicates that the inflow exceeds the discharge and implies that the pumping capacity of a single pump is deficient. The unweighted scores and associated descriptions are as follows:

- (5) Discharge flow capacity ratio is less than or equal to 0.9.
- (4) Discharge flow capacity ratio is between 0.9 and 1.0.
- (3) Discharge flow capacity ratio is between 1.0 and 1.1.
- (2) Discharge flow capacity ratio is between 1.1 and 1.2.
- (1) Discharge flow capacity ratio is greater than 1.2.

Maximum Pump Cycling Index (Current)

The maximum pump cycling index for current inflow conditions is calculated using the following approach.

Approach

- Determine the maximum number of pump cycles per hour from run time data.
- Determine the maximum allowable cycles per hour for the motor size. Based on industry standards, motors up to 25 HP are assumed to be able to reasonably provide up to 8 cycles per hour.
- Determine the maximum allowable cycles per hour for the pump station. Take the total number of pumps at the pump station and subtract one. This assumes one pump is out of service for these calculations. Multiply this number by the maximum allowable cycles per hour for the motor size.
- Determine the maximum pump cycling index. This index is equal to the maximum number of cycles per hour divided by the maximum allowable cycles per hour for the pump station configuration and motor size.

An index greater than 1.0 indicates that the motor is more likely to have a reduction in useful service life. This is due to the motor turning on/off (cycling) more frequently than other motors with an index less than 1.0. The unweighted scores and associated descriptions are as follows:

- (5) Pump cycling index is less than or equal to 1.0.
- (4) Pump cycling index is between 1.0 and 1.1.
- (3) Pump cycling index is between 1.1 and 1.2.

- (2) Pump cycling index is between 1.2 and 1.3.
- (1) Pump cycling index > 1.3.

Condition of Sump Pump

The sump pump and associated piping were assessed in the dry wells to determine if the sump pump system is functioning properly. If the sump pump system is having significant operational issues or experiencing significant signs of wear (e.g., corrosion, leaks, etc.), the PS could incur additional damage to pumps, electrical equipment, etc., as a result of water inundating the dry well. The sump pump system was assessed based on RH2 site visit observations and discussions with City operators. The unweighted scores and associated descriptions are follow:

- (5) None to slight signs of wear to sump pump system. No problems with sump pump system operation.
- (4) Slight to moderate signs of wear or problems with sump pump system operation.
- (3) Moderate signs of wear to sump pump system. Moderate problems with sump pump system operation.
- (2) Moderate to widespread signs of wear or problems with sump pump system operation.
- (1) Widespread signs of wear to sump pump system. Significant problems with sump pump system operation or sump pump system is inoperable.

Condition of Valves and Piping

The valves and piping in the dry wells were observed for signs of corrosion and leakage, as well as the effectiveness of the overall seals on the valves. If a valve is not operating as designed, sewage may be unable to flow through the system. The condition is based on RH2 site visit observations and discussions with operators. This category is used to assess the overall condition and current operation of the valves and piping. The unweighted scores and associated descriptions are as follows:

- (5) None to slight signs of corrosion of valves and mechanical piping. No problems with valve operation.
- (4) Slight to moderate signs of corrosion or problems with valve operation.
- (3) Moderate signs of corrosion of valves and mechanical piping. Moderate problems with valve operation.
- (2) Moderate to widespread signs of corrosion or problems with valve operation. Some leakage.
- (1) Widespread signs of corrosion of valves and mechanical piping. Significant problems with valve operation, or valve is inoperable, or valve does not seal completely.

Number of Times Pumps Deragged in Last Year

The number of times the pumps in the dry wells have been deragged is used to assess the capability of the pumps to handle the pumped wastewater and the extent of maintenance needed to clear rags from the pumps. Rags can potentially create excessive wear or damage to pump impellors, cause a higher power drain on motors under load, and reduce the flow capacity of the pumps until they are removed. The costs associated with pump deragging needs to be compared to the costs associated with replacing the pumps to evaluate if a pump replacement is more cost-effective than continuing to maintain the existing pumps. The number of times the pumps have been deragged is based on Cityworks' records and discussions with City operators. The unweighted scores and associated descriptions are follow:

- (5) No known repairs.
- (4) One known time pumps have been deragged.
- (3) Two or three known times pumps have been deragged.
- (2) Four or five known times pumps have been deragged.
- (1) More than five known times pumps have been deragged.

Motors

Motor Age (for Each Pump)

Motor age is used to assess the overall life of each motor currently installed. Typically, motors are the same age as the related pump since the pump and motor are usually replaced at the same time. However, there may be some instances where a dry well has become flooded and a motor will be replaced before the pump is replaced. Motor age is based on the final construction date indicated on record drawings and discussions with operators. The unweighted scores and associated descriptions are as follows:

- (5) Age is less than or equal to 5 years.
- (4) Age is between 5 years and 10 years.
- (3) Age is between 10 years and 15 years.
- (2) Age is between 15 years and 20 years.
- (1) Age is greater than 20 years.

Motor Maximum Voltage Imbalance (for Each Pump)

The maximum voltage imbalance is used to assess the reliability of the electrical system to provide power to each motor. Determining voltage imbalance is based on the following approach, with voltage field measurements and calculations provided by PumpTech.

Approach

- Determine the maximum voltage deviation (MVD) in volts between legs.
- Determine the average voltage of 3 legs (V_{AVG}) in volts.
- Determine the maximum voltage imbalance (MVI) in percent.
  - $MVI = \frac{MVD}{V_{AVG}} \times 100$

According to the National Electrical Manufacturers Association (NEMA), voltage imbalance for 3-phase induction motors is as defined in the equation. NEMA recommends that voltage imbalances at the motor terminals not exceed 1 percent. Larger voltage imbalances are much more likely to cause overheating and reduced motor life, typically require derating of the motor, and will void most manufacturers' warranties. If a motor exceeds 1 percent, then field measurements should be performed every 6 to 9 months to determine the rate at which the imbalance increases so that the motor's remaining life can be better estimated. If the imbalance exceeds 3 percent within the next 12 to 18 months, then the motor should be replaced within 3 years. The unweighted scores and associated descriptions are as follows:

- (5) Voltage imbalance is less than or equal to 0.25 percent.
- (4) Voltage imbalance is between 0.25 percent and 0.5 percent.
- (3) Voltage imbalance is between 0.50 percent and 0.75 percent.
- (2) Voltage imbalance is between 0.75 percent and 1.0 percent.
- (1) Voltage imbalance is greater than 1.0 percent.

Motor Maximum Current Imbalance (for Each Pump)

The maximum current imbalance is based on current field measurements and calculations by PumpTech. It is used to assess the reliability of the electrical system to provide power to each motor. Determining the maximum current imbalance is based on the following approach.

Approach

- Determine the maximum current deviation (MID) in amps between legs.
- Determine the average current of 3 legs (I_{AVG}) in amps.
- Determine the maximum current imbalance (MII) in percent.
    - $MII = \frac{MID}{I_{AVG}} \times 100$

According to the Fluke 43B *Power Quality Analyzer Applications Guide* (2001), the maximum current imbalance for a 3-phase induction motor should not exceed 10 percent, otherwise the motor is more likely to overheat and experience reduced motor life. If a motor exceeds 10 percent, then field measurements should be performed every 6 to 9 months to determine the rate at which the imbalance increases so that the motor's remaining life can be better estimated. If the imbalance exceeds 15 percent within the next 12 to 18 months, the motor should be replaced within 3 years. The unweighted scores and associated descriptions are as follows:

- (5) Current imbalance is less than or equal to 1 percent.
- (4) Current imbalance is between 1 percent and 3 percent.
- (3) Current imbalance is between 3 percent and 6 percent.
- (2) Current imbalance is between 6 percent and 10 percent.
- (1) Current imbalance is greater than 10 percent.

Motor Maximum Lateral Vibration Index (for Each Pump)

This index is used to assess the balance of the pump/motor assembly and is determined by the following approach and based on field measurements performed by PumpTech.

Approach

- Determine if the pump is oriented either horizontally or vertically.
- Measure the lateral vibration at each of the approximate locations shown in **Figures 2** and **3**, depending on the orientation of the pump.

Figure 2

Vertical Pump Vibration Monitoring Points

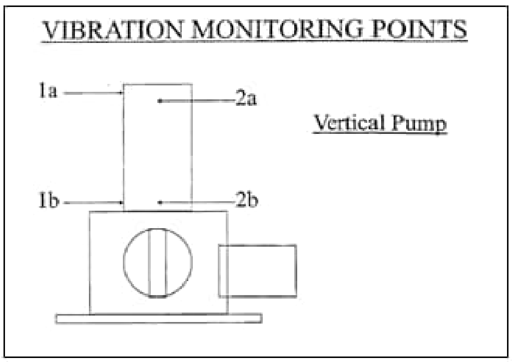
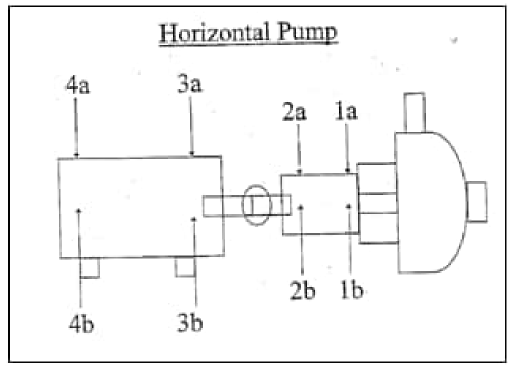


Figure 3

Horizontal Pump Vibration Monitoring Points



- Determine the maximum vibration reading (MVR) for each pump.
- Determine the maximum allowable lateral vibration (MALV) based on the motor size and orientation as shown in **Table 2** (based on information from American National Standards Institute [ANSI] / Hydraulic Institute [HI] Standard 9.6.4-2009: American National Standard for Rotodynamic Pumps for Vibration Measurements and Allowable Values).

Table 2

Maximum Allowable Lateral Vibration

Brake HP	Vertical (in/sec)
7.5	0.30
10.0	0.30

in/sec = inches per second

- Determine the lateral vibration index (LVI).
  - $LVI = \frac{MVR}{MALV}$

An index greater than 1.0 indicates that the vibration is the least acceptable and is assigned an unweighted score of 1. An index less than 0.25 indicates the most acceptable vibration reading and is assigned a score of 5. Pump/motor assemblies with LVI values exceeding 1.0 should be monitored. The unweighted scores and associated descriptions are as follows:

- (5) LVI is less than or equal to 0.25.
- (4) LVI is between 0.25 and 0.50.
- (3) LVI is between 0.50 and 0.75.
- (2) LVI is between 0.75 and 1.00.
- (1) LVI is greater than 1.00.

Motor Megger Index (for Each Pump)

The motor megger index is used to assess the insulation condition for each motor. The index is determined by the following approach and based on field measurements performed by PumpTech.

Approach

- Determine if the pump is oriented either horizontally or vertically.
- Determine the brake horsepower of the motor.
- Determine the megger reading (MR) per manufacturer's recommendations.
- Determine the minimum allowable megger reading (MAMR) based on motor size brake horsepower as shown in **Table 3**.

Table 3

Minimum Allowable Megger Readings

Brake HP	Vertical Mohms – Megaohms - MΩ
5.0	500
7.5	475*
10.0	450

***Note:** The minimum allowable megger reading for a 7.5 HP pump was interpolated from the minimum allowable megger readings for 5.0 HP and 10.0 HP pumps.

- Determine the megger index (MI).
  - $MI = \frac{MR}{MAMR}$

A MI less than 0.25 indicates the motor insulation is in the least acceptable condition and is assigned an unweighted score of 1. An index greater than 1.0 indicates that the motor insulation is in the most acceptable condition and is assigned a score of 5. Motors with MI values less than 1.0 should be monitored. The unweighted scores and associated descriptions are as follows:

- (5) MI is greater than 1.0.
- (4) MI is between 0.75 and 1.0.
- (3) MI is between 0.50 and 0.75.
- (2) MI is between 0.25 and 0.50.
- (1) MI is less than 0.25.

Force Main (Exterior to the PS)

The exterior force main is considered to be the alignment beyond the exterior face of the PS wall penetration and extends to the discharge connection. The following categories have been included in the scoring process.

Age

Age is used to assess the expected condition of the interior lining and the pipe's ability to resist higher flows due to related changes in the pumping capacities. The age of a force main outside the exterior wall of a PS is defined as the total number of years in service from installation date to inventory date, without regard to temporary inactive time due to repairs. If a force main is replaced, then the age is the total number of years in service from replacement date to inventory date. Age is based on record drawings and discussions with City operators. The unweighted scores and associated descriptions are as follows:

- (5) Force main age is less than or equal to 20 years.
- (4) Force main age is between 20 years and 40 years.
- (3) Force main age is between 40 years and 60 years.
- (2) Force main age is between 60 years and 80 years.
- (1) Force main age is less than 80 years.

Material

The pipe material as shown on record drawings is used to assess the vulnerability of the force main. Force main material used before the 1940s was typically cast iron, which was more brittle and susceptible to tuberculation of the interior surface compared to cast-iron after the 1940s. In addition, some force main alignments have different types of material depending on the location and type of material used during repairs. Weak zones may exist at locations where materials transition from one to another. A force main that has several types of material may be more susceptible to failure. The unweighted scores and associated descriptions are as follows:

- (5) High-density polyethylene (HDPE).
- (4) Ductile iron).
- (3) Cast-iron after 1945.

- (2) Polyvinyl chloride (PVC).
- (1) Asbestos cement or galvanized steel.

Force Main Velocity (Current)

The force main velocity for current conditions is calculated using the following approach.

Approach

- Determine the pumping capacity for each pump using the pump tests.
- Determine the interior cross-sectional area for the maximum nominal size of force main section within a particular alignment.
- Determine the force main velocity equal to the maximum of the pump capacities at that pump station divided by the interior area.

Relatively slow force main velocities are less likely to move wastewater through a force main and may result in sedimentation within the pipeline. Velocities that are too fast may cause scouring of the pipe lining, hydraulic surges, or adverse effects at the discharge location maintenance hole or connection. The unweighted scores and associated descriptions are as follows:

- (5) Force main velocities greater than or equal to 2.5 feet per second (fps) and less than or equal to 8.0 fps.
- (3) Force main velocities greater than or equal to 2.0 fps and less than 2.5 fps, or greater than 8.0 fps and less than or equal to 10.0 fps.
- (1) Force main velocities are less than 2.0 fps, or greater than 10.0 fps.

Emergency Power and Bypass

EG Power

Based on RH2 site visit observations and discussions with operators, the emergency generator (EG) power is used to assess the ability to provide the and reliability of providing emergency power to the PS. The unweighted scores and associated descriptions are as follows:

- (5) On-site EG set and EG plug, with low to moderate possibility of power outages affecting the PS.
- (4) On-site EG set and EG plug, with high possibility of power outages affecting the PS.
- (3) On-site EG set or EG plug, with any possibility of power outage.
- (2) No on-site EG set or EG plug, with low to moderate possibility of power outages affecting the PS.
- (1) No on-site EG set or EG plug, with high possibility of power outages affecting the PS.

Controls and Electrical Power

Type of Pump Control System

Systems with backup features are most reliable. The reliability of the control system was assessed based on discussions with City operators. The unweighted scores and associated descriptions are as follows:

- (5) Transducer with programmable logic controller (PLC) and FOGRod (or similar) backup.
- (4) Transducer with PLC and float backup.
- (3) Transducer with PLC and no float backup.
- (2) Floats, but no PLC.
- (1) Other.

Pump Control System Age

The pump control system age is based on discussions with operators. This also is used to assess the reliability of the control system. The unweighted scores and associated descriptions are as follows:

- (5) Age is less than or equal to 5 years.
- (4) Age is between 5 years and 9 years.
- (3) Age is between 9 years and 14 years.
- (2) Age is between 14 years and 20 years.
- (1) Age is greater than 20 years.

Motor Control Panel Age

The motor control panel age is based on discussions with operators and is used to assess the reliability of the control system. The unweighted scores and associated descriptions are as follows:

- (5) Age is less than or equal to 10 years.
- (4) Age is between 10 years and 15 years.
- (3) Age is between 15 years and 25 years.
- (2) Age is between 25 years and 35 years.
- (1) Age is greater than 35 years.

Condition of Motor Control Panel

The current condition of the motor control panel is based on RH2 site visit observations and discussions with operators. Panels were observed for signs of wear and tear, corrosion, and noise. The unweighted scores and associated descriptions follow:

- (5) None to slight signs of wear, corrosion, and/or chattering/humming when the pumps turn on.
- (4) Slight to moderate signs.
- (3) Moderate signs of wear, corrosion, and/or chattering/humming.
- (2) Moderate to widespread signs.
- (1) Widespread signs of wear, corrosion, and/or chattering/humming.

Condition of Electrical Conduit in the PS

The condition of the electrical conduit is based on RH2 site visit observations and discussions with operators. Electrical conduit protects wiring from moisture, flammable materials, animals, etc. The unweighted scores and associated descriptions are as follows:

- (5) None to slight signs of wear of electrical conduits.
- (4) Slight to moderate signs of wear.
- (3) Moderate signs of wear of electrical conduits.
- (2) Moderate to widespread signs of wear.
- (1) Widespread signs of wear of electrical conduits.

Condition of Electrical and Control Panel

The condition of the PS electrical and control panel is based on RH2 site visit observations and discussions with operators. This is used to assess the panels for signs of wear, including a lack of remaining outlets, rust, and visible damage. The unweighted scores and associated descriptions are as follows:

- (5) None to slight signs of wear at PS electrical and control panel.
- (4) Slight to moderate signs of wear.
- (3) Moderate signs of wear for PS electrical and control panel.
- (2) Moderate to widespread signs of wear.
- (1) Widespread signs of wear at PS electrical and control panel.

Condition of External Electrical Wiring (Power Lines to PS)

The condition of external electrical wiring is based on RH2 site visit observations. External power lines and junction boxes were examined for signs of cracking insulation, burns, corrosion, and rusting. The unweighted scores and associated descriptions are as follows:

- (5) None to slight signs of wear for electrical wiring, such as brittle and cracking insulation, signs of arcing, burn marks, corrosion at connection points, rusting or broken junction, or disconnected boxes.
- (4) Slight to moderate signs of wear.
- (3) Moderate signs of wear for electrical wiring.
- (2) Moderate to widespread signs of wear.
- (1) Low hanging power lines or widespread signs of wear for electrical wiring, such as brittle and cracking insulation, signs of arcing, burn marks, corrosion at connection points, rusting or broken junction, or disconnected boxes.

Assessment and Evaluations

Ranking Matrix

The Ranking Matrix, provided as **Appendix E** of this report, summarizes the overall ranking results of all five PSs, as well as the ranking results from each of the main criterion. The main criterion and related sub-criterion are explained previously in the **Ranking Categories** section of this report.

Column A lists the criterion category, column B lists the sub-criterion, and column C lists the weighting values for the sub-criterion. A weighting factor for each sub-criterion is a value from 1 to 5, where 1 is the least important and 5 is the most important. Columns D to H summarize the weighted scores for each sub-criterion and PS, and then provide an individual ranking score at the end of each main criterion. Column I shows the maximum possible value for the sub-criterion.

An individual ranking score is based on the percentage of available points for the station being assessed. The actual available points are determined in the Ranking Report Details in **Appendix F**. The maximum available points for each type of station and sub-criterion are determined based on available data. The total weighted points divided by the maximum available weighted points provide a percentage of maximum available points for each station, which are used to rank the PSs.

Ranking Matrix – Detailed

To minimize the subjectivity of the scoring process, a weighted scoring technique for the PS components was used. This section provides a detailed summary of the calculations, parameters, and assumptions used to assess the weighted scores for the individual sub-criterion that are provided in **Appendix F**.

Columns B and C list the range of values used to compare against the calculated values in columns E to I. If a calculated value falls within a given range, then the corresponding unweighted score (1 to 5, where 1 is poor and 5 is best) in column A is multiplied by the weighting factor in column D to provide the final individual weighted scores in the blue-shaded cells in columns E to I and summarized on the “Scores” sheet.

The weighting factor is in column D as bold text with the prefix "weight:" and a number from 1 to 5 that is linked to the "Scores" sheet.

The sub-criterion for the weighted scores is located in column C. Intermediate calculations are typically shaded in gray and located just below each sub-criterion. Yellow shaded cells typically represent manually inserted data based on non-database sources, such as subjective data based on site-specific conditions, anecdotal information, or past data sheets.

This concludes the section of the report for grading and pump stations as they exist currently. The **Condition Monitoring Schedule** section describes monitoring frequency for the various conditions of each pump station.

Condition Monitoring Schedule

Based on RH2 site visits, PS data recorded, the ranking matrix, and anecdotal reports from City operators, the following PS items have been determined need routine inspection and testing in order to objectively determine when each item should be repaired or replaced.

Cityworks

Every 6 months:

- Record number and dates of overflows;
- Record apparent severity of grease accumulation:
  - Record thickness of grease accumulation;
  - Record area of grease accumulation; and
  - Record time to remove grease accumulation;
- Record apparent severity of wet well rock/grit/obstruction accumulation:
  - Record thickness of wet well rock/grit/obstruction accumulation;
  - Record area of wet well rock/grit/obstruction accumulation; and
  - Record time to remove wet well rock/grit/obstruction accumulation;
- Visually inspect health, fire, and life safety systems; and
- Evaluate pump and wet well control settings.

Every 2 years:

- Visually inspect exterior concrete (i.e., walls and roof);
- Visually inspect dry well concrete (i.e., floor, walls, ceiling, and pump pads);
- Visually inspect dry well infiltration;
- Visually inspect dry well metals (i.e., grating, railing, hatches, ladders, and cabinets);
- Visually inspect dry well lighting;
- Visually inspect dry well valves and piping;

- Visually inspect dry well water pumping system (i.e., pump, piping, and hose);
- Visually inspect sump pumps (i.e., pump, sump pump, piping, and hose);
- Visually inspect wet well concrete (i.e., floor, walls, and ceiling);
- Visually inspect wet well infiltration;
- Visually inspect wet well metals (i.e., grating, railing, hatches, ladders, pipes, and valves);
- Visually inspect concrete in hydraulic grade control maintenance hole (i.e., channel, bench, walls, and ceiling);
- Visually inspect metal in hydraulic grade control maintenance hole (i.e., lids, hatches, ladders, pipes);
- Visually inspect dock(s), if applicable (i.e., decking, pilings, and dock protection);
- Inspect condition of each electrical motor's oil (for each pump);
- Perform lateral vibration tests for each pump over 20 years old and/or if known to be subjected to rocks and/or ragging problems due to various obstructions;
- Perform megger testing for each motor over 25 years old and/or if the PS has experienced more than two power failures and/or surges in the last 12 months;
- Visually inspect mechanical seals for excessive leakage;
- Visually inspect motor control panel;
- Visually inspect electrical conduit in the PS;
- Visually inspect PS electrical and control panel;
- Visually inspect external electrical wiring (power lines to PS); and
- Perform two pump tests (either pump-down, with a temporary strap-on flow meter, or with a temporary insertion flow meter) to compare against available records (for each pump):
    - Observe each pump's pumped flow rate over the pump's life to assess the change in capacity.
    - Record pump shutoff head (for each pump).
    - Record pumping capacity (for each pump).
    - Record discharge pressure (for each pump).
    - Record suction pressure (for each pump).
    - Record voltage for each of the 3 legs (for each pump).
    - Record operating current for each of the 3 legs (for each pump).
        - Observe the trend of each pump motor's current draw over the motor's life to determine if it is drawing more current.

- Record wiring power factor (for each pump).
- Record maximum voltage deviation (for each pump).
- Record maximum current deviation (for each pump).

Every 5 years:

- Visually inspect apparent ground settlement next to the PS; and
- Visually inspect rip rap along the lakeside, if applicable.

Spreadsheet (to be linked to Cityworks)

Every 2 years:

- Evaluate wet well cycling index;
- Evaluate pump flow capacity ratio (for each pump);
- Evaluate pump/motor efficiency index (for each pump):
    - Evaluate pump total dynamic head (for each pump);
    - Evaluate pump water horsepower (for each pump);
    - Evaluate motor electrical horsepower (for each pump); and
    - Evaluate wire-to-water efficiency (for each pump).
- Evaluate motor maximum voltage imbalance (for each pump);
- Evaluate motor maximum current imbalance (for each pump);
- Evaluate motor maximum lateral vibration index (for each pump):
    - Evaluate maximum vibration reading (for each pump).
- Evaluate motor megger index (for each pump); and
- Evaluate force main velocity (for each pump).

Establishing Replacement Priorities

The table in **Appendix E** titled "Overall Ranking" was used to establish the priority order in which PS rehabilitation projects should be performed. The ranking of the PSs by each scoring category also are presented. This enables the City to see which station has the most deficient pumps, wet well, motors, etc.

The priorities shown later in the **Recommended Improvements and CIP** section of this Report are intended to be a starting point for updating the City's wastewater PS CIP. The CIP timeline presented at the end of this section is flexible and can be adjusted as the City's needs change over time.

Each of RH2's recommended improvements are ranked individually in the **Recommended Improvements and CIP** sections of this Report as identified in the list that follows:

- Priority 1 – Required or highly recommended items to improve PS operation.
- Priority 2 – Recommended items to enhance PS operation.
- Priority 3 – Optional items recommended to improve PS operation.

Cost Estimates

Project costs for the proposed improvements were estimated based on costs of similar recently constructed sewer projects around the Puget Sound area and are presented in 2023 dollars. The cost estimates shown in **Appendix G** include the estimated construction cost of the improvement and indirect costs estimated at 50 percent of the construction cost for engineering design, construction contract administration, project administration, permitting, and legal and administrative services. The construction cost estimates include the following: a sales tax of 10.1 percent; a construction contingency of 30 percent; and a risk contingency of 30 percent. The costs do not include costs associated with easement acquisition.

Cost estimates prepared by RH2 for projects in the CIP are considered to be Class 5 estimates, based on standards established by the American Association of Cost Engineers. Class 5 estimates are described as being prepared with very limited information and subsequently have wide accuracy ranges. The typical accuracy range for this cost estimate class is from -20 percent to -50 percent on the low side and from +30 percent to +100 percent on the high side. Class 5 estimates are prepared for any number of strategic business planning purposes including, but not limited to, market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.

The final cost of the projects will depend on actual labor and material costs, site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs likely will vary from those presented. Because of these factors, funding needs must be reviewed carefully prior to making specific financial decisions or establishing final budgets.

The cost estimates shown in **Appendix G** are based on rehabilitating the existing PSs per the recommendations in this report. It is RH2's opinion that the existing stations are in good condition, spacious, and able to be upgraded to safe and durable pump stations. The cost estimates provided include the Priority 1, 2, and 3 recommended improvements and show subtotals for each priority group. It should be noted that the overall project costs to rehabilitate these PSs likely will increase if the construction of the recommended improvements is split out into multiple smaller projects (i.e., if Priority 3 improvements for one PS are completed as a standalone project) because some of the associated tasks to complete the construction projects will need to be performed more than once, such as permitting, bidding, construction mobilization, etc. Overall, RH2 believes it will be more cost-effective and take less time for the City to rehabilitate the existing PSs, rather than replace them. Replacing the existing PSs would require more substantial bypass systems (if the new station is located at the existing site) or the acquisition of additional land for relocating the stations (in/along/near the waterfront, depending on the site). Property acquisition and permitting for new PSs along the waterfront will be costly and time intensive, if not impossible. These costs and efforts would be in addition to other design and construction costs and efforts for each PS replacement.

The useful life of a rehabilitated PS is anticipated to be approximately the same as a new PS. Due to how corrosive the wastewater is in some of the observed wet wells, the useful life of the proposed wet well coatings is anticipated to be approximately 15 to 20 years based on the results observed at similar sites. The City should plan to begin tracking the condition of the proposed wet well coatings around this timeframe to evaluate if the coatings need to be replaced and/or repaired before the concrete begins corroding again. The quality of the original construction of the existing pump stations was good; rehabilitating these stations in place can be done for much less than replacing them with new pump stations. With regular maintenance, coatings, and equipment replacements, the rehabilitated pump stations should last at least another 50 years.

Future Project Cost Adjustments

All cost estimates shown in the tables are presented in 2023 dollars. Therefore, it is recommended that future costs be adjusted to account for the effects of inflation and changing construction market conditions at the actual time of project implementation. Future costs can be estimated using the Engineering News Record Construction Cost Index for the Seattle area or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.

The cost estimates presented in this Report are based on the information currently available. As the City implements the recommendations, the cost and timing of projects may be revised.

Recommended Improvements and CIP

This section outlines the deficiencies identified for each of the five City PSs evaluated, improvements recommended to address those deficiencies, and the estimated project cost to implement the recommended improvements.

The City’s 2018 GSP identified and outlined separate projects for PS accessibility improvements, PS EG replacement, telemetry/SCADA upgrades and maintenance, and lake line improvements, so those assets are not evaluated and their associated costs are not included in this section.

PS 19 Deficiencies and Recommendations

Observed Deficiencies

The following deficiencies were identified for PS 19 based on the City’s feedback, observations during the site visit, and the pump station evaluations.

- **The pumps are in poor condition and have excessive vibration.** The determined pumping capacity for two of the pumps (Pumps 2 and 3) from the pump tests are less than the design pump capacity. The pumps are almost 30 years old. According to the PumpTech Service Reports, vibration readings taken during the site visit on Pumps 1 and 3 are elevated, and some readings are above Hydraulic Institute’s limit.

- **The valves are old and in poor condition.** The gate and check valves are all original and are almost 60 years old. The valves do not operate properly and sometimes leak. Additionally, the paint is peeling on the piping in the dry well.

Photo of PS 19 pumps, valves, and fittings on dry well lower level.

- **There is no flow meter or pressure gauge.** There is no way to monitor pumped flow rates or discharge pressures for the pumps.
- **The pressure data logger readings fluctuated and some were negative.** The baseline static pressure data loggers readings fluctuated in a daily recurring pattern and were lower at night (from approximately midnight to approximately 7:00 a.m.) (from approximately 10:00 p.m. to approximately 3:00 a.m.) (see **Appendix A**). This could be due to the hydraulic conditions in the lake line changing, such as grit or air pockets accumulating in the lake line and then being flushed out when there is enough flow to scour this grit or purge this air from the lake line. The data logger also read negative pressures at times. This could be due to a pressure gauge that was out of calibration (which caused the readings to be off by a few pounds per square inch [psi]) or could be due to a vacuum that formed in the lake line at times.
- **The flushing system is old and not in operation.** The plug and gate valves are original and almost 60 years old. The air actuator for the flush valves has failed, and the City made the plug valve inoperable over 15 years ago. The actuator and the plug valve need to be replaced.
- **The concrete in the wet well is in poor condition.** The concrete in the wet well is showing signs of corrosion.


Photos of PS 19 wet well concrete condition.

- **The wet well access ladder is in poor condition.** The ladder in the wet well has corroded noticeably.

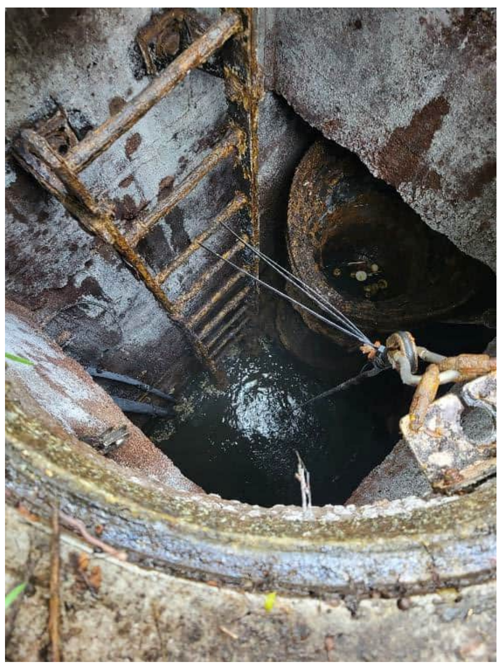


Photo of PS 19 wet well ladder.

- **The wet well does not have a properly operating vent to allow air discharge and supply.** According to City staff, the sand filter for the ventilation system has failed. Due to the lack of a properly operating vent supply, the wet well maintenance hole lid can be difficult to open at times when the pumps are running according to City staff. Additionally, it has been observed that sometimes air from the wet well makes its way through the dry well sump pump piping (through the sump pump check valve) and into the dry well. This air makes a “burbling” noise while it makes its way through water in the dry well sump. This may correspond with air being displaced in the wet well when it is being filled with wastewater flow from PS 18.

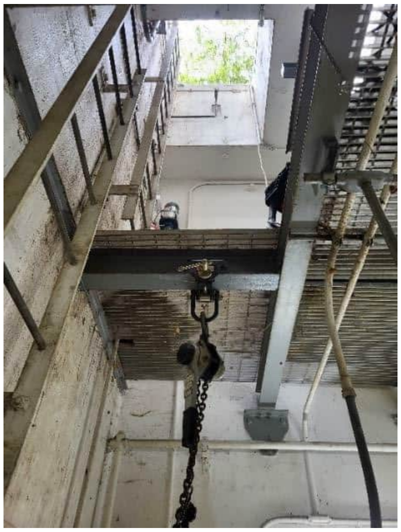
- **Odor complaints.** According to City staff, there have been odor complaints about this PS and PS 21.
- **The wood decking on the dock is showing signs of rotting.** The concrete under the wooden dock is in good condition, but the condition of the piles for the dock is not known.


Photos of wooden decking on top of dock at PS 19.

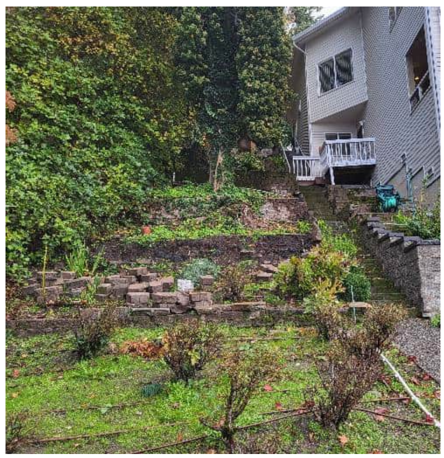
Photo of PS 19 concrete dock under decking.

- **The motor control panels are old and parts are unavailable.** The motor control panels are almost 30 years old, and the manufacturer has said that parts are obsolete and no longer available according to City staff.

- **The distribution panels, circuit breakers, and conductors are almost 30 years old and have reached the end of their lifespan.**
- **The wet well pressure transducer level sensor is in a poor location.** The level sensor is in a location that is difficult to access and requires wet well entry for maintenance.
- **The water level in the hydraulic grade maintenance hole (HGMH) cannot be monitored at this time or cannot measure how much flow recirculates through the HGMH back to this PS.** Additionally, the frame for the HGMH moved while City staff were lifting the HGMH cover during the RH2 site visit.
- **The grating platform in the dry well is old.** The existing grating is all original and almost 60 years old. The grating is deformed in places, and the grating hatch (to the dry well lower level) rubs against an electrical conduit when it is opened and closed. City staff have indicated that they would like the grating platform replaced since it is deformed in places and the grating hatch can be difficult to open and close.




Existing PS 19 grating and ladders in dry well (left). Existing condition of PS 19 dry well entrance (right).

Existing PS 19 site from the north, looking south (left). PS 19 site looking east (right). PS 19 can only be accessed by foot or boat.


Existing PS 19 site from dock, looking towards dry well access (left). Existing PS 19 site access from the south, looking north (right).

- **Soil erosion and the lack of site drainage are increasing the maintenance needed at this PS.** This PS has no site drainage and is located downhill of a steep slope, which is contributing to soil erosion from the uphill slope to cover the PS access points**.** The City previously installed additional maintenance hole risers on the HGMH, but debris and soil eroding from the uphill slope continue to cover the HGMH and other PS access points.

Other Observations

The following additional observations were made for PS 19 based on the City's feedback and observations during the site visit.

- There is no direct vehicular access to the PS site. The PS site is difficult to access and requires walking along the lakeshore across a few frontage properties.
- Due to the PS's proximity to Lake Washington which has its controlled by the Ballard Locks, the site should not be susceptible to localized flooding.
- There are trees and shrubs at the PS site, which notably limit site access. The adjacent vegetation needs to continue being trimmed back to maintain PS access.
- The PS is approximately 40 feet from nearest residence based on available GIS data.
- The exterior concrete that was visible appears to be in an acceptable condition with some signs of wear and aesthetic/non-structural damage including, but not limited to, small pieces of concrete that have "chipped off."
- There were no noticeable signs of active infiltration in the wet well. The wet well should be further evaluated during construction, once the temporary bypass is in place and the wet well has been drained. Then a more accurate evaluation of the wet well infiltration can be made.

- There were no noticeable signs of cracks in the concrete with active infiltration in the dry well.
- The PS has a pile driven, pre-cast concrete dock with pre-cast concrete support beams/caps and wood decking on top.
- The existing dry well and wet well entrance hatches, flooring, lighting, ventilation, and fire/safety detectors appear to be in good condition.

Existing lighting in PS 19 dry well (right).
Location of existing PS 19 generator (right).

Recommended Improvements

RH2 recommends the following improvements for PS 19 based on the City's feedback, observations during the site visit, and pump station evaluations. These recommended improvements are outlined in **Appendix H**. These improvements are prioritized based on the priority rankings listed in the **Establishing Replacement Priorities** section of this Report.

Priority 1 Improvements

- Replace all three pumps to address the deficiencies with the pumps. Install variable frequency drives (VFDs) on all the pumps. VFDs will better control flow rates to match influent flows to reduce pump cycling and flow recirculation that may occur at the HGMH.
- Replace all the mechanical fittings and piping in the dry well to address the valve deficiencies. Replace the gate valves with plug valves, which are typically preferred in wastewater applications.
    - Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.
- Rehabilitate the wet well structure (walls, floor, and ceiling) and coat the inside of the wet well with a lining system that will reduce the rate of concrete corrosion and extend the life of the existing wet well structure. The concrete wet well walls, floor, and ceiling should be restored to their original thickness and resurfaced. First, remove any spalling

concrete and prepare the concrete surface and any exposed rebar in accordance with the selected rehabilitation product's installation procedures. The rebar condition should be further evaluated. The recommended approach is to assess the condition of the rebar prior to construction to minimize change orders during construction; however, the rebar condition assessment will require temporary pumping by the City to access the existing wet well safely. If the rebar has corroded too much, it may be necessary to install new rebar to replace the missing rebar or implement similar measures.

  - If new rebar needs to be installed, precautions should be taken for cathodic protection of the new rebar, such as installing anodes with the new rebar.
  - Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.

- Install a wet well vent with an in-line carbon filter on the exhaust/intake for odor control to allow better air discharge and supply for the wet well. This improvement will allow the wet well maintenance hole lid to be opened when the pumps are running and may reduce odor complaints. This improvement will also eliminate the issue of air from the wet well being displaced into the dry well through the sump pump piping. The carbon media will need to be replaced on a recurring interval when the media is expended.

Photo of three in-line carbon filters with exhaust/intake piping at a recently constructed lift station.

- Replace the motor control panels to address the deficiencies with the pumps. Install new motor control panels that would contain modern, readily available parts. Additionally, installing VFDs concurrently with replacement pumps as described previously would allow for better flow control and reduced pump cycling. This work could be performed when the pumps and valves are replaced, so that the temporary sewer bypass is available and no additional downtime would be required.

- Replace the electrical distribution equipment, including the service disconnect, distribution panels, circuit breakers, lighting transformer, and conductors serving the station. This work could be performed when the pumps and valves are replaced, so that the temporary sewer bypass is available and no additional downtime would be required.

Priority 2 Improvements

- Install a flow meter on the force main header and pressure gauges on piping near the pump discharges to enhance the City's ability to evaluate the capacity of the pumps and determine if the pumps may be in need of maintenance, such as unclogging. Connect the flow meter and pressure transducer to the City's telemetry system so they can be monitored remotely.
- Remove the wet well ladder. If a new ladder is desired by City staff, install a fiber glass reinforced plastic (FRP) ladder, which is better suited for the wet well environment.

Priority 3 Improvements

- Replace the existing flushing valve with a plug valve (or butterfly valve) with an electronic actuator. Connect the flushing valve actuator to the City's telemetry system so it can be controlled and monitored remotely.
- Replace the wood decking for the dock next to the pump station to provide safer access.
- Relocate the wet well pressure transducer level sensor closer to the wet well access hatch and ladder so that it is easier to access for maintenance.
- Install a level sensor in the HGMH so the water level in the HGMH can be measured and the amount of recirculated flow can be estimated.
- Adhere the frame for the HGMH to the manhole collars, so the frame does not move when the cover is lifted off the HGMH.
- Replace the existing grating platform in the dry well with new FRP grating.
- Install site drainage to redirect surface water away from the PS. Install a short retaining wall(s) (less than 2 feet tall) to prevent soil eroding from the uphill steep slope from covering the PS access points, including the HGMH.

Additional Improvements

- In order to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well), a temporary sewer bypass will be needed to take the existing pump station offline. One option to accomplish this bypass is outlined as follows and as shown in **Appendix H**.
  - Install an access hatch or maintenance hole lid (through the top of the wet well and near the influent lake line). This will allow the temporary bypass pump suction piping to be installed from the upstream lake line to the outside of the wet well.

- Install the temporary bypass pumps on site. Place the bypass pumps on land if viable based on site accessibility and if adjacent homeowners agree. Otherwise, place the bypass pumps on a barge.
- Construct a temporary sound wall or enclosure on site to reduce the amount of noise the adjacent homeowners are exposed to by these pumps. Whether the bypass pumps are electrical or diesel powered, they will make a noticeable amount of noise and will operate continuously for an extended period of time. The temporary sound wall or enclosure should help mitigate noise complaints from adjacent property owners.
- Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the bypass discharge in the portion of the lake line that is connected to the HGMH. A discharge header is recommended near the HGMH so multiple pumps can be utilized for the temporary bypass system.
- Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or maintenance hole lid) and connect the piping to a flow-thru plug installed in the upstream lake line pipe. A suction header is recommended in the wet well so multiple pumps can be utilized for the temporary bypass system.
- Prior to implementing this sewer bypass, it is recommended to evaluate the condition of the lake line adjacent to this PS to determine if this part of the lake line is in sufficient condition to accommodate the bypass system.

- Evaluate the piles for the dock to determine if they need to be replaced. Cost estimates shown in **Appendix G** do not include costs for replacing the dock piles.

Estimated Project Cost of Recommended PS 19 Improvements

RH2 estimates that the total project cost for these recommended PS 19 improvements is approximately $5.7 million. This cost assumes a barge will be needed for construction of some of these improvements, including staging for the bypass pumps. A summary of this estimate is provided in **Appendix G**.

RH2 estimates that design for these recommended improvements would take approximately 9 months to complete. Since this PS is located in close proximity to Lake Washington, permitting for these recommended improvements is estimated to take 4 to 12 months, depending on exemption applicability and permitting requirements. Permitting could be completed in parallel with design of the recommended improvements.

PS 20 Deficiencies and Recommendations

Observed Deficiencies

The following deficiencies were identified for PS 20 based on the City's feedback, observations during the site visit, and the PS evaluations.

- **The pumps are in poor condition and have excessive vibration.** The determined pumping capacity for each pump from the pump tests are less than the design pump capacity. The pumps are almost 30 years old and clog multiple times per year. According to the PumpTech Service Report(s), vibration readings taken during the site visit on Pump 2 are excessive, and vibration readings taken on Pump 3 are at the high limit for continuous operation.

- **The valves are old and in poor condition.** The gate and check valves are all original and almost 60 years old. The gate valves are prone to breaking, and the check valves need to be replaced. Additionally, the paint on the piping is peeling in the dry well.

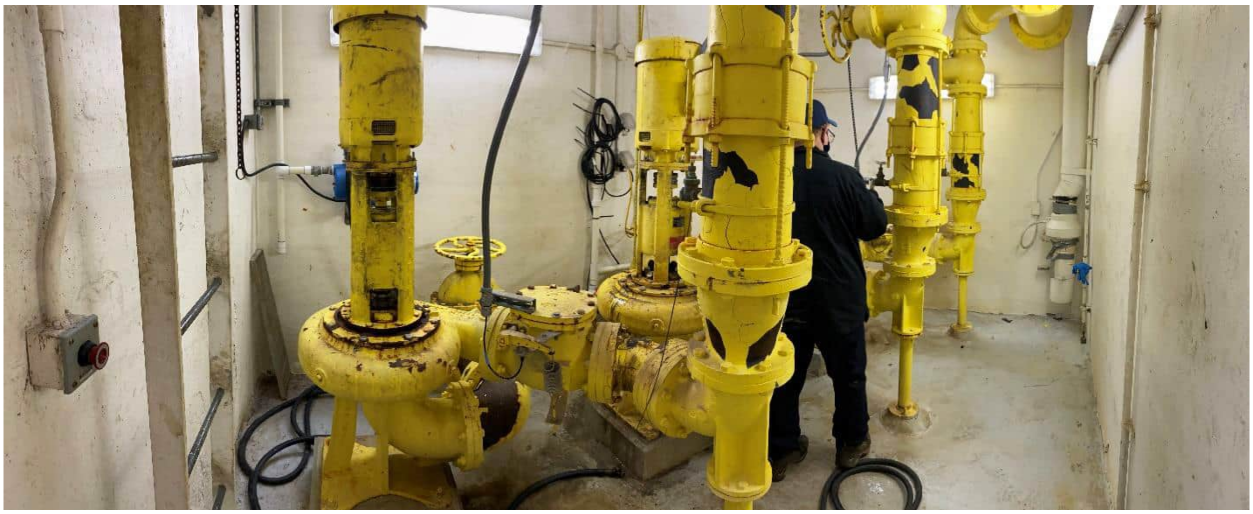


Photo of PS 20 pumps, valves, and fittings on dry well lower level.

- **There is no flow meter or pressure gauge.** There is not enough straight piping to install a meter and accurately monitor pumped flow rates or discharge pressures for the pumps.
- **The concrete in the wet well is in poor condition.** The concrete in the wet well has corroded noticeably, and the rebar is exposed in several places.

Photos of PS 20 wet well concrete condition and exposed rebar.

- **The wet well access ladder is in poor condition.** The ladder in the wet well has corroded noticeably and the lower portion of the ladder is missing.

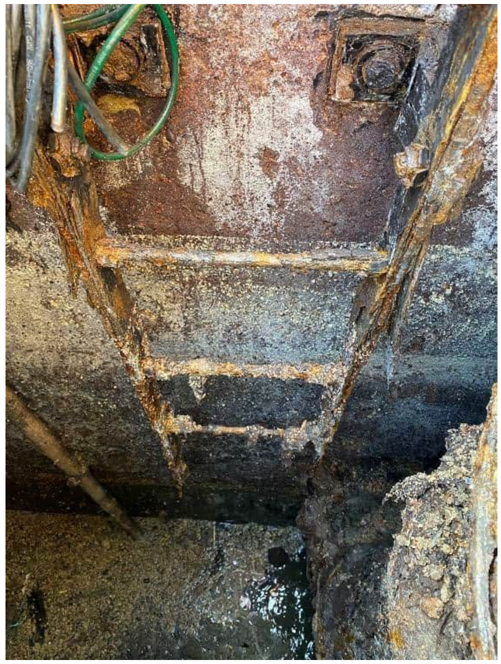
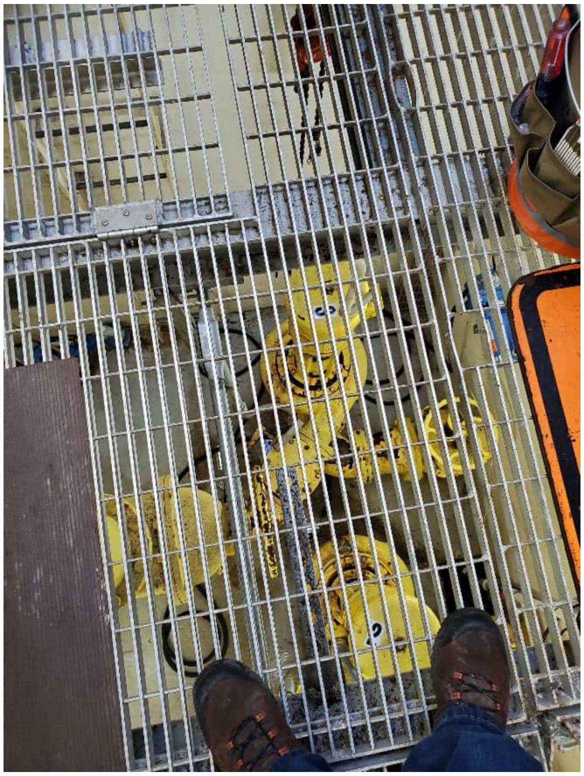


Photo of PS 20 wet well ladder with missing rungs and signs of metal and concrete corrosion.

- **The wet well does not have a vent to allow air discharge and supply.**
- **The motor control panels are old and parts are unavailable.** The motor control panels are almost 30 years old, and the manufacturer has said the parts are obsolete and no longer available according to City staff.
- **The distribution panels, circuit breakers, and conductors are almost 30 years old and have reached the end of their lifespan.**
- **There currently is no way to monitor the water level in the HGMH or how much flow recirculates through the HGMH back to this pump station.**
- **The grating platform in the dry well is old.** The existing grating is all original and almost 60 years old. City staff have indicated they would like the grating platform replaced since it is deformed in places and the grating hatch (to the dry well lower level) can be difficult to open and close.



Existing PS 20 dry well grating (left). PS 20 below-grade, on-site diesel generator (right).

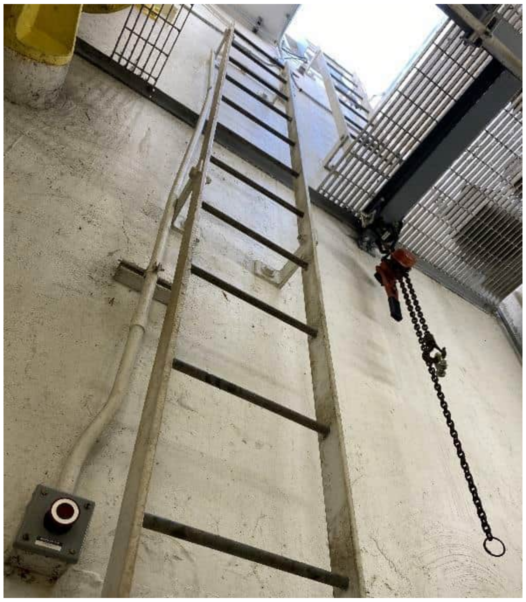
Other Observations

The following observations were made for PS 20 based on the City's feedback and observations during the site visit.

- The PS site is easily accessible from 85th Avenue SE.
- Due to the PS's proximity to Lake Washington which has its controlled by the Ballard Locks, the site should not be susceptible to localized flooding. There is a gentle slope to the PS (and lakeshore) from 85th Avenue SE. There did not appear to be any noticeable site impacts due to surface water runoff.
- There are grass, trees, and bushes at the PS site, but none of the nearby vegetation notably limits site access.
- The PS is approximately 40 feet from nearest residence based on available GIS data.
- The exterior concrete that was visible appears to be in acceptable condition with some signs of wear and aesthetic/non-structural damage including, but not limited to, small pieces of concrete that have "chipped off."
- There were no noticeable signs of active infiltration in the wet well. The wet well should be further evaluated during construction, once the temporary bypass is in place and the wet well has been drained. Then a more accurate evaluation of the wet well infiltration can be made.

- There were no noticeable signs of active infiltration in the dry well due to cracks in the concrete.
- The pump station's lighting, flooring, ventilation, and fire/safety detectors all appear to be in good condition.
- The dry well's access hatch and ladder appear to be in good condition.

PS 20 site and wet well and dry well access (left).



Existing PS 20 lighting (left). Existing condition of PS 20 dry well access ladder (right).

Recommended Improvements

RH2 recommends the following improvements for PS 20 based on the City's feedback, observations during the site visit, and PS evaluations. These recommended improvements are outlined in **Appendix H**. These improvements are prioritized based on the priority rankings listed in the **Establishing Replacement Priorities** section of this Report.

Priority 1 Improvements

- Replace all three pumps to address the deficiencies. Install VFDs on all the pumps. VFD low rates can better control flow rates to match influent flows to reduce pump cycling and flow recirculation that may occur at the HGMH.
- Replace all the mechanical fittings and piping in the dry well to address the valve deficiencies. Replace the gate valves with plug valves, which are typically preferred in wastewater applications.
    - Flows at this sewer PS will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.
    - After the initial evaluation of PS 20 was completed, all the check valves were replaced at this PS. The replacement of these check valves is not reflected in the evaluations or cost estimates contained in this Report.
- Rehabilitate the wet well structure (walls, floor, and ceiling) and coat the inside of the wet well with a lining system that will reduce the rate of concrete corrosion and extend the life of the existing wet well structure. The concrete wet well walls, floor, and ceiling should be restored to their original thickness and resurfaced. First, remove any spalling concrete and prepare the surface of the concrete and any exposed rebar in accordance with the selected rehabilitation product's installation procedures. Further evaluation of the rebar condition should be further evaluated. The recommended approach is to assess the condition of the rebar prior to construction to minimize change orders during construction. However, the rebar condition assessment will require temporary pumping by the City in order to access the existing wet well safely. If the rebar has corroded too much, it may be necessary to install new rebar to replace the missing rebar or implement similar measures.
    - If new rebar needs to be installed, precautions should be taken for cathodic protection of the new rebar, such as installing anodes with the new rebar.
    - Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.
- Replace the motor control panels to address the deficiencies with the pumps. Install new motor control panels that would contain modern, readily available parts. Additionally, installing VFDs concurrently with the replacement pumps as described previously would allow for better flow control and reduce pump cycling. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.
- Replace the electrical distribution equipment, including the service disconnect, distribution panels, circuit breakers, lighting transformer, and conductors serving the station. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.

Priority 2 Improvements

- Install a flow meter on the force main header and pressure gauges on piping near the pump discharges to enhance the City's ability to evaluate the capacity of the pumps and if the pumps may be in need of maintenance, such as deragging. A flow meter also will be useful to evaluate infiltration and inflow from upstream sewers or breached lake lines. Connect the flow meter and pressure transducers to the City's telemetry system so they can be monitored remotely.
- Remove the wet well ladder. If a new ladder is desired by City staff, install a FRP ladder, which is better suited for the wet well environment.

Priority 3 Improvements

- Install a wet well vent with an in-line carbon filter on the exhaust/intake for odor control to allow better air discharge and supply for the wet well. The carbon media will need to be replaced on a recurring interval when the media is expended.
- Install a level sensor in the HGMH so the water level in the HGMH can be measured and the amount of recirculated flow can be estimated at this PS.
- Replace the existing grating platform in the dry well with new FRP grating.

Additional Improvements

- In order to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well), a temporary sewer bypass will be needed to take the existing PS offline. One option to accomplish this bypass is outlined as follows and as shown in **Appendix H**:
    - Install an access hatch or maintenance hole lid (through the top of the wet well and near the influent lake line). This will allow the temporary bypass pump suction piping to be installed from the upstream lake line to the outside of the wet well.
    - Install the temporary bypass pumps on site. Place the bypass pumps on land if viable based on site accessibility and if adjacent homeowners agree. Otherwise, place the bypass pumps on a barge. Cost estimates shown in **Appendix G** assume a barge will be used for installation.
    - Construct a temporary sound wall or enclosure on site to reduce the amount of noise the adjacent homeowners are exposed to by these pumps. Whether the bypass pumps are electrical or diesel powered, they will make a noticeable amount of noise and will operate continuously for an extended period of time. The temporary sound wall or enclosure should help mitigate noise complaints from adjacent property owners.
    - Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the bypass discharge in the portion of the lake line that is connected to the HGMH. A discharge header is recommended near the HGMH so multiple pumps can be utilized for the temporary bypass system.

  - Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or maintenance hole lid) and connect the piping to a flow-thru plug installed in the upstream lake line pipe. A suction header is recommended in the wet well so multiple pumps can be utilized for the temporary bypass system.
  - Prior to implementing this sewer bypass, it is recommended to evaluate the condition of the lake line adjacent to this PS to determine if this part of the lake line is in sufficient condition to accommodate the bypass system.
- An additional temporary sewer bypass will be needed to redirect flows from the upland sewer system prior to taking the existing PS offline to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well, similar to the sewer bypass). One option to accomplish this bypass would be to install a temporary flow-thru plug in upstream gravity sewer main and a bypass pump in the HGMH for temporary bypass pumping of the upland sewer system. Wastewater could then be pumped from the HGMH gravity inlet to the pipe in HGMH that is connected to the lake line. This option for the upland sewer bypass is outlined in **Appendix H**.

Estimated Project Cost of Recommended PS 20 Improvements

RH2 estimates that the total project cost of the PS 20 recommended improvements for PS 20 is approximately $5.3 million. This cost assumes a barge will be needed for construction of some of these improvements, including staging for the bypass pumps. A summary of this estimate is provided in **Appendix G**.

RH2 estimates that design for these recommended improvements would take approximately 9 months to complete. Since this PS is located in close proximity to Lake Washington, permitting for these recommended improvements is estimated to take 4 to 12 months, depending on exemption applicability and permitting requirements. Permitting could be completed in parallel with design of the recommended improvements.

PS 21 Deficiencies and Recommendations

Observed Deficiencies

The following deficiencies were identified for PS 21 based on the City's feedback, observations during the site visit, and the pump station evaluations.

- **The pumps are in poor condition and have excessive vibration.** The determined pumping capacity for each pump from the pump tests are less than the design pump capacity. The pumps are almost 30 years old and rag multiple times per year. According to the PumpTech Service Report(s), vibration readings taken during the site visit on Pumps 1 and 2 exceeded the lateral vibration limit for continuous operation.
- **Valves are old and in poor condition.** The gate and check valves are all original and almost 60 years old. The gate valves are prone to breaking, and one of the check valves needs to be replaced. Additionally, the paint is peeling on the piping in the dry well.

Photo of PS 21 pumps, valves, and fittings on dry well lower level.

- **There is no flow meter or pressure gauge.** There is no way to monitor pumped flow rates or discharge pressures for the pumps.
- **The concrete in the wet well is in poor condition.** The concrete in the wet well is showing signs of corrosion.

Photos of PS 21 wet well concrete condition.

- **The wet well access ladder is in poor condition.** The ladder in the wet well has corroded noticeably.

Photo of PS 21 wet well ladder.

- **The wet well does not have a properly operating vent to allow air discharge and supply.** According to City staff, the sand filter for the ventilation system has failed. Due to the lack of a properly operating vent supply, the wet well maintenance hole lid can be difficult to open at times when the pumps are running according to City staff.
- **Odor complaints.** According to City staff, adjacent residents complain about odor from this PS.
- **The wood decking on the dock is showing signs of rotting.**

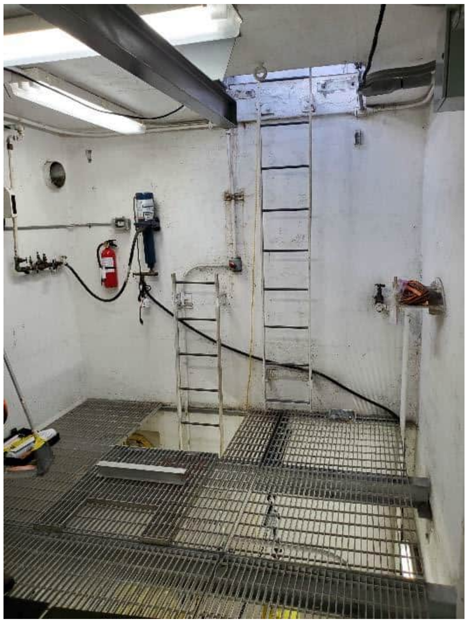
Photos of dock on top of PS 21.

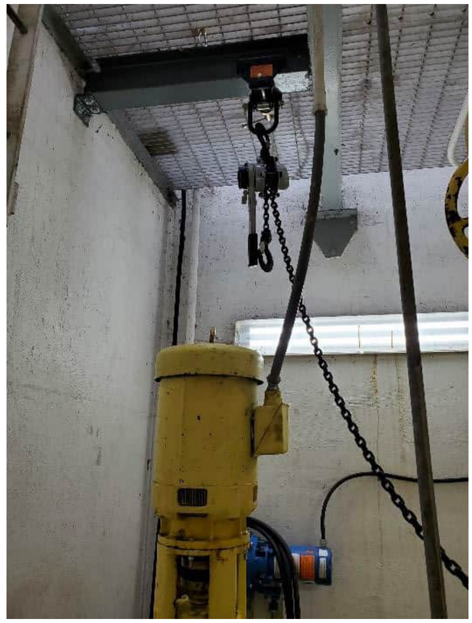
- **The motor control panels are old and parts are unavailable.** The motor control panels are almost 30 years old, and the manufacturer has said the parts are obsolete and no longer available according to City staff.

- **The distribution panels, circuit breakers, and conductors are almost 30 years old and have reached the end of their lifespan.**
- **The water level in the HGMH cannot be monitored and cannot measure how much flow recirculates through the HGMH back to this PS.**
- **This PS has a 3-phase converter in a panel near the generator.** Only two phases of overhead power from Puget Sound Every (PSE) serve this PS.

PS 21 upland generator access (left). PS 21 existing Cummins generator ATS (right).

- **The grating platform in the dry well is old.** The existing grating is all original and almost 60 years old. City staff have indicated they would like the grating platform replaced since it is deformed in places and the grating hatch (to the dry well lower level) can be difficult to open and close.





Existing PS 21 dry well grating and ladders (left). Existing PS 21 lighting in dry well (right).

Other Observations

The following observations were made for PS 21 based on the City's feedback and observations during the site visit.

- The PS site is easily accessible through the driveway at 7964 E Mercer Way.
- Due to the PS's proximity to Lake Washington which has its controlled by the Ballard Locks, the site should not be susceptible to localized flooding. The PS is in the lake but has a gentle slope to the PS (and lakeshore) from the access point. There did not appear to be any noticeable site impacts due to surface water runoff.
- There are grass and bushes at the PS site and trees nearby, but none of the nearby vegetation notably impacts site access.
- The PS is approximately 70 feet from nearest residence based on available GIS data.
- The exterior concrete that was visible appears to be in acceptable condition with some signs of wear and aesthetic/non-structural damage including, but not limited to, small pieces of concrete that have "chipped off."
- There were no noticeable signs of active infiltration in the wet well. The wet well should be further evaluated during construction, once the temporary bypass is in place and the wet well has been drained. Then a more accurate evaluation of the wet well infiltration can be made.
- There were no noticeable signs of active infiltration in the dry well due to cracks in the concrete.
- The PS has a concrete dock (the PS concrete structure) with wood decking on top. The City's deed for the PS 21 site is included in **Appendix I**.

- The existing entry hatches, dry well ladder, flooring, lighting, ventilation, and fire/safety detectors for the pump station appear to be in good condition.


PS 21 dock access from 8002 Avalon Place (left). PS 21 dry well access hatch (right).

Recommended Improvements

RH2 recommends the following improvements for PS 21 based on the City's feedback, observations during the site visit, and the pump station evaluations. These recommended improvements are outlined in **Appendix H**. These improvements are prioritized based on the priority rankings listed in the **Establishing Replacement Priorities** section of this Report.

Priority 1 Improvements

- Replace all three pumps to address the deficiencies with the pumps. Install VFDs on all the pumps. VFDs can better control flow rates to match influent flows to reduce pump cycling and flow recirculation that may occur at the HGMH.
- Replace all the mechanical fittings and piping in the dry well to address the valve deficiencies. Replace the gate valves with plug valves, which are typically preferred in wastewater applications.
  - Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.
  - After the initial evaluation of PS 21 was completed, all the check valves were replaced at this PS. The replacement of these check valves is not reflected in the evaluations or cost estimates contained in this Report.
- Rehabilitate the wet well structure (walls, floor, and ceiling) and coat the inside of the wet well with a lining system that will reduce the rate of concrete corrosion and extend the life of the existing wet well structure. The concrete wet well walls, floor, and ceiling should be restored to their original thickness and resurfaced. First, remove any spalling

concrete and prepare the concrete surface and any exposed rebar in accordance with the selected rehabilitation products' installation procedures. The rebar condition should be further evaluated. The recommended approach is to assess the condition of the rebar prior to construction to minimize change orders during construction. However, the rebar condition assessment will require temporary pumping by the City to access the existing wet well safely. If the rebar has corroded too much, it may be necessary to install new rebar to replace the missing rebar or implement similar measures.

  - If new rebar needs to be installed, precautions should be taken for cathodic protection of the new rebar, such as installing anodes with the new rebar.
  - Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.

- Install a wet well vent with an in-line carbon filter on the exhaust/intake for odor control to allow better air discharge and supply for the wet well. This improvement should allow the wet well maintenance hole lid to be opened when the pumps are running and may reduce odor complaints from adjacent residents. The carbon media will need to be replaced on a recurring interval when the media is expended.
- Replace the motor control panels to address the deficiencies with the pumps. Install new motor control panels that would contain modern, readily available parts. Additionally, installing VFDs concurrently with replacement pumps as described previously would allow for better flow control and reduce pump cycling. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.
- Replace the electrical distribution equipment, including the service disconnect, distribution panels, circuit breakers, lighting transformer, and conductors serving the station. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.

Priority 2 Improvements

- Install a flow meter on the force main header and pressure gauges on piping near the pump discharges to enhance the City's ability to evaluate the capacity of the pumps and determine if the pumps may be in need of maintenance, such as unclogging. Connect the flow meter and pressure transducer to the City's telemetry system so they can be monitored remotely.
- Remove the wet well ladder. If a new ladder is desired by City staff, install a FRP ladder, which is better suited for the wet well environment.

Priority 3 Improvements

- Replace the wood decking for the dock on top of the PS to provide safer access to the PS and for adjacent residents who may use this dock.
- Install a level sensor in the HGMH so the water level in the HGMH can be measured and the amount of recirculated flow can be estimated.

- Replace the existing grating platform in the dry well with new FRP grating.

Additional Improvements

- In order to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well), a temporary sewer bypass will be needed to take the existing pump station offline. One option to accomplish this bypass is outlined as follows and as shown in **Appendix H**:
    - Install an access hatch or maintenance hole lid (through the top of the wet well and near the influent lake line). This will allow the temporary bypass pump suction piping to be installed from the upstream lake line to the outside of the wet well.
    - Install the temporary bypass pumps on site. Place the bypass pumps on land if viable based on site accessibility and if adjacent homeowners agree. Otherwise, place the bypass pumps on a barge.
    - Construct a temporary sound wall or enclosure on site to reduce the amount of noise the adjacent homeowners are exposed to by these pumps. Whether the bypass pumps are electrical or diesel powered, they will make a noticeable amount of noise and will operate continuously for an extended period of time. The temporary sound wall or enclosure should help mitigate noise complaints from adjacent property owners.
    - Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the bypass discharge in the portion of the lake line that is connected to the HGMH. A discharge header is recommended near the HGMH so multiple pumps can be utilized for the temporary bypass system.
    - Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or maintenance hole lid) and connect the piping to a flow-through plug installed in the upstream lake line pipe. A suction header is recommended in the wet well so multiple pumps can be utilized for the temporary bypass system.
    - Prior to implementing this sewer bypass, it is recommended to evaluate the condition of the lake line adjacent to this PS to determine if this part of the lake line is in sufficient condition to accommodate the bypass system.
- To determine the feasibility of installing 3-phase power to the PS to eliminate the existing phase converter, further investigation and coordination with PSE is required. Costs for this type of improvement are highly variable and depend directly on design plans developed by PSE.

Estimated Project Cost of Recommended PS 21 Improvements

RH2 estimates that the total project cost of the PS 21 recommended improvements is approximately $5.2 million. This cost assumes a barge will be needed for construction of some of these improvements, including staging for the bypass pumps. A summary of this estimate is provided in **Appendix G**.

RH2 estimates that design for these recommended improvements would take approximately 9 months to complete. Since this PS is located in close proximity to Lake Washington, permitting for these recommended improvements is estimated to take 4 to 18 months, depending on exemption applicability and permitting requirements. Permitting could be completed in parallel with design of the recommended improvements.

PS 22 Deficiencies and Recommendations

Observed Deficiencies

The following deficiencies were identified for PS 22 based on the City's feedback, observations during the site visit, and the PS evaluations.

- **The pumps are in poor condition.** The determined pumping capacity for each pump from pump tests are less than the design pump capacity. The pumps are almost 30 years old and clog multiple times per year. According to the PumpTech Service Report, vibration readings taken during the site visit on Pump 1 are elevated, and one reading is above Hydraulic Institute's limit.
- **The valves are old and in poor condition.** The gate and check valves are all original and almost 60 years old. The valves do not operate properly and sometimes leak. Additionally, the paint is peeling on the piping in the dry well.

Photo of PS 22 pumps, valves, and fittings on dry well lower level.

- **There is no flow meter or pressure gauge.** There is not enough straight piping to install a meter and accurately monitor pumped flow rates or discharge pressures for the pumps.
- **The pressure data logger readings fluctuated.** The baseline static pressure data loggers readings fluctuated in a daily recurring pattern and were lower at night (from approximately 10:00 p.m. to approximately 3:00 a.m.), as shown in the charts in **Appendix A**). This could be due to the hydraulic conditions in the lake line changing, such as grit or air pockets accumulating in the lake line and then being flushed out when there is enough flow to scour this grit or purge this air from the lake line.

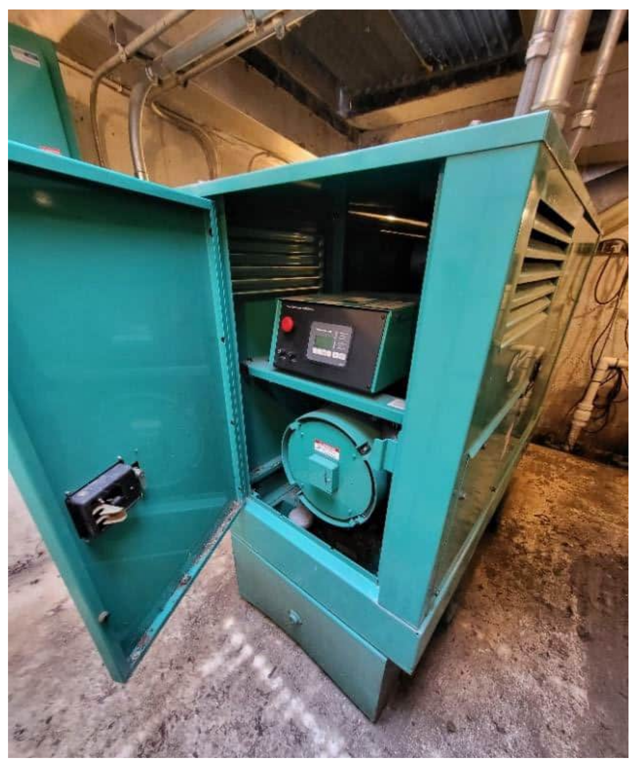
- **The flushing system is old and not in operation.** The plug and gate valves are original and almost 60 years old. The air actuator for the flush valves has failed, and the City made the plug valve inoperable over 15 years ago. The actuator and the plug valve need to be replaced.
- **The concrete in the wet well is in poor condition.** The concrete in the wet well is showing signs of corrosion.


Photos of PS 22 wet well concrete condition.

- **The wet well access ladder is in poor condition.** The ladder in the wet well has corroded noticeably.

Photo of PS 22 wet well ladder.

- **The wet well does not have a vent to allow air discharge and supply.** The lid may not be able to be removed when this occurs.
- **The motor control panels are old and parts are unavailable.** The motor control panels are almost 30 years old, and the manufacturer has said the parts are obsolete and no longer available according to City staff.
- **The distribution panels, circuit breakers, and conductors are almost 30 years old and have reached the end of their lifespan.**
- **There is an electrical switch next to the wet well cover** that is powered but does not operate any equipment in the dry well and its use is unknown. This switch is in a poor location, does not comply with the current National Electrical Code, and is not rated for outdoor use.
- **The wet well pressure transducer level sensor is in a poor location.** The level sensor is in a location that is difficult to access and requires wet well entry for maintenance.
- **There is currently no way to monitor the water level in the HGMH or how much flow recirculates through the HGMH back to this pump station**
- **The grating platform in the dry well is old.** The existing grating is all original and almost 60 years old. City staff have indicated they would like the grating platform replaced since it is deformed in places and the grating hatch (to the dry well lower level) can be difficult to open and close.

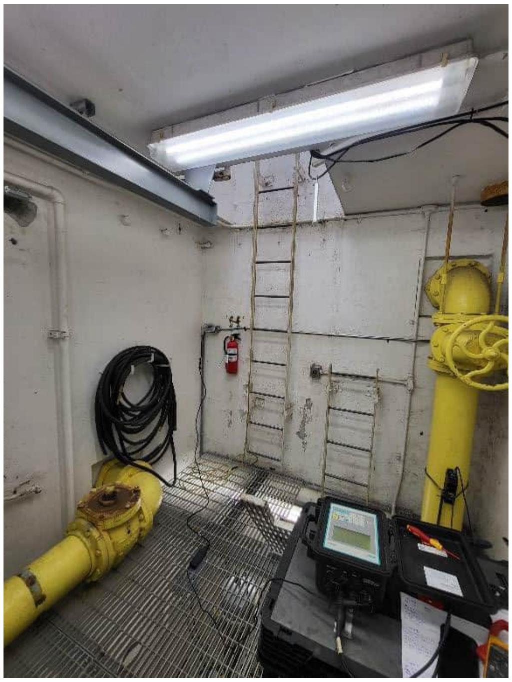
PS 22 exterior electrical switch (left). PS 22 existing below-grade generator (right).

Other Observations

The following observations were made for PS 22 based on the City's feedback and observations during the site visit.

- The PS site is easily accessible through the driveway to 6226 E Mercer Way.
- Due to the PS's proximity to Lake Washington which has its controlled by the Ballard Locks, the site should not be susceptible to localized flooding. There is a mild slope at the PS. There did not appear to be any noticeable site impacts due to surface water runoff.
- There are grass and shrubs at the PS site. An adjacent shrub needs to continue being trimmed back to maintain access to the dry well access hatch and one of the dry well vents.
- The PS is approximately 25 feet from nearest residence based on available GIS data.
- The exterior concrete that was visible appears to be in acceptable condition.
- There were no noticeable signs of active infiltration in the wet well. The wet well should be further evaluated during construction, once the temporary bypass is in place and the wet well has been drained. Then a more accurate evaluation of the wet well infiltration can be made.
- There were no noticeable signs of active infiltration in the dry well due to cracks in the concrete.
- The wet well and dry well entrances, dry well ladder, lighting, flooring, ventilation, and fire/safety detectors all appear to be in good condition.

PS 22 site on grassy slope.

PS 22 lighting and existing dry well grating (left). PS 22 dry well access hatch (right).

Recommended Improvements

RH2 recommends the following improvements for PS 22 based on the City's feedback, observations during the site visit, and PS evaluations. These recommended improvements are outlined in **Appendix H**. These improvements are prioritized based on the priority rankings listed in the **Establishing Replacement Priorities** section of this Report.

Priority 1 Improvements

- Replace all three pumps to address the deficiencies. Install VFDs on all the pumps. VFDs can better control flow rates to match influent flows to reduce pump cycling and flow recirculation that may occur at the HGMH.
- Replace all the mechanical fittings and piping in the dry well to address the valve deficiencies. Replace the gate valves with plug valves, which are typically preferred in wastewater applications.
    - Flows at this PS will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.
- Rehabilitate the wet well structure (walls, floor, and ceiling) and coat the inside of the wet well with a lining system that will reduce the rate of concrete corrosion and extend the life of the existing wet well structure. The concrete wet well walls, floor, and ceiling should be restored to their original thickness and resurfaced. First, remove any spalling concrete and prepare the concrete surface and any exposed rebar in accordance with the selected rehabilitation product's installation procedures. Further evaluation of the rebar condition should be further evaluated. The recommended approach is to assess the condition of the rebar prior to construction to minimize change orders during

construction. However, the rebar condition assessment will require temporary pumping by the City to access the existing wet well safely. If the rebar has corroded too much, it may be necessary to install new rebar to replace the missing rebar or implement similar measures.

- If new rebar needs to be installed, precautions should be taken for cathodic protection of the new rebar, such as installing anodes with the new rebar.
- Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.

- Replace the motor control panels to address the deficiencies with the pumps. Install new motor control panels that would contain modern, readily available parts. Additionally, installing VFDs concurrently with replacement pumps as described previously would allow for better flow control and reduce pump cycling. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.
- Replace the electrical distribution equipment, including the service disconnect, distribution panels, circuit breakers, lighting transformer, and conductors serving the PS. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.
- The electrical switch next to the wet well cover needs to be relocated or abandoned once its use is identified.

Priority 2 Improvements

- Install a flow meter on the force main header and pressure gauges on piping near the pump discharges to enhance the City's ability to evaluate the capacity of the pumps and if the pumps may be in need of maintenance, such as deragging. A flow meter also will be useful to evaluate infiltration and inflow from upstream sewers or breached lake lines. In addition, connect the flow meter and pressure transducers to the City's telemetry system so they can be monitored remotely.
- Remove the wet well ladder. If a new ladder is desired by City staff, install a FRP ladder, which is better suited for the wet well environment.

Priority 3 Improvements

- Install a wet well vent with an in-line carbon filter on the exhaust/intake for odor control to allow better air discharge and supply for the wet well. The carbon media will need to be replaced on a recurring interval when the media is expended.
- Replace the existing flushing valve with a plug valve (or butterfly valve) with an electronic actuator. Connect the flushing valve actuator to the City's telemetry system so it can be controlled and monitored remotely.
- Relocate the wet well pressure transducer level sensor closer to the wet well access hatch and ladder so that it is easier to access for maintenance.

- Install a level sensor in the HGMH so the water level in the HGMH can be measured and the amount of recirculated flow can be estimated at this PS.
- Replace the existing grating platform in the dry well with new FRP grating.

Additional Improvements

- In order to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well), a temporary sewer bypass will be needed to take the existing PS offline. One option to accomplish this bypass is outlined as follows and as shown in **Appendix H**:
    - Install an access hatch or maintenance hole lid (through the top of the wet well and near the influent lake line). This will allow the temporary bypass pump suction piping to be installed from the upstream lake line to the outside of the wet well.
    - Install the temporary bypass pumps on site. Place the bypass pumps on land if viable based on the site accessibility and if adjacent homeowners agree. Otherwise, place the bypass pumps on a barge. Cost estimates shown in **Appendix G** assume a barge will be used for installation.
    - Construct a temporary sound wall or enclosure on site to reduce the amount of noise the adjacent homeowners are exposed to by these pumps. Whether the bypass pumps are electrical or diesel powered, they will make a noticeable amount of noise and will operate continuously for an extended period of time. The temporary sound wall or enclosure should help mitigate noise complaints from adjacent property owners.
    - Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the bypass discharge in the portion of the lake line that is connected to the HGMH. A discharge header is recommended near the HGMH so multiple pumps can be utilized for the temporary bypass system.
    - Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or maintenance hole lid) and connect the piping to a flow-through plug installed in the upstream lake line pipe. A suction header is recommended in the wet well so multiple pumps can be utilized for the temporary bypass system.
    - Prior to implementing this sewer bypass, it is recommended to evaluate the condition of the lake line adjacent to this PS to determine if this part of the lake line is in sufficient condition to accommodate the bypass system.

Estimated Project Cost of Recommended PS 22 Improvements

RH2 estimates that the total project cost of the recommended PS 22 improvements is approximately $4.6 million. This cost assumes a barge will be needed for construction of some of these improvements, including staging for the bypass pumps. A summary of this estimate is provided in **Appendix G**.

RH2 estimates that design for these recommended improvements would take approximately 9 months to complete. Since this PS is located in close proximity to Lake Washington, permitting for these recommended improvements is estimated to take 4 to 12 months, depending on exemption applicability and permitting requirements. Permitting could be completed in parallel with design of the recommended improvements.

PS 23 Deficiencies and Recommendations

Observed Deficiencies

The following deficiencies were identified for PS 23 based on the City's feedback, observations during the site visit, and the PS evaluations.

- **The pumps are in poor condition.** The determined pumping capacity for each pump from pump tests are less than the design pump capacity. The pumps are almost 30 years old and clog multiple times per year. According to the PumpTech Service Report, one of the vibration readings taken on Pump 2 during the site visit was high enough to trigger a warning level and should be monitored.
- **The valves are old and in poor condition.** The gate and check valves are all original and almost 60 years old. The valves do not operate properly and sometimes leak. Additionally, the paint is peeling on the piping in the dry well.

Photo of PS 23 pumps, valves, and fittings on dry well lower level.

- **There is no flow meter or pressure gauge.** There is not enough straight piping to install a meter and accurately monitor pumped flow rates or discharge pressures for the pumps.
- **The concrete in the wet well is in poor condition.** The concrete in the wet well is showing signs of corrosion.

Photo of PS 23 wet well concrete condition.

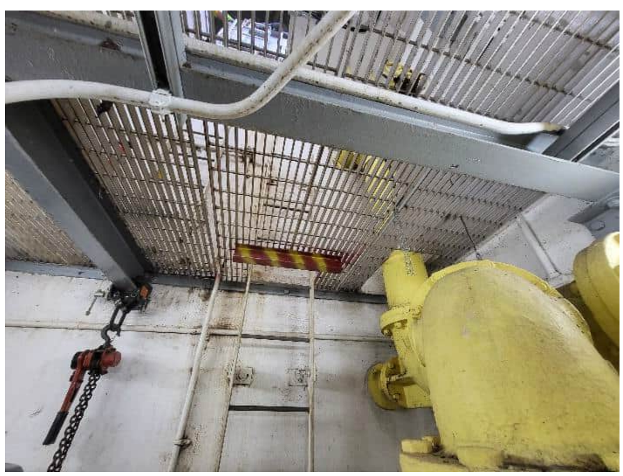
- **The wet well access ladder is in poor condition.** The ladder in the wet well has corroded noticeably.

Photo of PS 23 wet well ladder.

- **The wet well does not have a vent to allow air discharge and supply.**
- **The motor control panels are old and parts are unavailable.** The motor control panels are almost 30 years old, and the manufacturer has said the parts are obsolete and no longer available according to City staff.
- **The distribution panels, circuit breakers, and conductors are almost 30 years old and have reached the end of their lifespan.**

Existing PS 23 below-grade generator room.

- **There is currently no way to monitor the water level in the HGMH or how much flow recirculates through the HGMH back to this pump station.**
- **The grating platform in the dry well is old.** The existing grating is all original and almost 60 years old. The grating is deformed in places, and the grating hatch (to the dry well lower level) rubs against an electrical conduit when this hatch is opened and closed. City staff have indicated they would like the grating platform replaced since it is deformed in places and the grating hatch can be difficult to open and close.



Existing PS 23 dry well grating.

Other Observations

The following observations were made for PS 23 based on the City's feedback and observations during the site visit.

- The PS site is easily accessible through a parking area next to 5406 96th Avenue SE.
- Due to the PS's proximity to Lake Washington which has its controlled by the Ballard Locks, the site should not be susceptible to localized flooding. There is a gentle slope at

the PS towards the lakeshore from the access point. There did not appear to be any noticeable site impacts due to surface water runoff.

- There are grass and trees at the PS site, but none of the nearby vegetation notably limit site access.
- The PS is approximately 25 feet from nearest residence based on available GIS data.
- The exterior concrete that was visible appears to be in acceptable condition.
- There were no noticeable signs of active infiltration in the wet well. The wet well should be further evaluated during construction, once the temporary bypass is in place and the wet well has been drained. Then a more accurate evaluation of the wet well infiltration can be made.
- There were no noticeable signs of active infiltration in the dry well due to cracks in the concrete.
- PS 23’s existing entry hatches, dry well ladder, flooring, lighting, ventilation, and fire/safety detectors appear to be in good condition.

PS 23 wet well and dry well site and access.

PS 23 lighting in dry well (left). PS 23 dry well access hatch (left).

Recommended Improvements

RH2 recommends the following improvements for PS 23 based on the City's feedback, observations during the site visit, and the PS evaluations. These recommended improvements are outlined in **Appendix H**. These improvements are prioritized based on the priority rankings listed in the **Establishing Replacement Priorities** section of this Report.

Priority 1 Improvements

- Replace all three pumps to address the deficiencies with the pumps. Install VFDs on all the pumps. VFDs can be better control flow rates to match influent flows to reduce pump cycling and flow recirculation that may occur at the HGMH.
- Replace all the mechanical fittings and piping in the dry well to address the valve deficiencies. Replace the gate valves with plug valves, which are typically preferred in wastewater applications.
    - Flows at this PS will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the additional improvements section for this PS.
- Rehabilitate the wet well structure (walls, floor, and ceiling) and coat the inside of the wet well with a lining system that will reduce the rate of concrete corrosion and extend the life of the existing wet well structure. The concrete wet well walls, floor, and ceiling should be restored to their original thickness and resurfaced. First, remove any spalling concrete and prepare the concrete surface and any exposed rebar in accordance with the selected rehabilitation product's installation procedures. Further evaluation of the rebar condition should be further evaluated. The recommended approach is to assess the condition of the rebar prior to construction to minimize change orders during construction. However, the rebar condition assessment will require temporary pumping by the City to access the existing wet well safely. If the rebar has corroded too much, it

may be necessary to install new rebar to replace the missing rebar or implement similar measures.

- If new rebar needs to be installed, precautions should be taken for cathodic protection of the new rebar, such as installing anodes with the new rebar.
- Flows at this pump station will need to be bypassed for these improvements to be constructed. The bypass improvements are discussed later in the **Additional Improvements** section for this PS.

- Replace the motor control panels to address the deficiencies with the pumps. Install new motor control panels that would contain modern, readily available parts. Additionally, installing VFDs concurrently with replacement pumps as described previously would allow for better flow control and reduce pump cycling. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.
- Replace the electrical distribution equipment, including the service disconnect, distribution panels, circuit breakers, lighting transformer, and conductors serving the PS. This work could be performed when the pumps and valves are replaced so the temporary sewer bypass is available and no additional downtime would be required.

Priority 2 Improvements

- Install a flow meter on the force main header and pressure gauges on piping near the pump discharges to enhance the City's ability to evaluate the capacity of the pumps and if the pumps may be in need of maintenance, such as deragging. A flow meter also will be useful to evaluate infiltration and inflow from upstream sewers or breached lake lines. In addition, connect the flow meter and pressure transducers to the City's telemetry system so they can be monitored remotely.
- Remove the wet well ladder. If a new ladder is desired by City staff, install a FRP ladder, which is better suited for the wet well environment.

Priority 3 Improvements

- Install a wet well vent with an in-line carbon filter on the exhaust/intake for odor control to allow better air discharge and supply for the wet well. The carbon media will need to be replaced on a recurring interval when the media is expended.
- Install a level sensor in the HGMH so the water level in the HGMH can be measured and the amount of recirculated flow can be estimated at this PS.
- Replace the existing grating platform in the dry well with new FRP grating.

Additional Improvements

- In order to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well), a temporary sewer bypass will be needed to take the existing PS offline. One option to accomplish this bypass is outlined as follows and as shown in **Appendix H**:

- Install an access hatch or maintenance hole lid (through the top of the wet well and near the influent lake line). This will allow the temporary bypass pump suction piping to be installed from the upstream lake line to the outside of the wet well.
- Install the temporary bypass pumps on site. Place the bypass pumps on land if viable based on the site accessibility and if adjacent homeowners agree. Otherwise, place the bypass pumps on a barge. Cost estimates shown in **Appendix G** assume a barge will be used for installation.
- Construct a temporary sound wall or enclosure on site to reduce the amount of noise the adjacent homeowners are exposed to by these pumps. Whether the bypass pumps are electrical or diesel powered, they will make a noticeable amount of noise and will operate continuously for an extended period of time. The temporary sound wall or enclosure should help mitigate noise complaints from adjacent property owners.
- Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the bypass discharge in the portion of the lake line that is connected to the HGMH. A discharge header is recommended near the HGMH so multiple pumps can be utilized for the temporary bypass system.
- Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or maintenance hole lid) and connect the piping to a flow-through plug installed in the upstream lake line pipe. A suction header is recommended in the wet well so multiple pumps can be utilized for the temporary bypass system.
- Prior to implementing this sewer bypass, it is recommended to evaluate the condition of the lake line adjacent to this PS to determine if this part of the lake line is in sufficient condition to accommodate the bypass system.

- An additional temporary sewer bypass will be needed to redirect flows from the upland sewer system prior to taking the existing PS offline to construct some of these improvements (such as replacing the valves and pipes and rehabilitating the wet well, similar to the sewer bypass). One option to accomplish this bypass would be to install a temporary flow-thru plug in upstream gravity sewer main and a bypass pump in the HGMH for temporary bypass pumping of the upland sewer system. Wastewater could then be pumped from the HGMH gravity inlet to the pipe in HGMH that is connected to the lake line. This option for an upland sewer bypass is outlined in **Appendix H**.

Estimated Project Cost of Recommended PS 23 Improvements

RH2 estimates that the total project cost of the recommended PS 23 improvements is approximately $4.5 million. This cost assumes a barge will be needed for construction of some of these improvements, including staging for the bypass pumps. A summary of this estimate is provided in **Appendix G**.

RH2 estimates that design for these recommended improvements would take approximately 9 months to complete. Since this PS is located in close proximity to Lake Washington, permitting for these recommended improvements is estimated to take 4 to 12 months, depending on exemption applicability and permitting requirements. Permitting could be completed in parallel with design of the recommended improvements.

Capital Improvement Plan

Based on the results of the evaluation rankings and cost estimates, the City's proposed wastewater PS CIP for the PSs evaluated is shown in **Table 4**. An overall ranking of 1 is the PS most in need of rehabilitation.

Table 4

Proposed Wastewater PS CIP

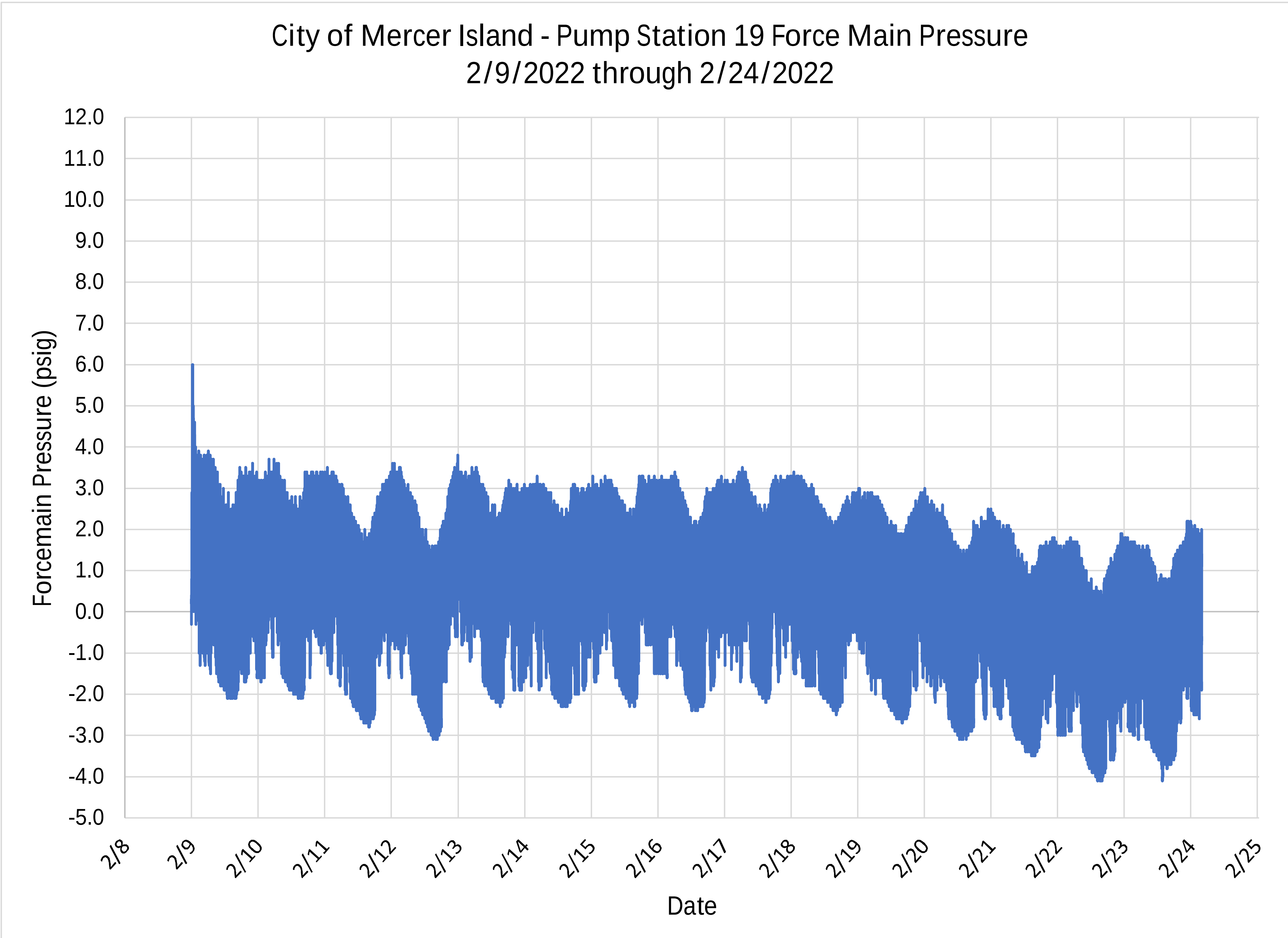
Sewer Pump Station No.	Total Estimated Project Cost	Overall Ranking	Priority 1 Estimated Cost	Priority 2 Estimated Cost	Priority 3 Estimated Cost
19	$5,695,000	3	$5,310,000	$58,000	$327,000
20	$5,270,000	1	$5,020,000	$59,000	$191,000
21	$5,150,000	2	$4,897,000	$59,000	$194,000
22	$4,615,000	4	$4,331,000	$50,000	$234,000
23	$4,520,000	5	$4,307,000	$50,000	$163,000
Total	$25,250,000	---	$23,865,000	$276,000	$1,109,000

Figures

Figure 1
Sewer System
General Sewer Plan
City of Mercer Island

Appendix A

Sewer Pump Station Pressure Charts



City of Mercer Island - Pump Station 19 Force Main Pressure
2/9/2022 through 2/24/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
2/8
2/9
2/10
2/11
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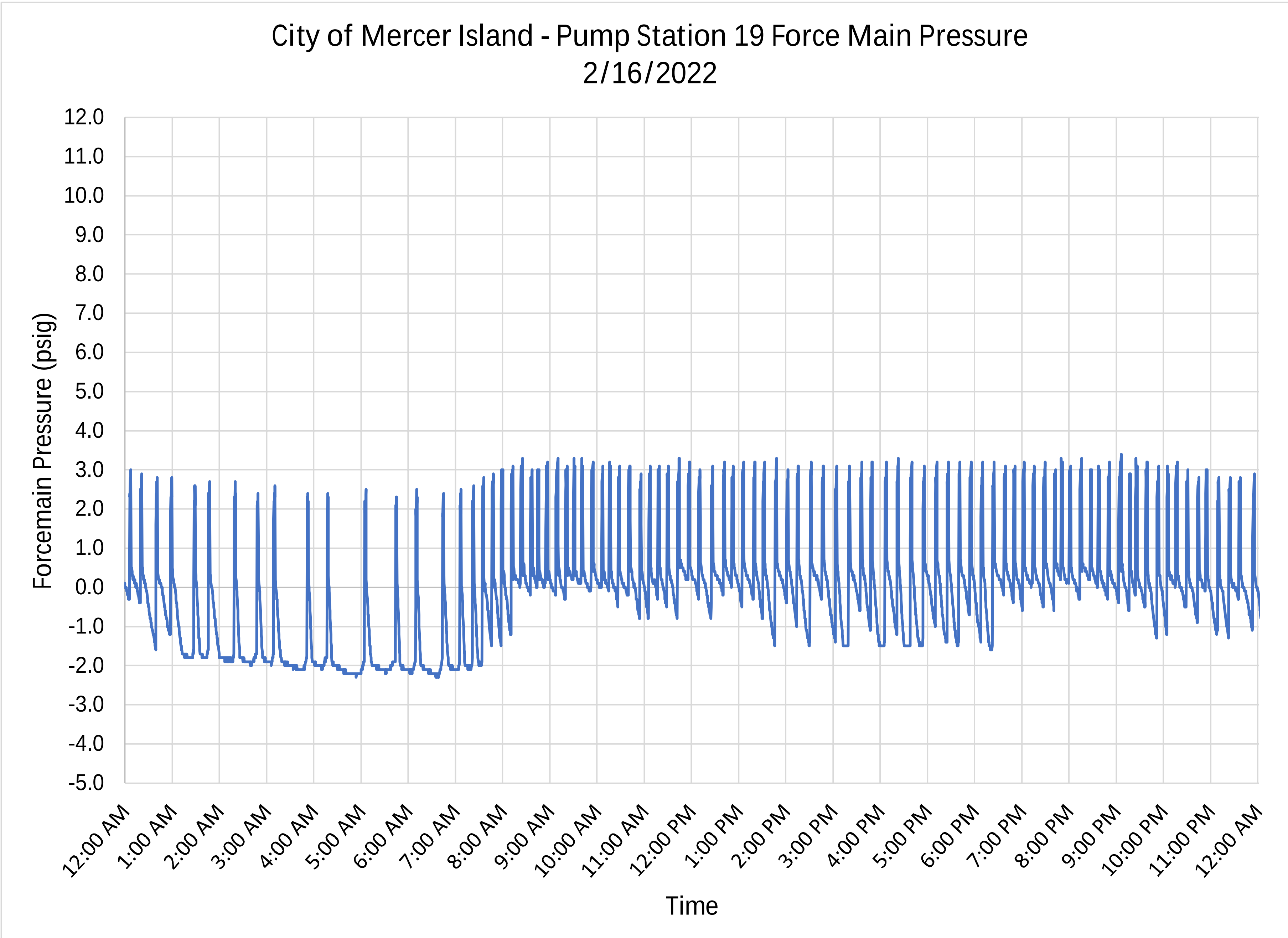
Date



City of Mercer Island - Pump Station 19 Force Main Pressure
2/16/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
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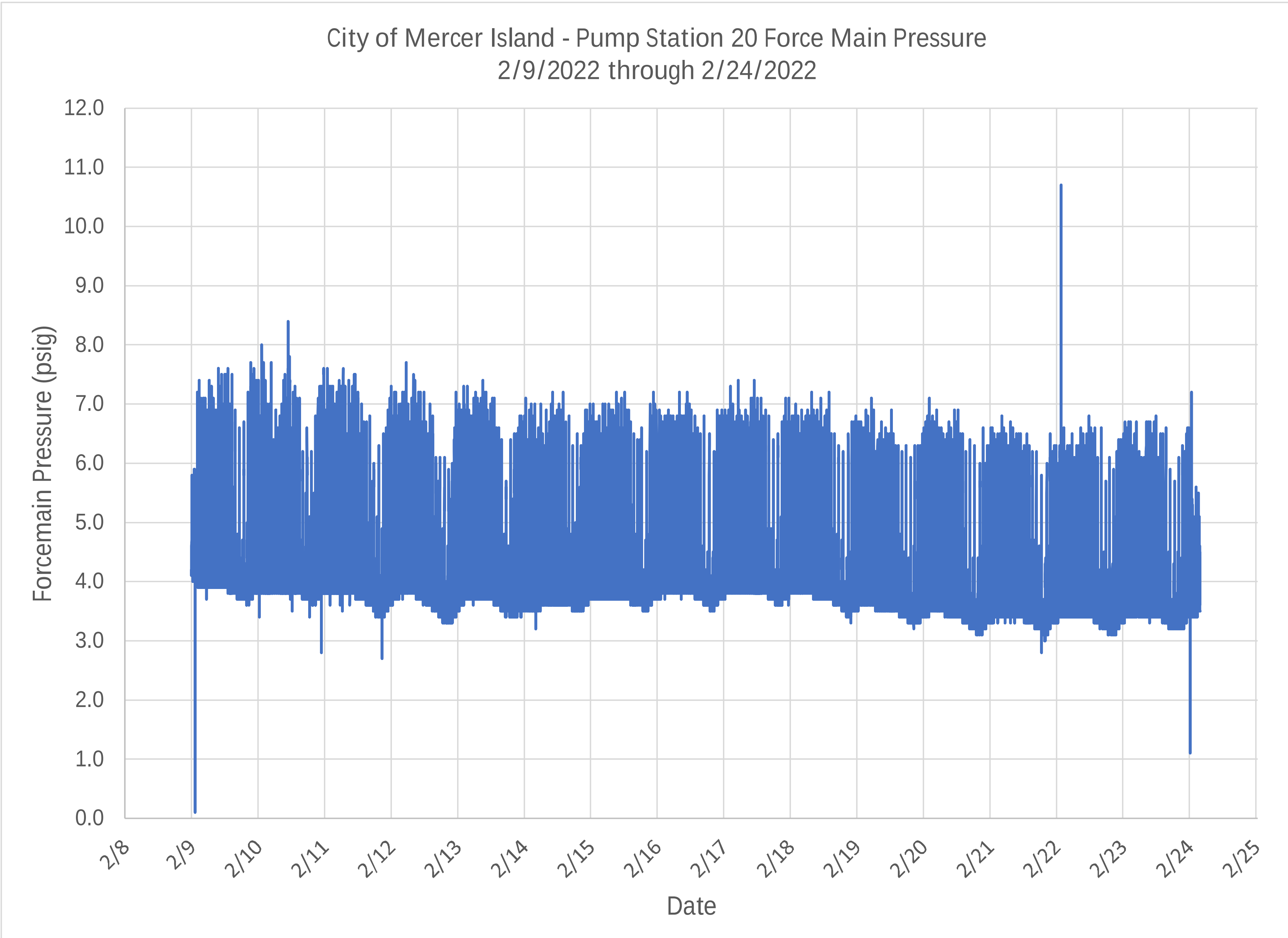
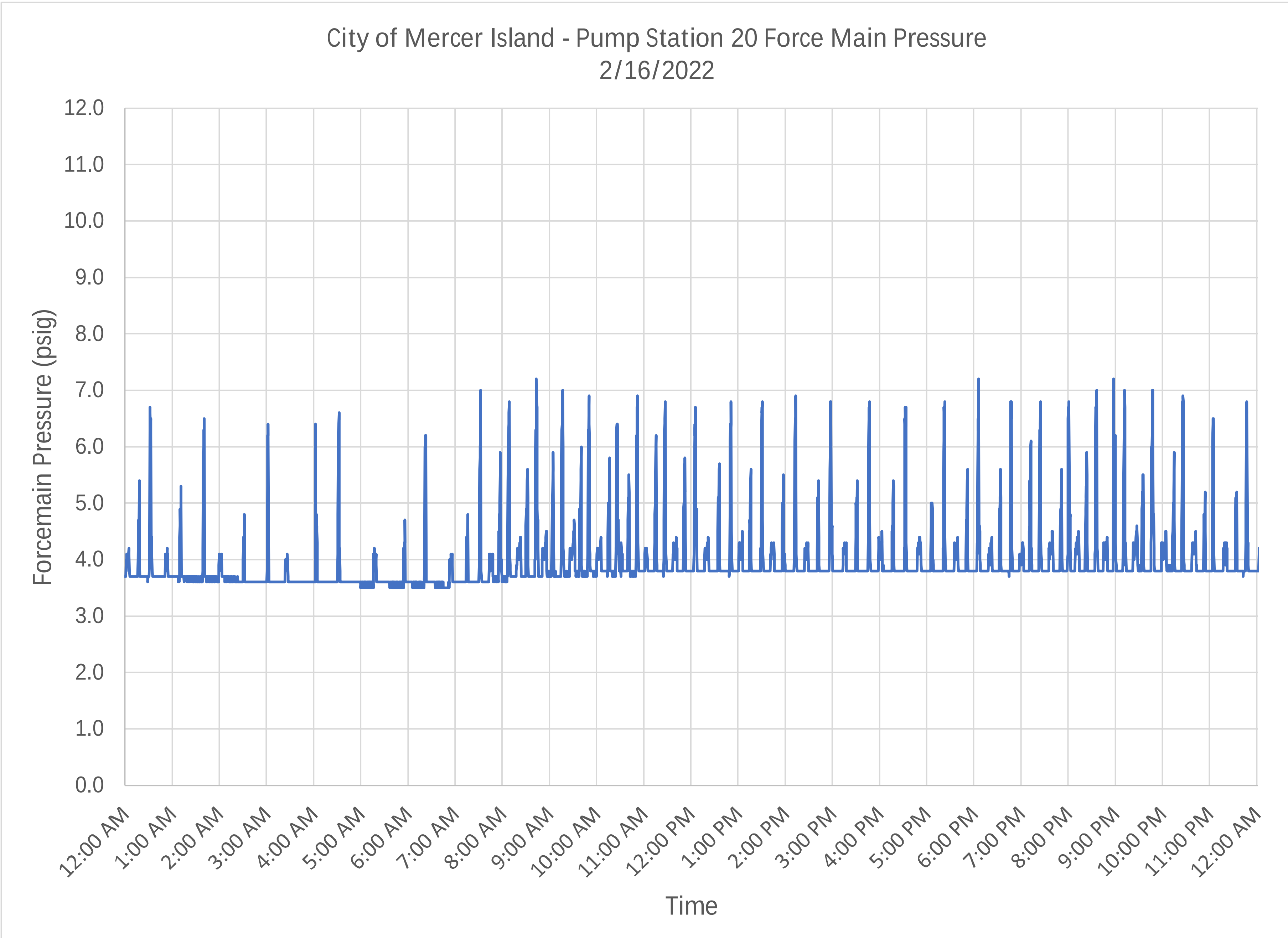
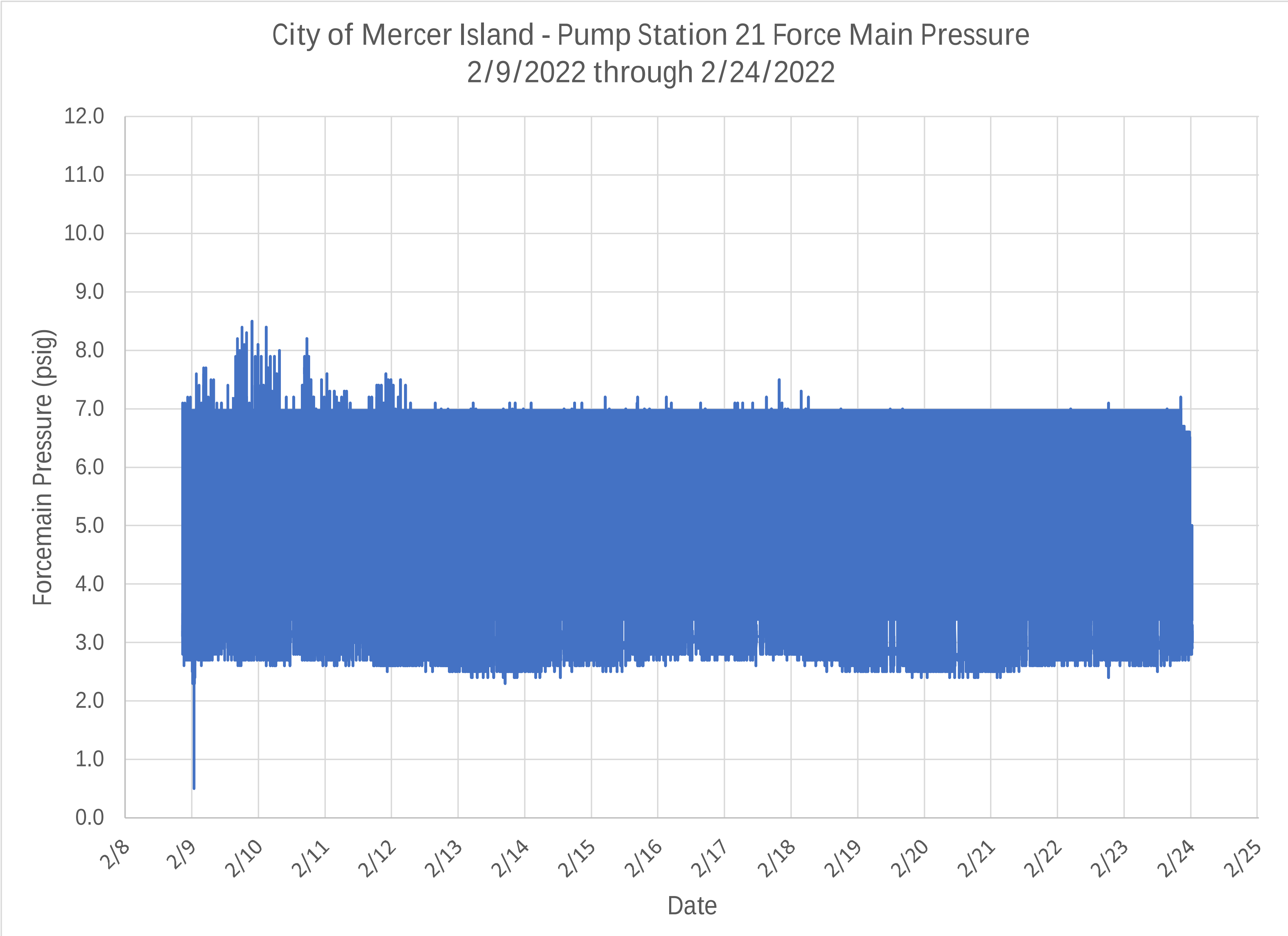
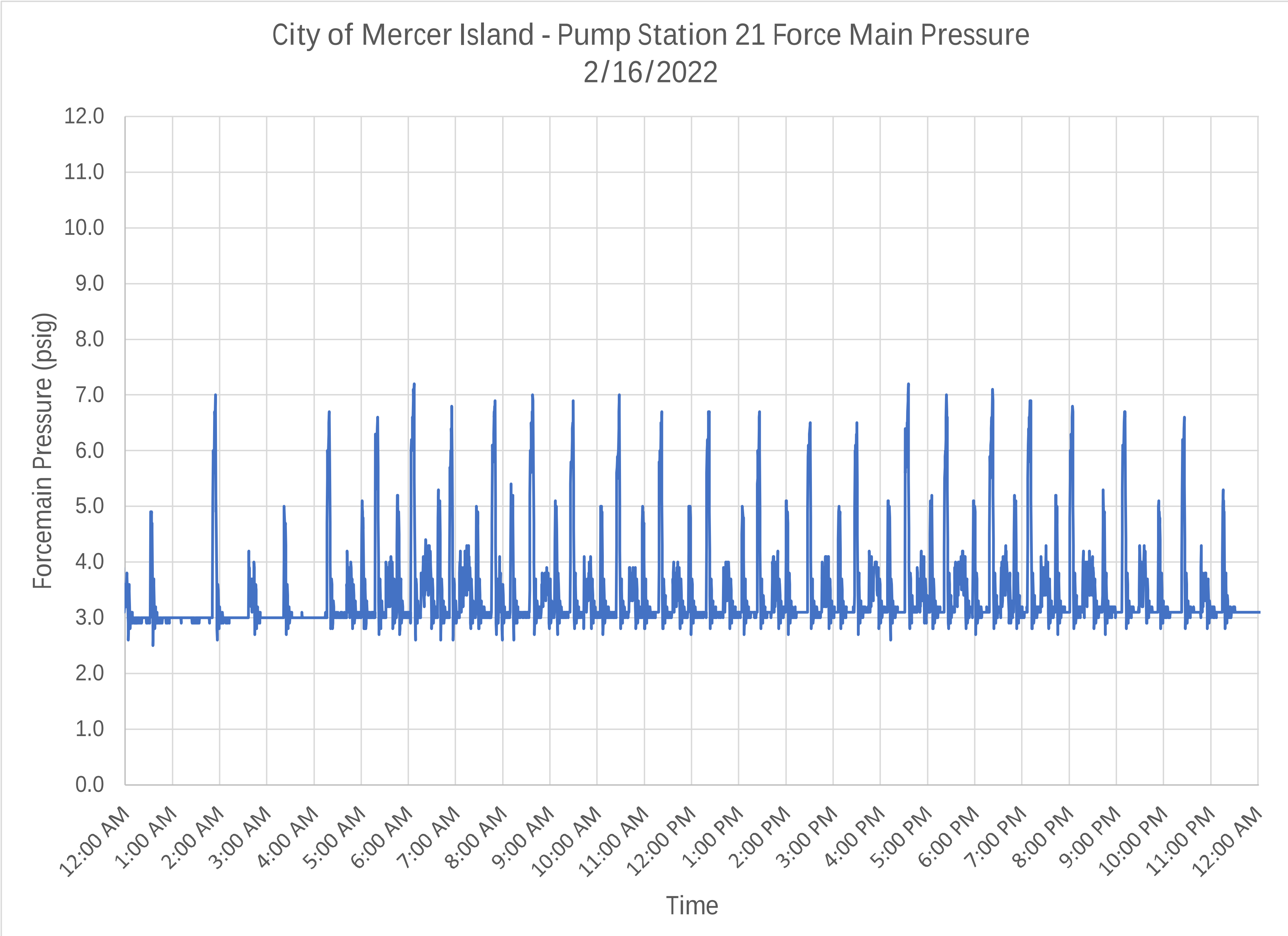
11:00 PM
12:00 AM
Time

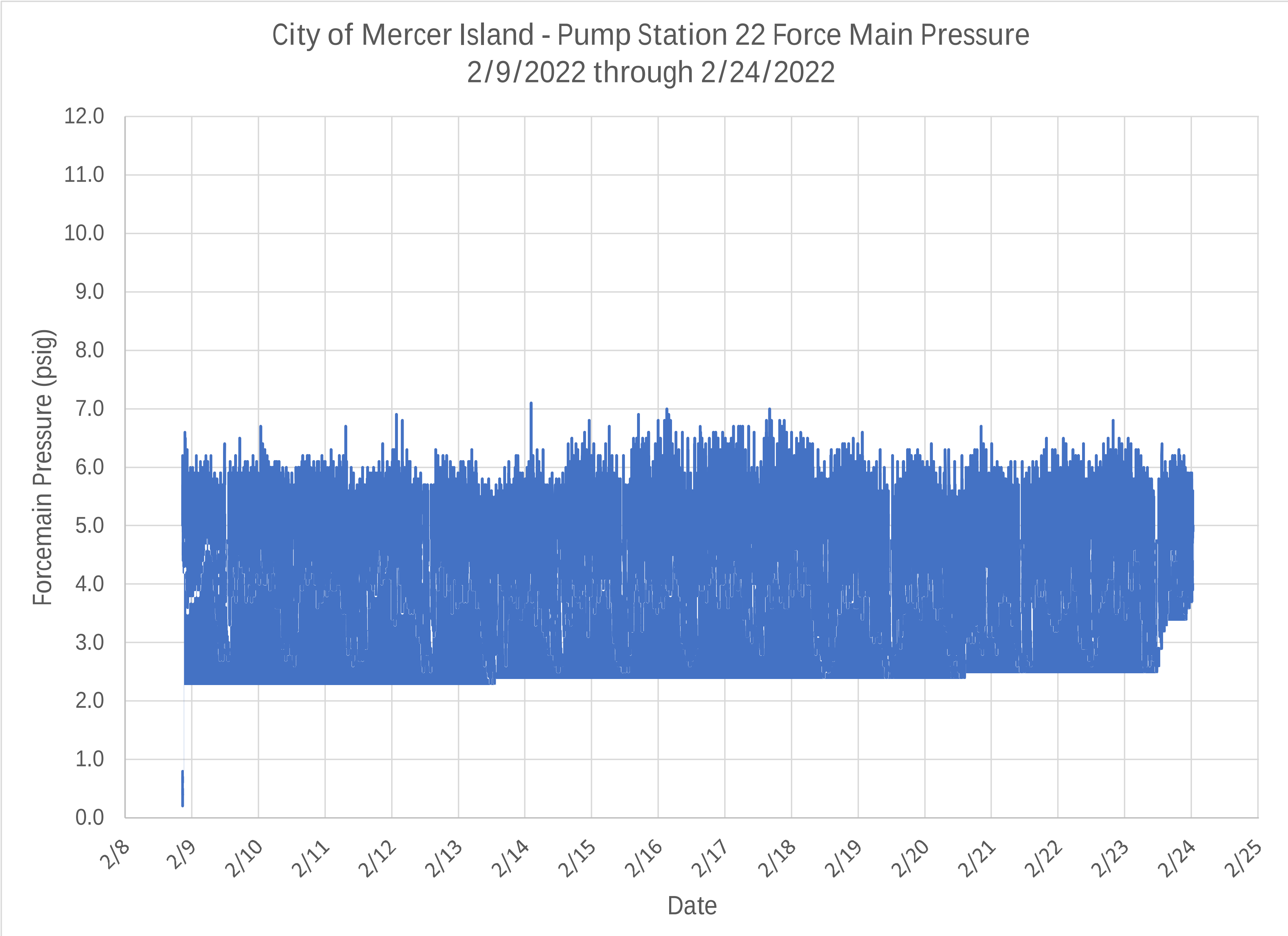

City of Mercer Island - Pump Station 20 Force Main Pressure
2/9/2022 through 2/24/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2/8
2/9
2/10
2/11
2/12
2/13
2/14
2/15
2/16
2/17
2/18
2/19
2/20
2/21
2/22
2/23
2/24
2/25
Date


City of Mercer Island - Pump Station 20 Force Main Pressure
2/16/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
Time

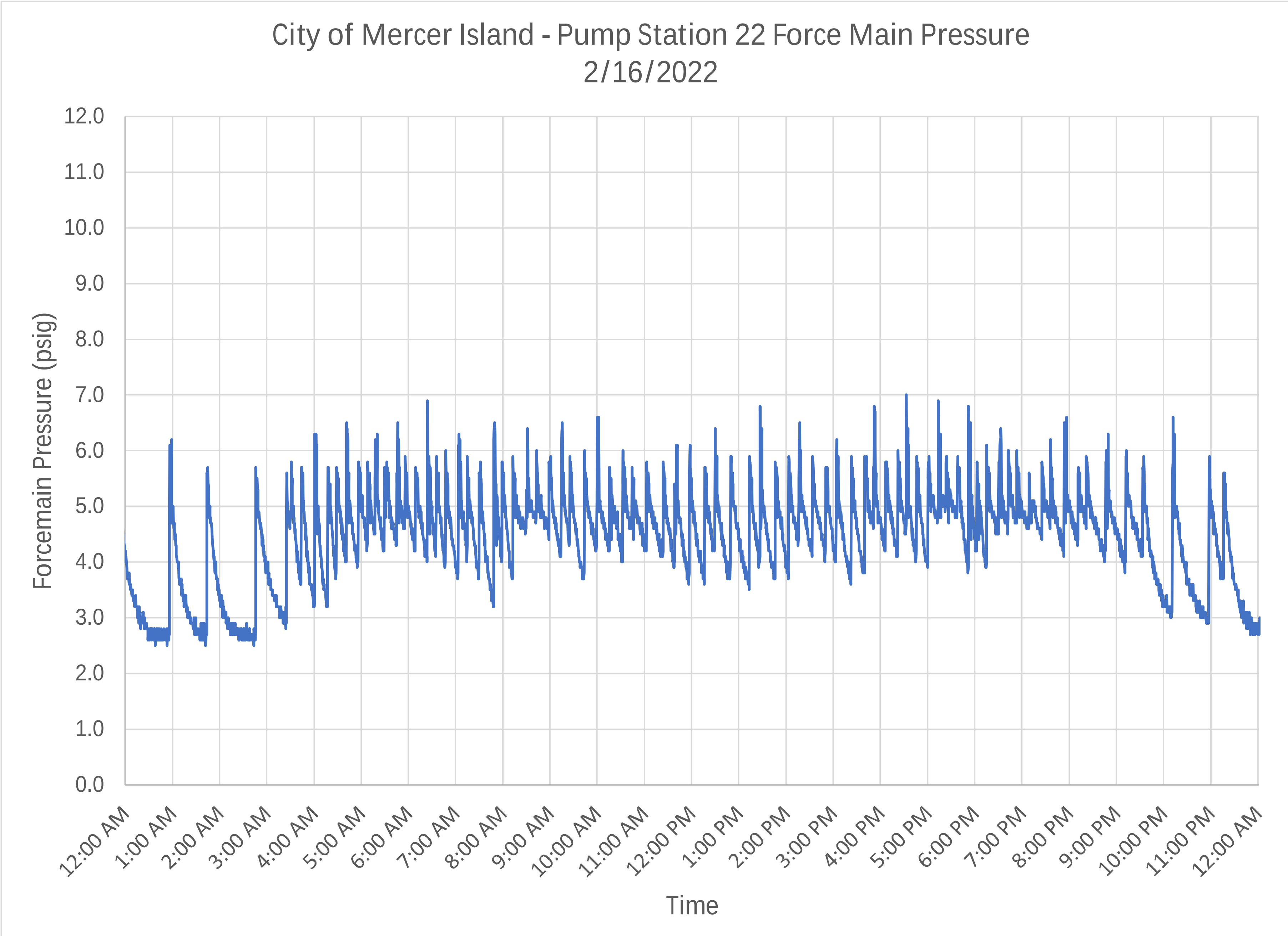


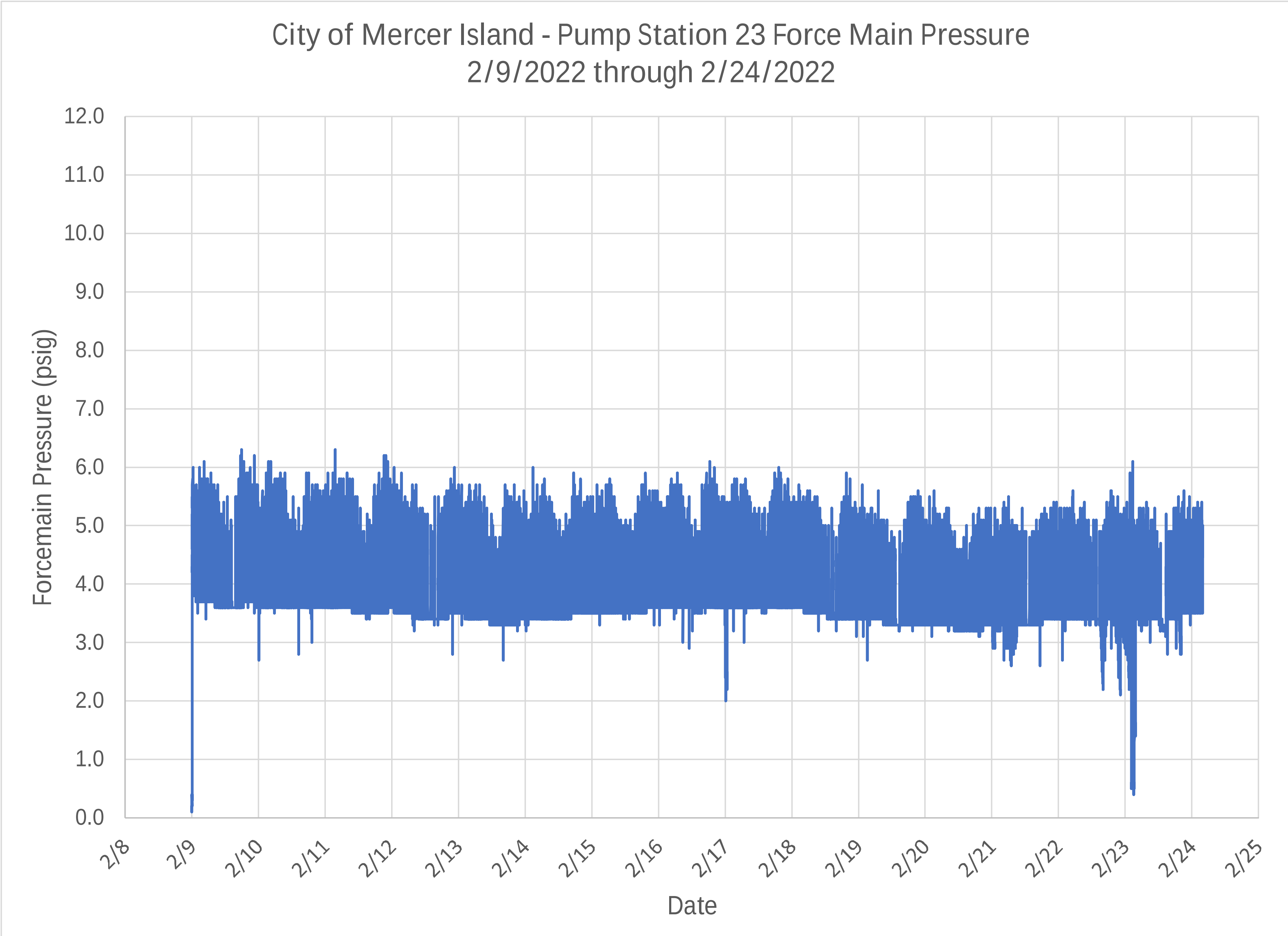
City of Mercer Island - Pump Station 21 Force Main Pressure
2/9/2022 through 2/24/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2/8
2/9
2/10
2/11
2/12
2/13
2/14
2/15
2/16
2/17
2/18
2/19
2/20
2/21
2/22
2/23
2/24
2/25
Date

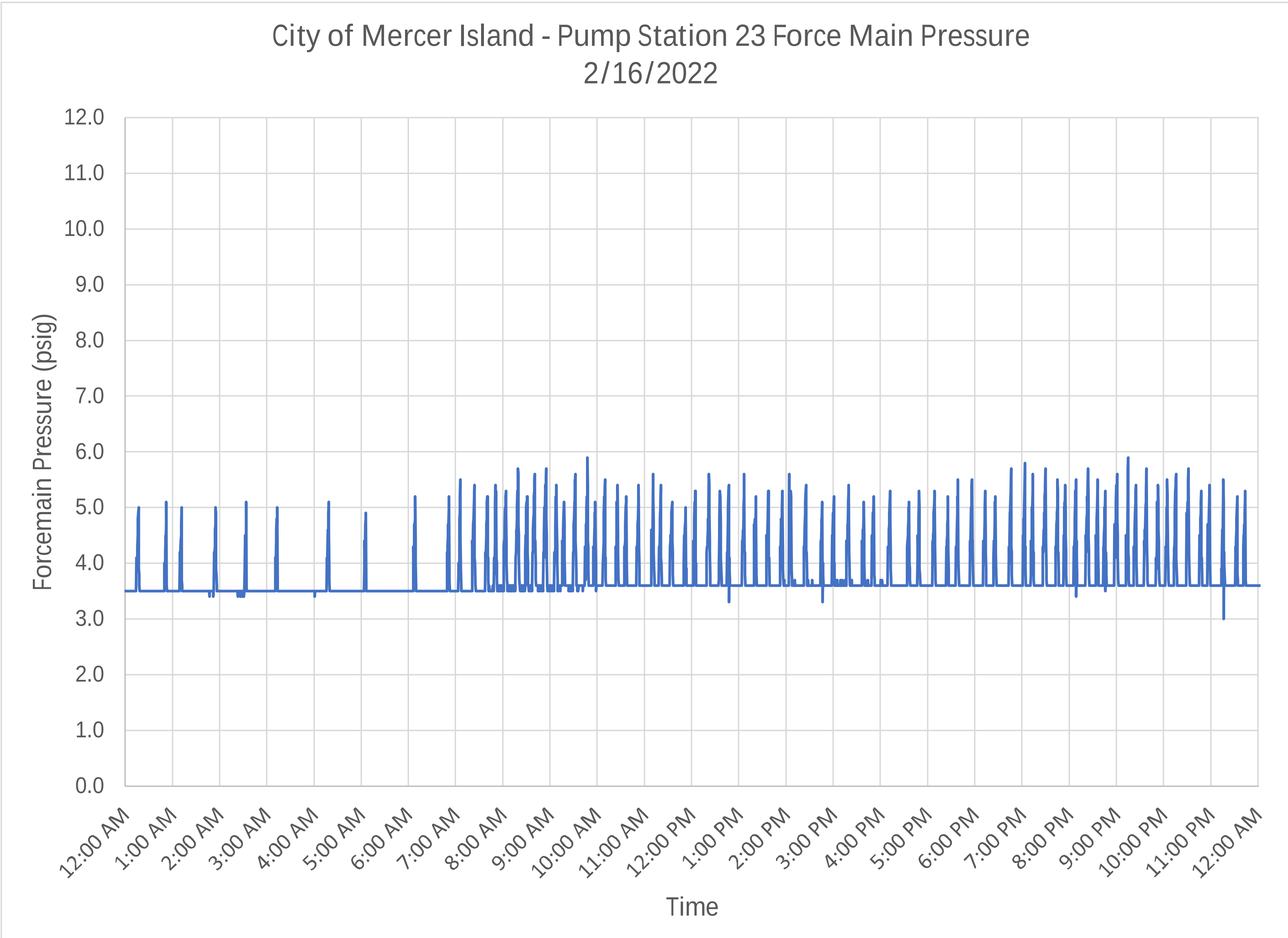

City of Mercer Island - Pump Station 21 Force Main Pressure
2/16/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
Time



City of Mercer Island - Pump Station 22 Force Main Pressure
2/9/2022 through 2/24/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2/8
2/9
2/10
2/11
2/12
2/13
2/14
2/15
2/16
2/17
2/18
2/19
2/20
2/21
2/22
2/23
2/24
2/25
Date

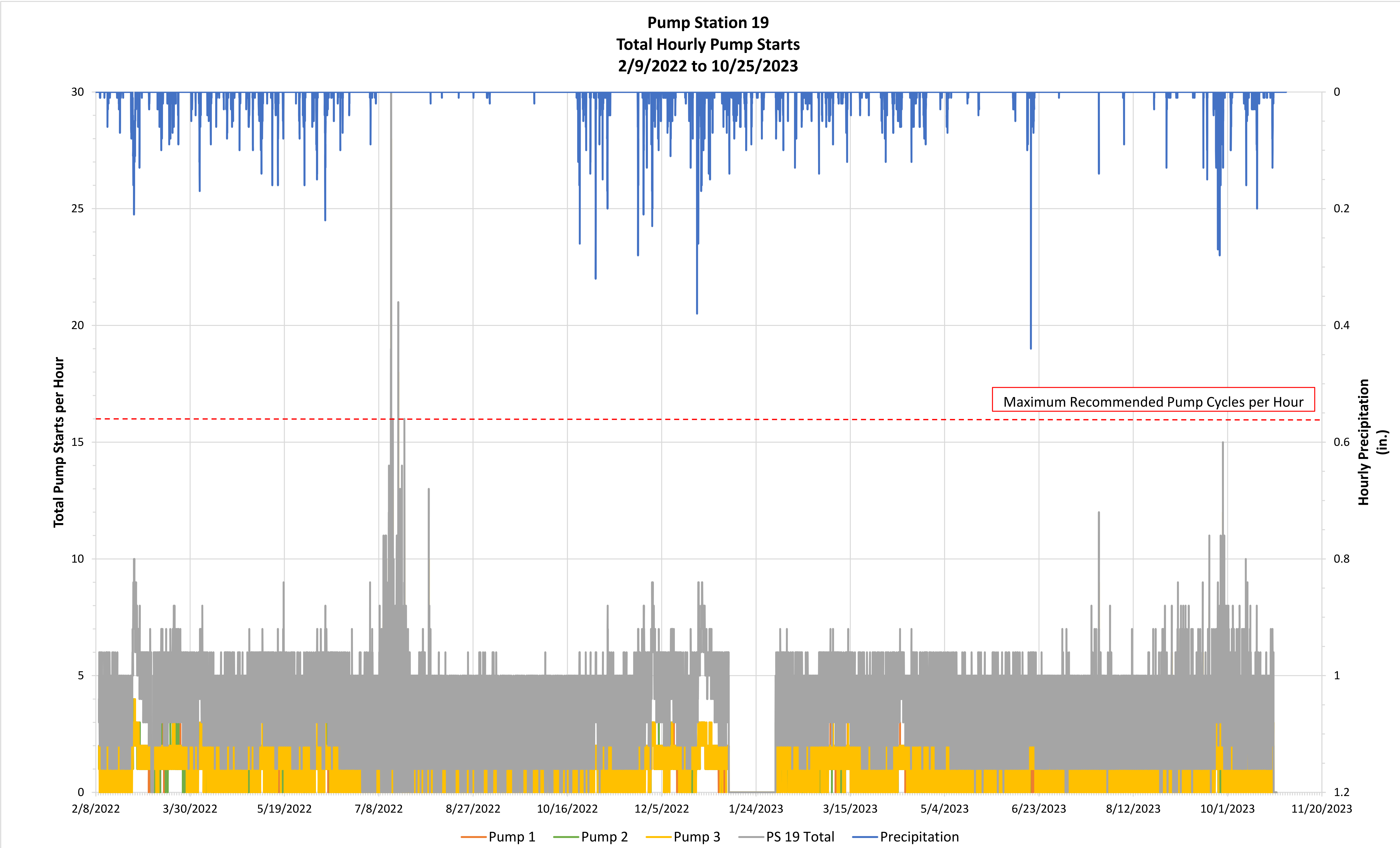

City of Mercer Island - Pump Station 22 Force Main Pressure
2/16/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
Time

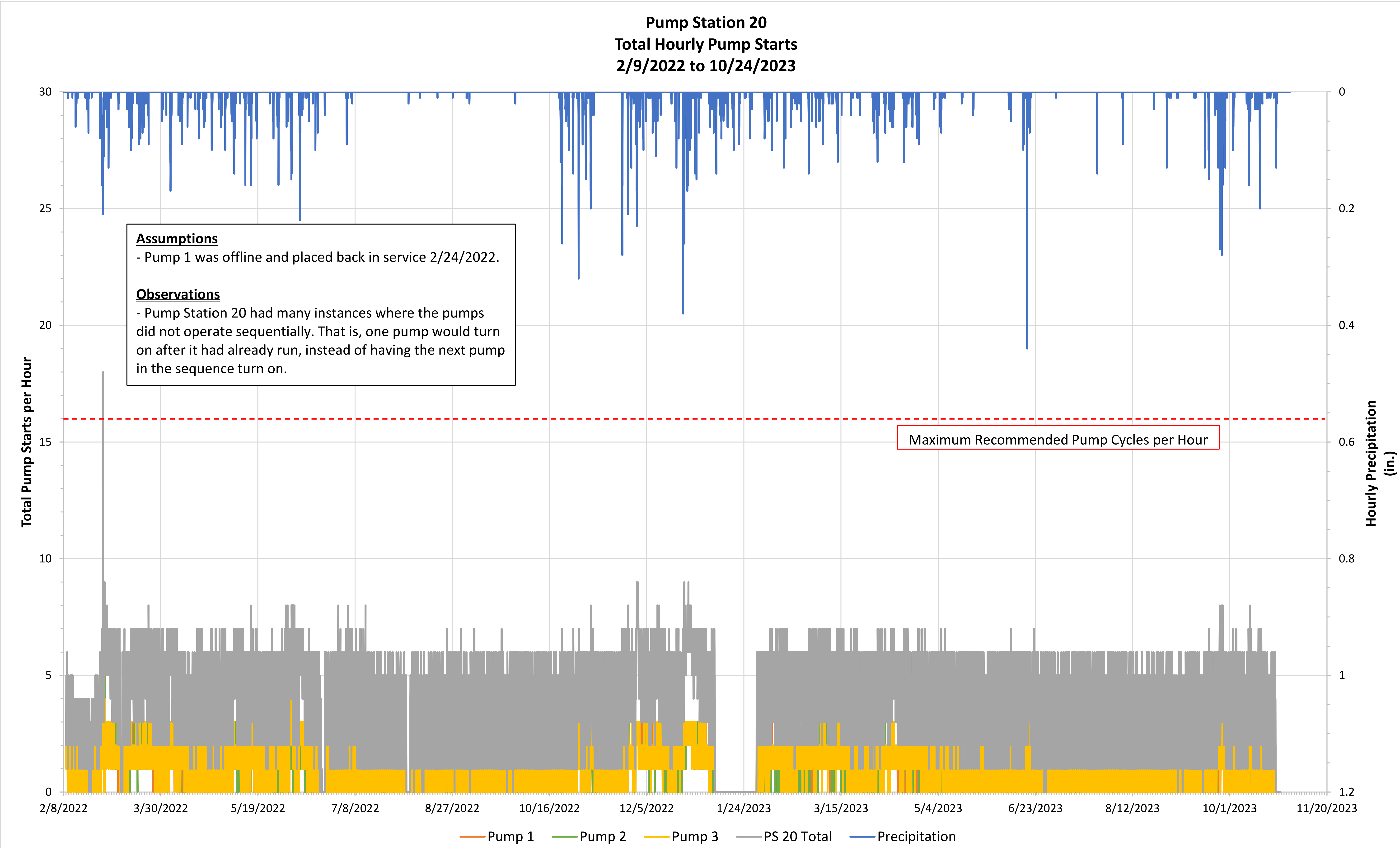

City of Mercer Island - Pump Station 23 Force Main Pressure
2/9/2022 through 2/24/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2/8
2/9
2/10
2/11
2/12
2/13
2/14
2/15
2/16
2/17
2/18
2/19
2/20
2/21
2/22
2/23
2/24
2/25
Date

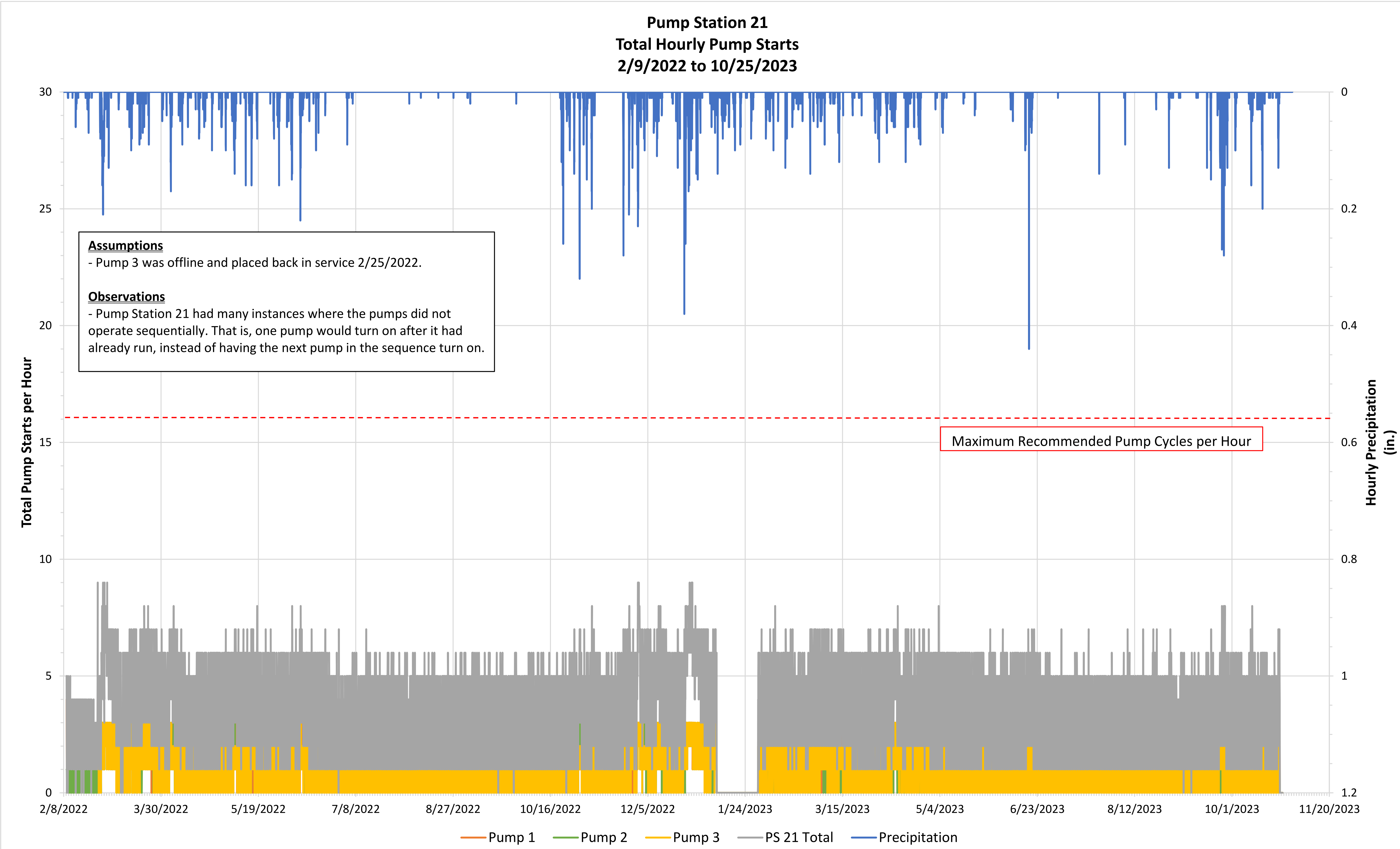

City of Mercer Island - Pump Station 23 Force Main Pressure
2/16/2022
Forcemain Pressure (psig)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
12:00 AM
Time

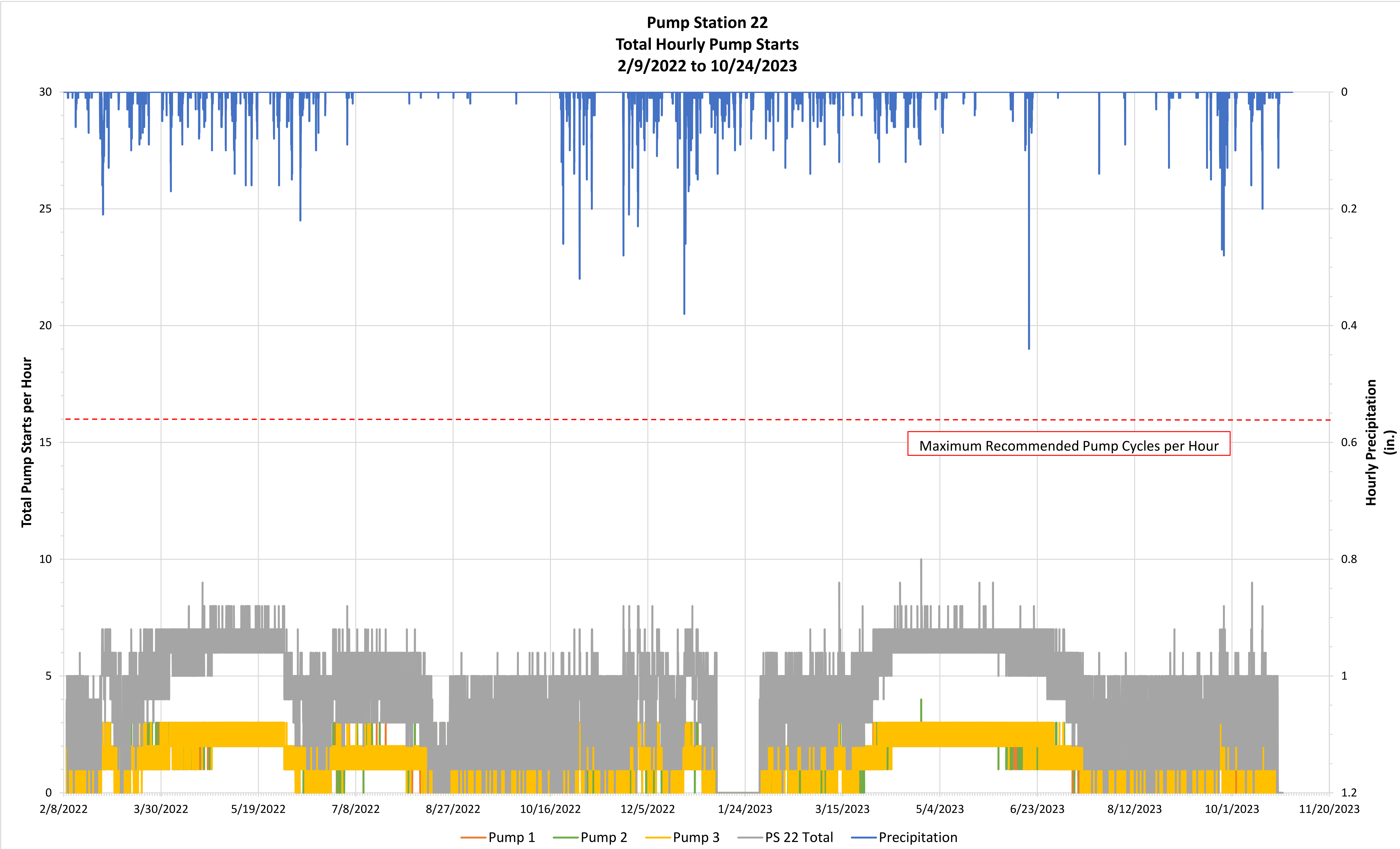
Appendix B

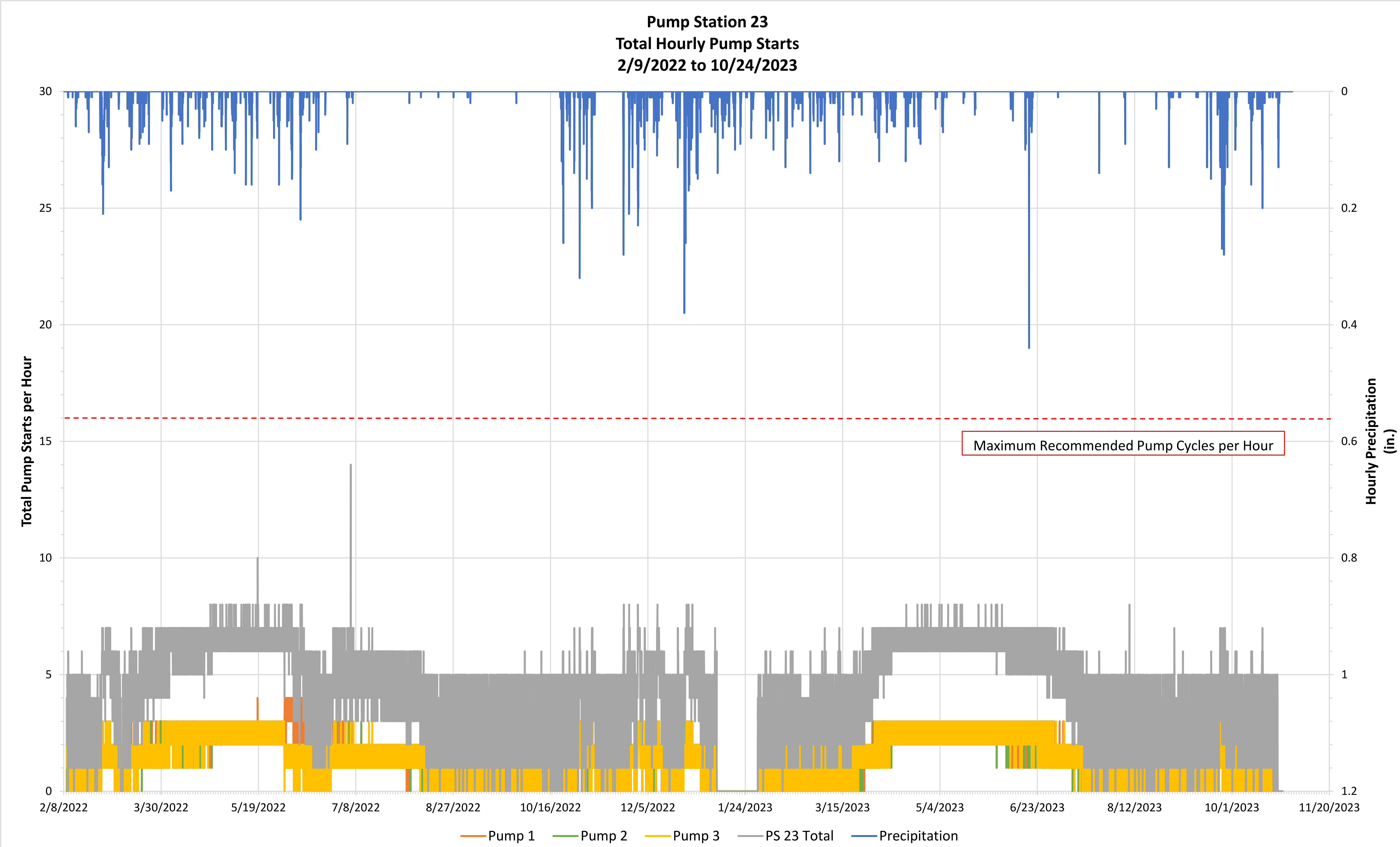
Sewer Pump Station Charts

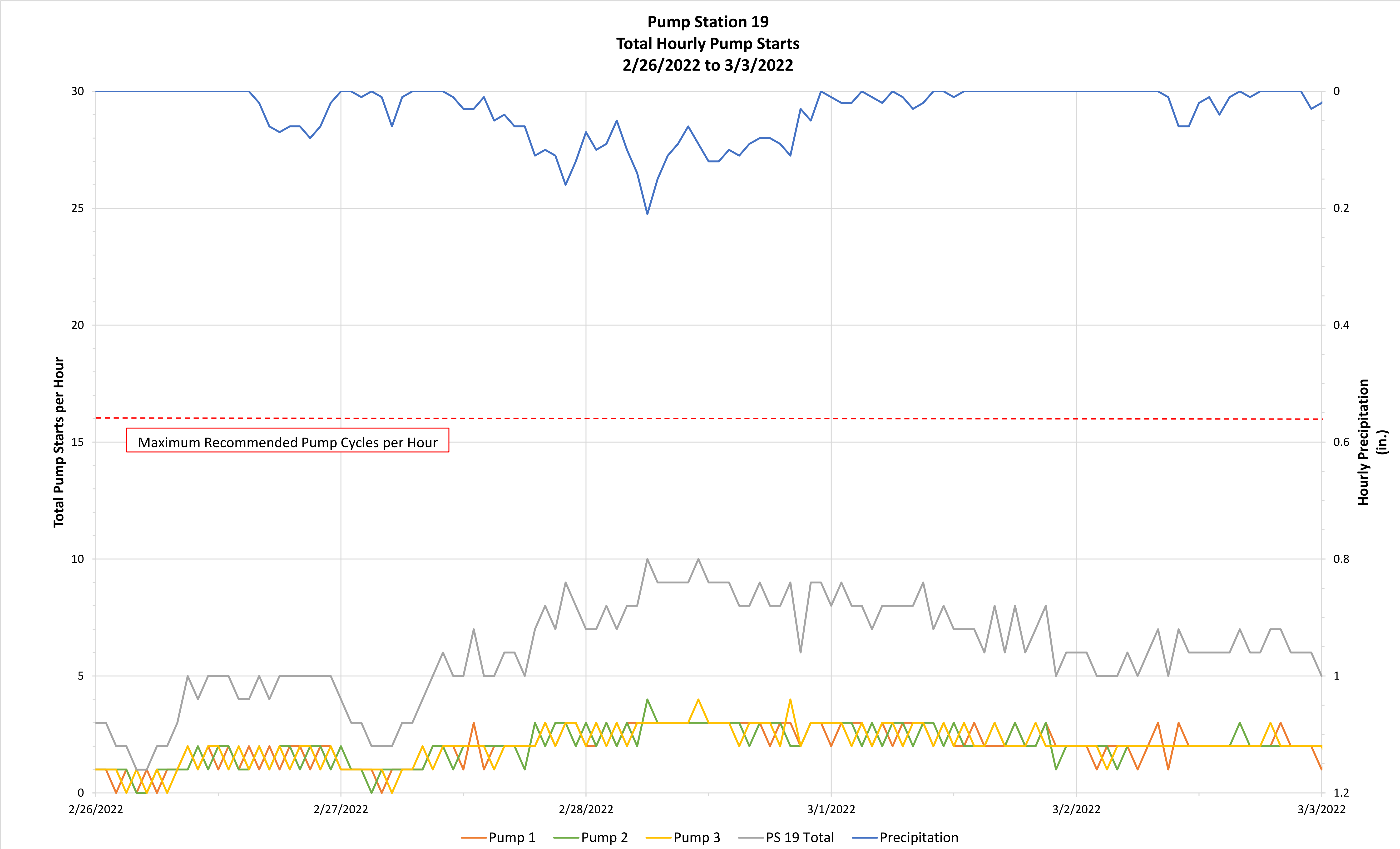

Pump Station 19
Total Hourly Pump Starts
2/9/2022 to 10/25/2023
Total Pump Starts per Hour
Hourly Precipitation (in.)
Maximum Recommended Pump Cycles per Hour
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation

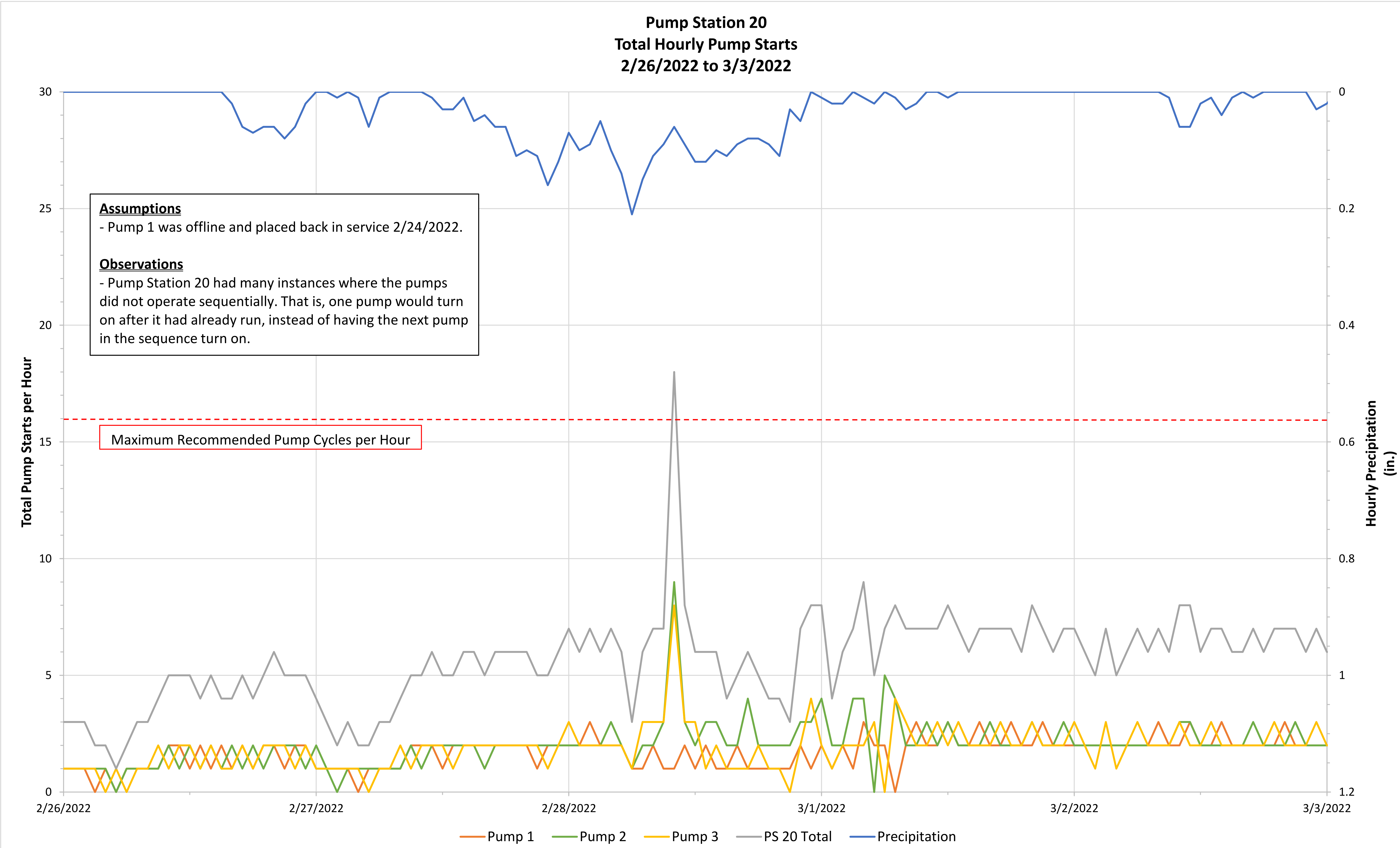

Pump Station 20
Total Hourly Pump Starts
2/9/2022 to 10/24/2023
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
Assumptions
- Pump 1 was offline and placed back in service 2/24/2022.
Observations
- Pump Station 20 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Maximum Recommended Pump Cycles per Hour
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation

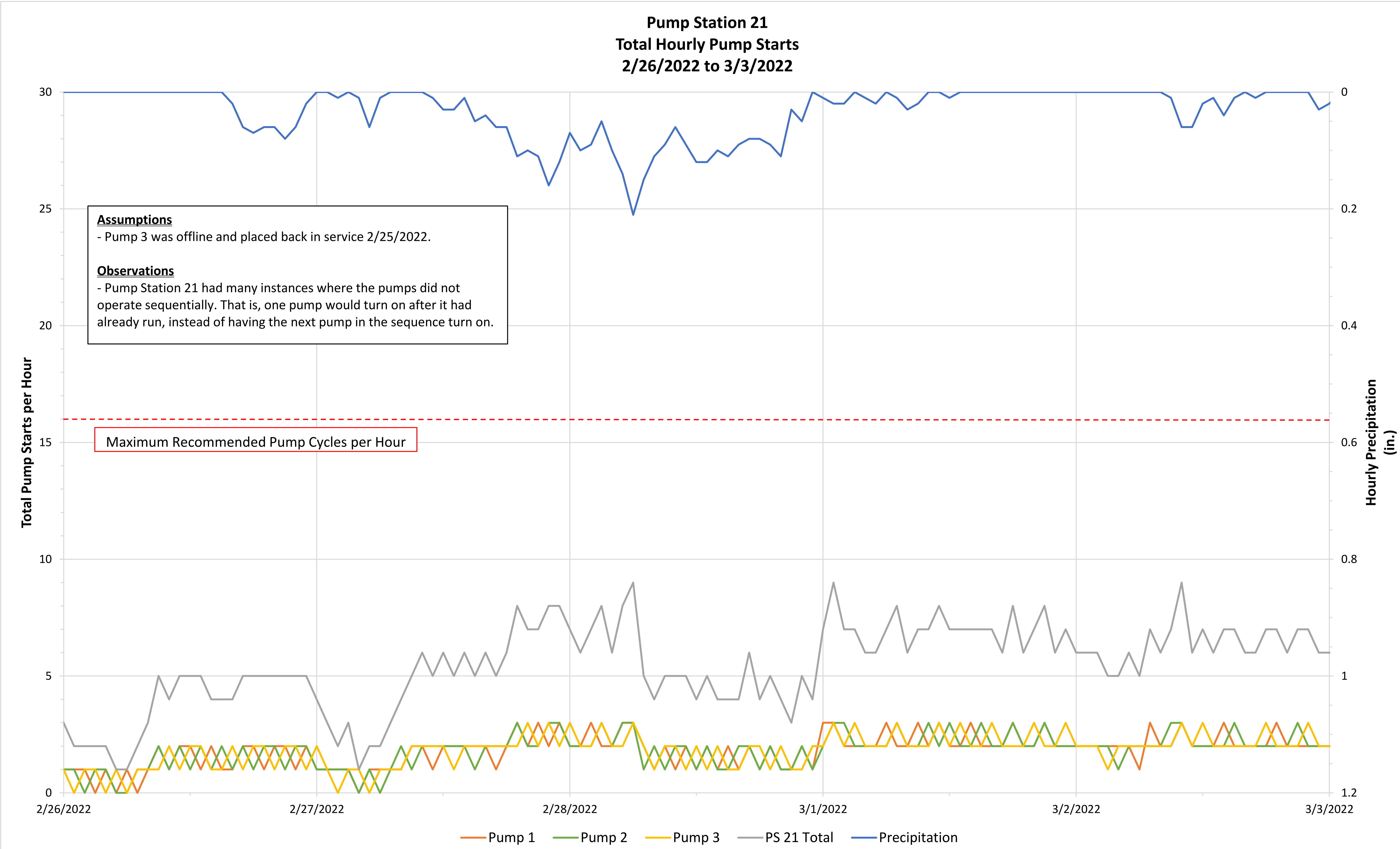

Pump Station 21
Total Hourly Pump Starts
2/9/2022 to 10/25/2023
Assumptions
- Pump 3 was offline and placed back in service 2/25/2022.
Observations
- Pump Station 21 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Maximum Recommended Pump Cycles per Hour
Total Pump Starts per Hour
Hourly Precipitation (in.)
0
5
10
15
20
25
30
1.2
1
0.8
0.6
0.4
0.2
0
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation

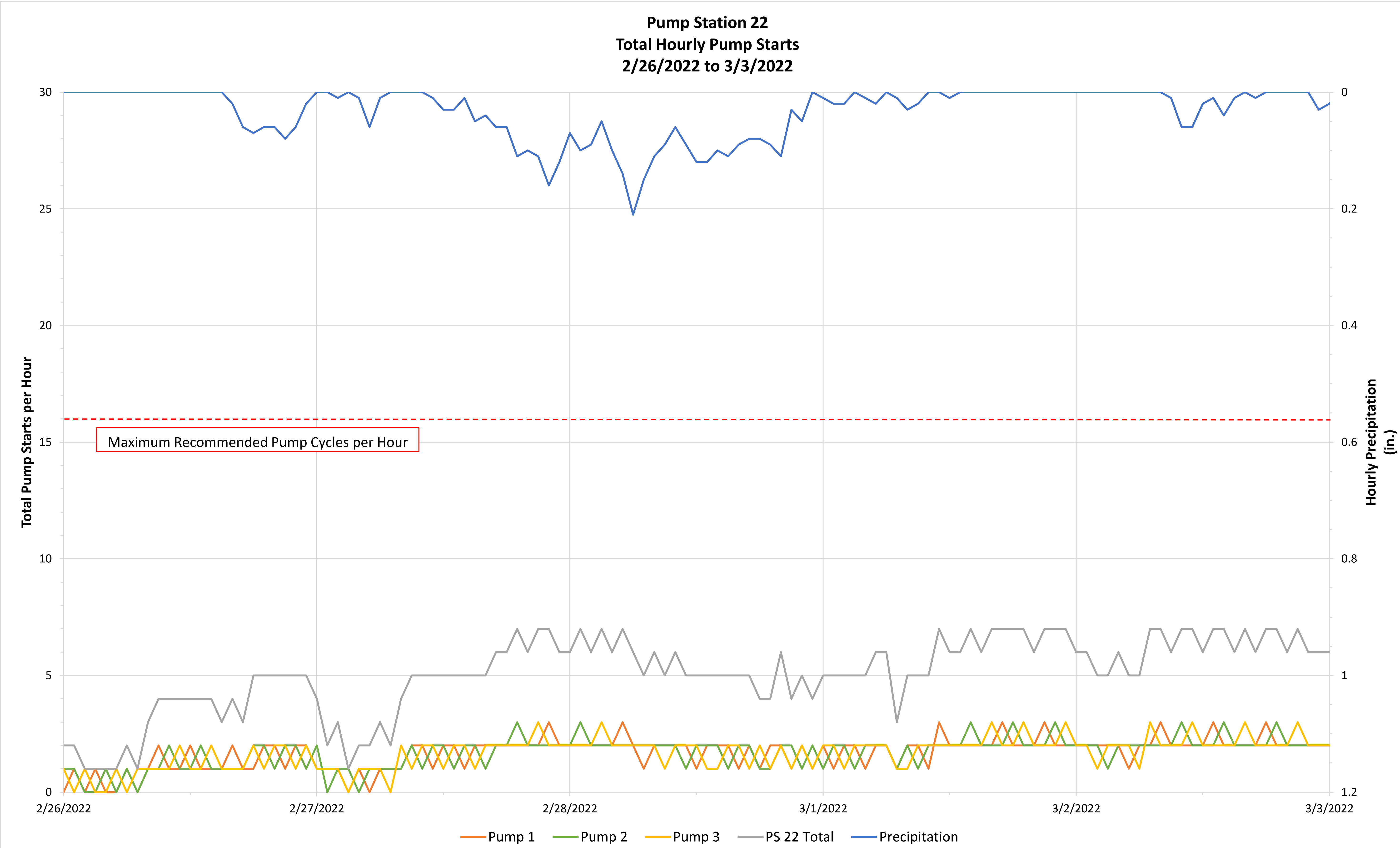

Pump Station 22
Total Hourly Pump Starts
2/9/2022 to 10/24/2023
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0.2
0.4
0.6
0.8
1
1.2
Maximum Recommended Pump Cycles per Hour
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

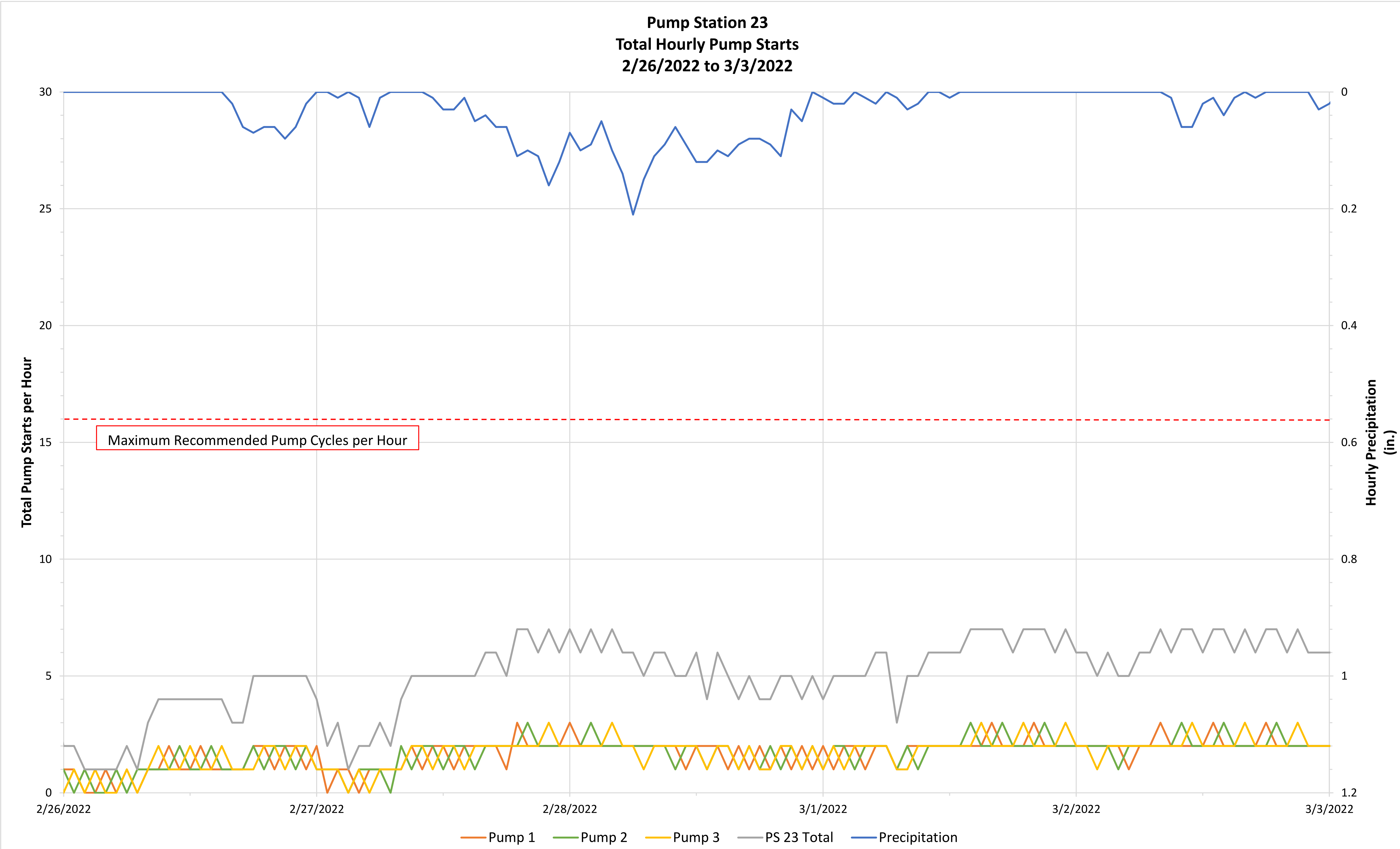

Pump Station 23
Total Hourly Pump Starts
2/9/2022 to 10/24/2023
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
Maximum Recommended Pump Cycles per Hour
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation

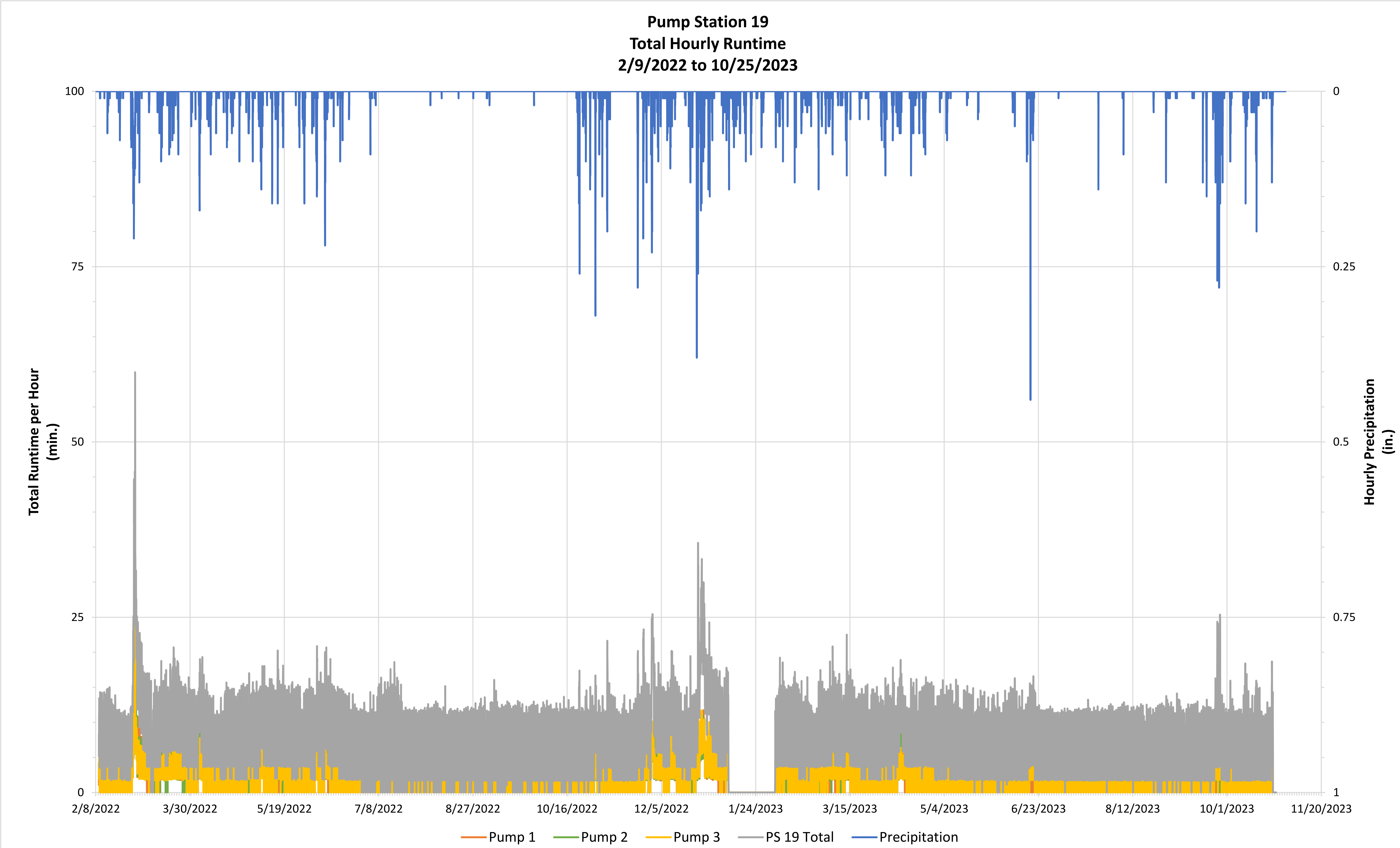

Pump Station 19
Total Hourly Pump Starts
2/26/2022 to 3/3/2022
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
Maximum Recommended Pump Cycles per Hour
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation

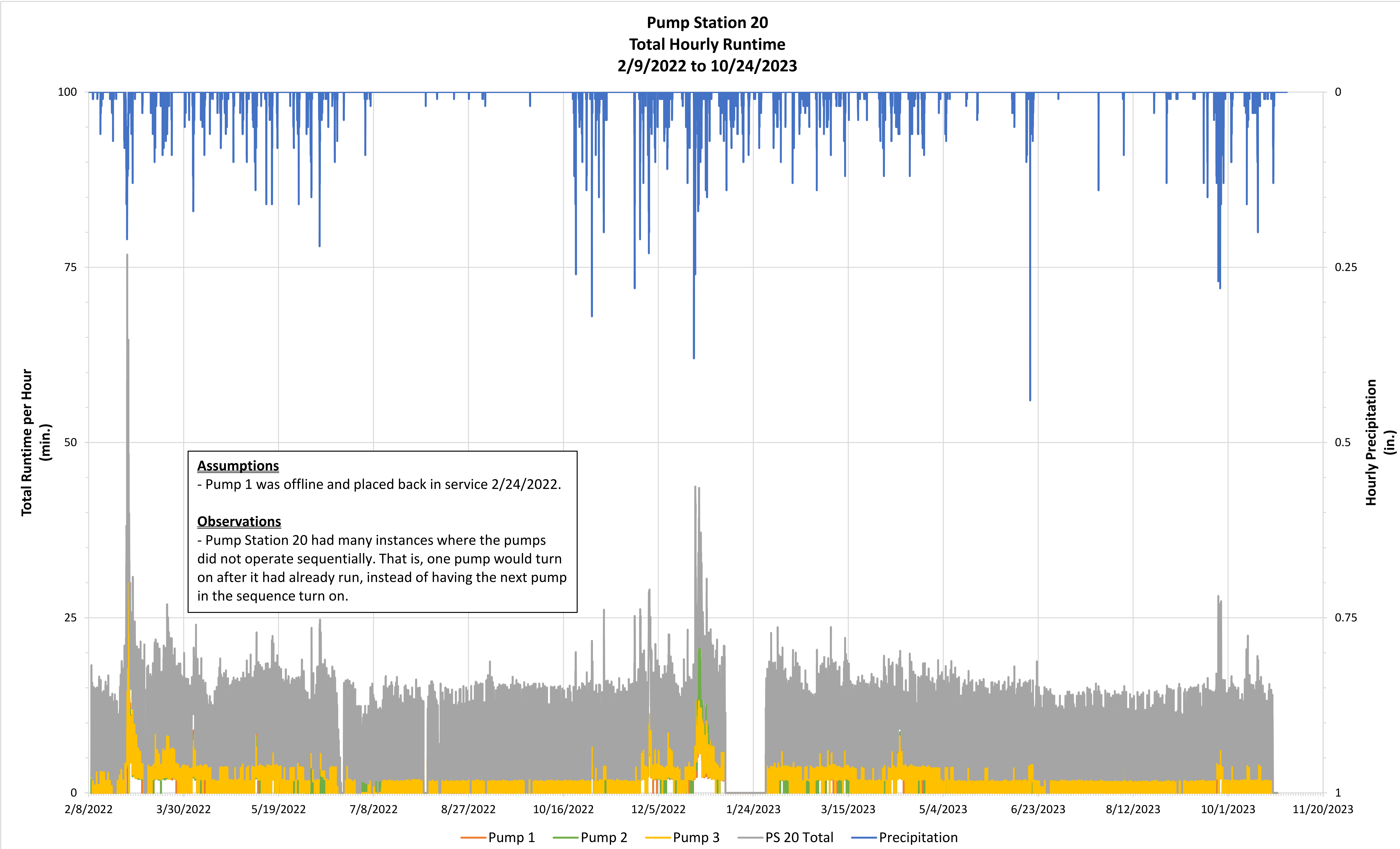

Pump Station 20
Total Hourly Pump Starts
2/26/2022 to 3/3/2022
Assumptions
- Pump 1 was offline and placed back in service 2/24/2022.
Observations
- Pump Station 20 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Maximum Recommended Pump Cycles per Hour
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation

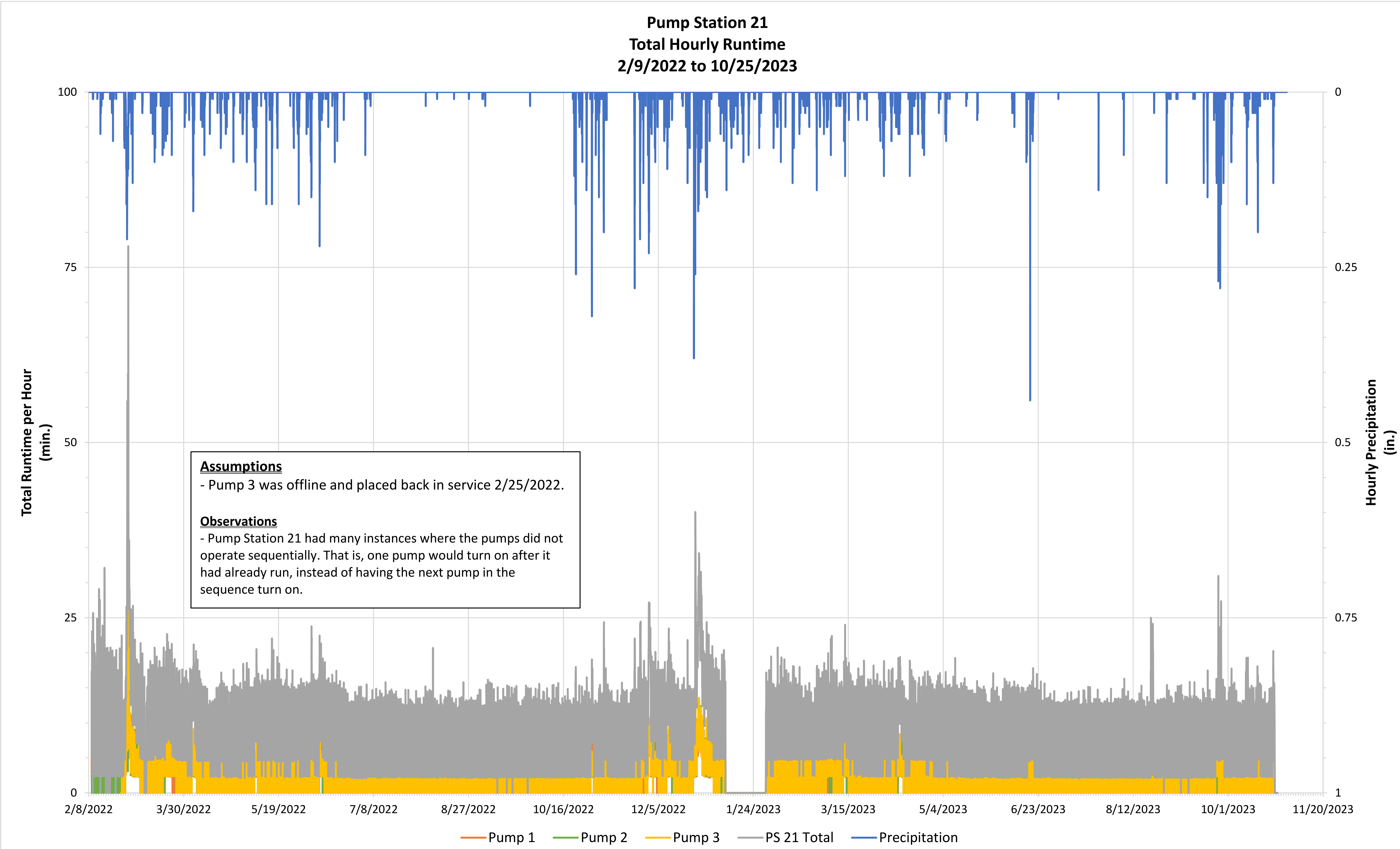

Pump Station 21
Total Hourly Pump Starts
2/26/2022 to 3/3/2022
Assumptions
- Pump 3 was offline and placed back in service 2/25/2022.
Observations
- Pump Station 21 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Maximum Recommended Pump Cycles per Hour
Total Pump Starts per Hour
Hourly Precipitation (in.)
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation

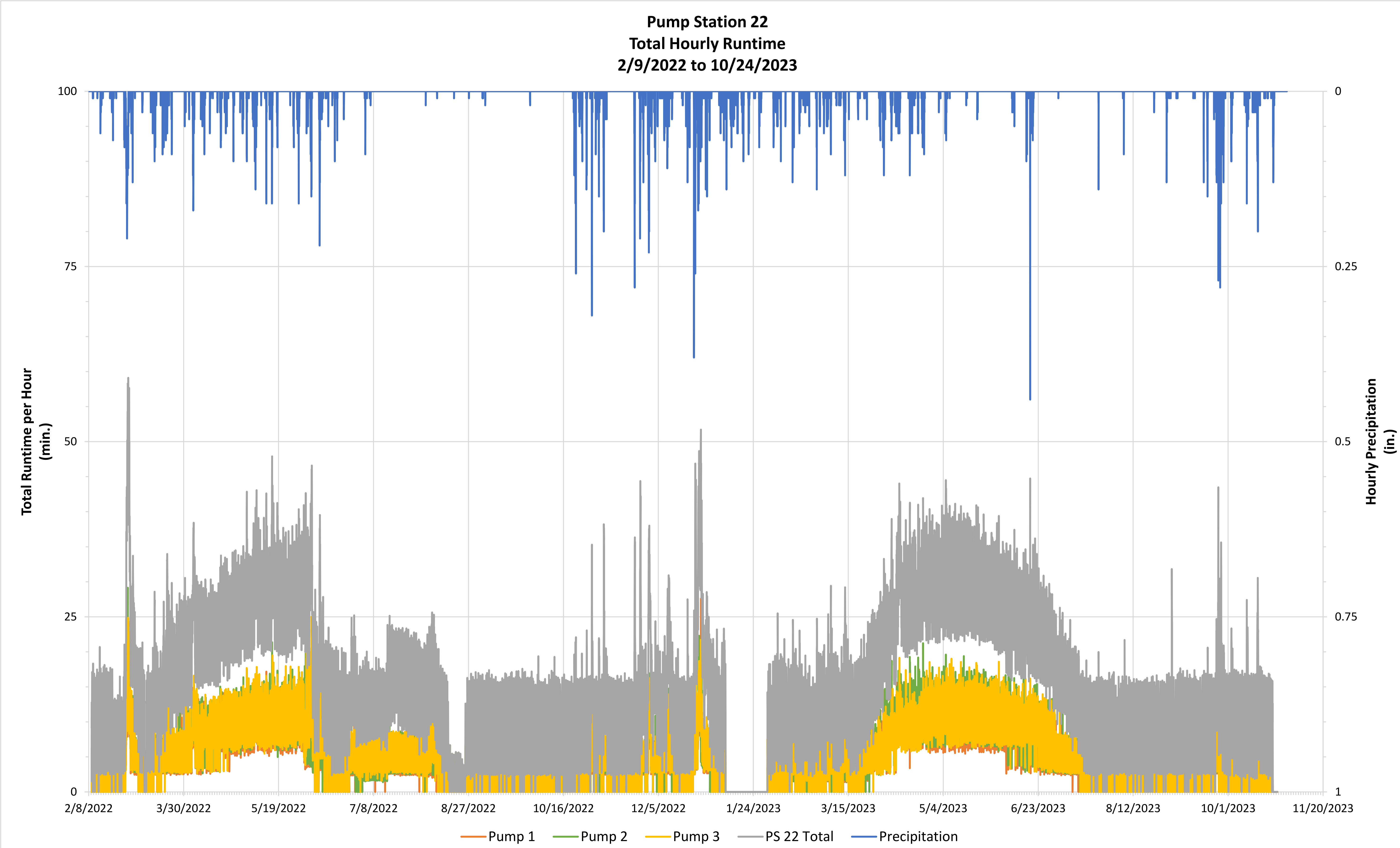

Pump Station 22
Total Hourly Pump Starts
2/26/2022 to 3/3/2022
Total Pump Starts per Hour
Hourly Precipitation (in.)
Maximum Recommended Pump Cycles per Hour
30
25
20
15
10
5
0
1.2
1
0.8
0.6
0.4
0.2
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

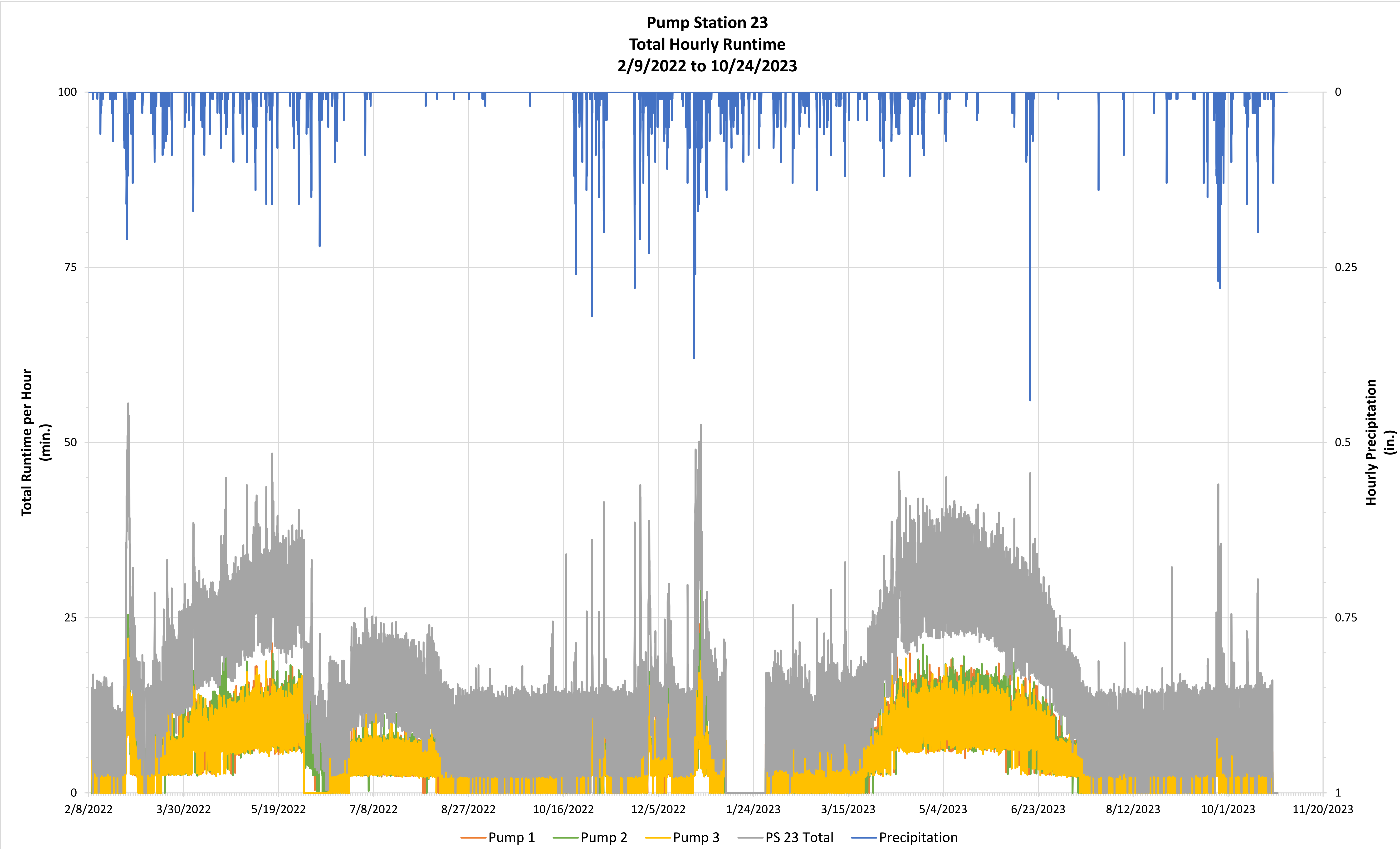

Pump Station 23
Total Hourly Pump Starts
2/26/2022 to 3/3/2022
Total Pump Starts per Hour
Hourly Precipitation (in.)
Maximum Recommended Pump Cycles per Hour
30
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
1.2
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation

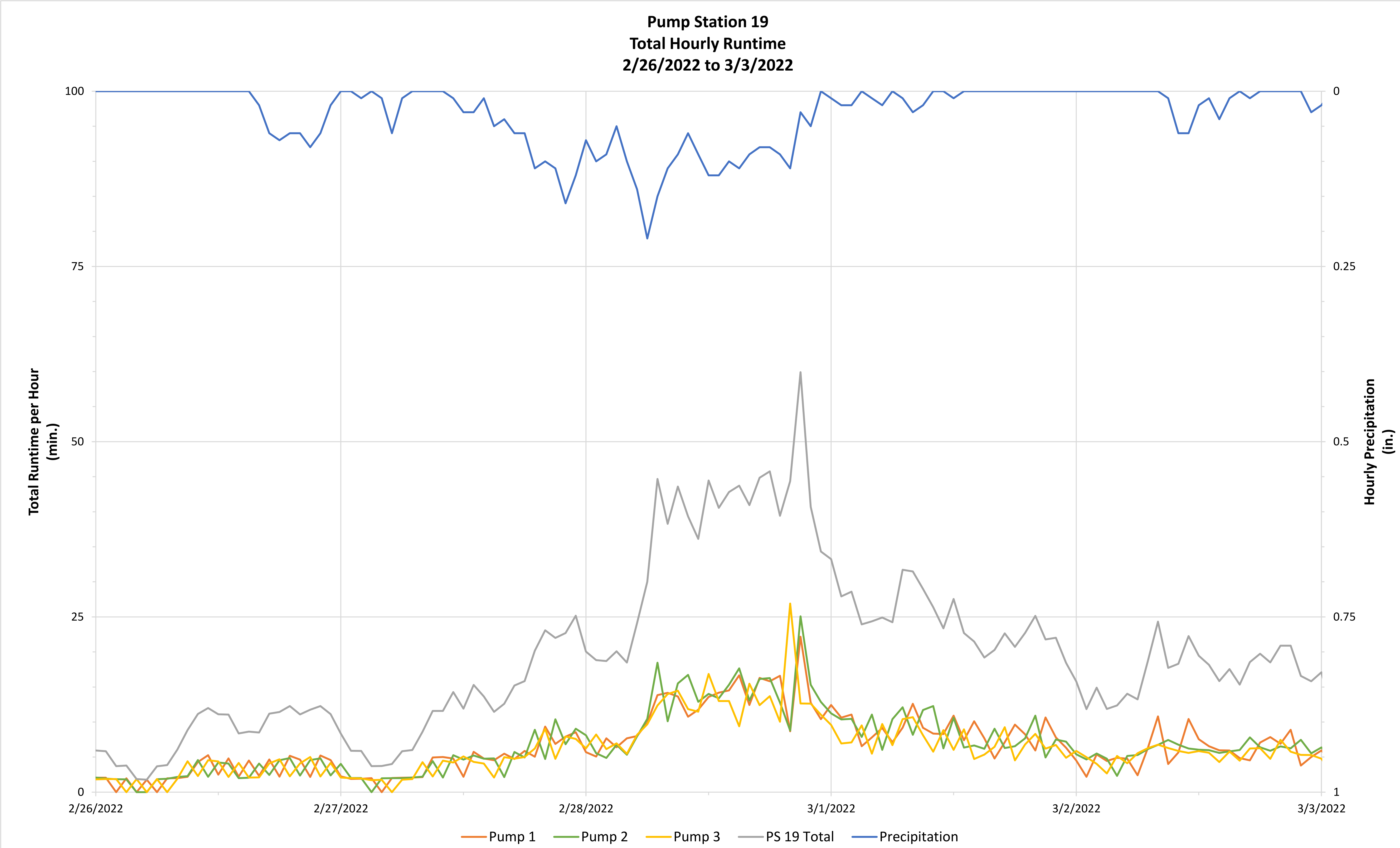

Pump Station 19
Total Hourly Runtime
2/9/2022 to 10/25/2023
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation

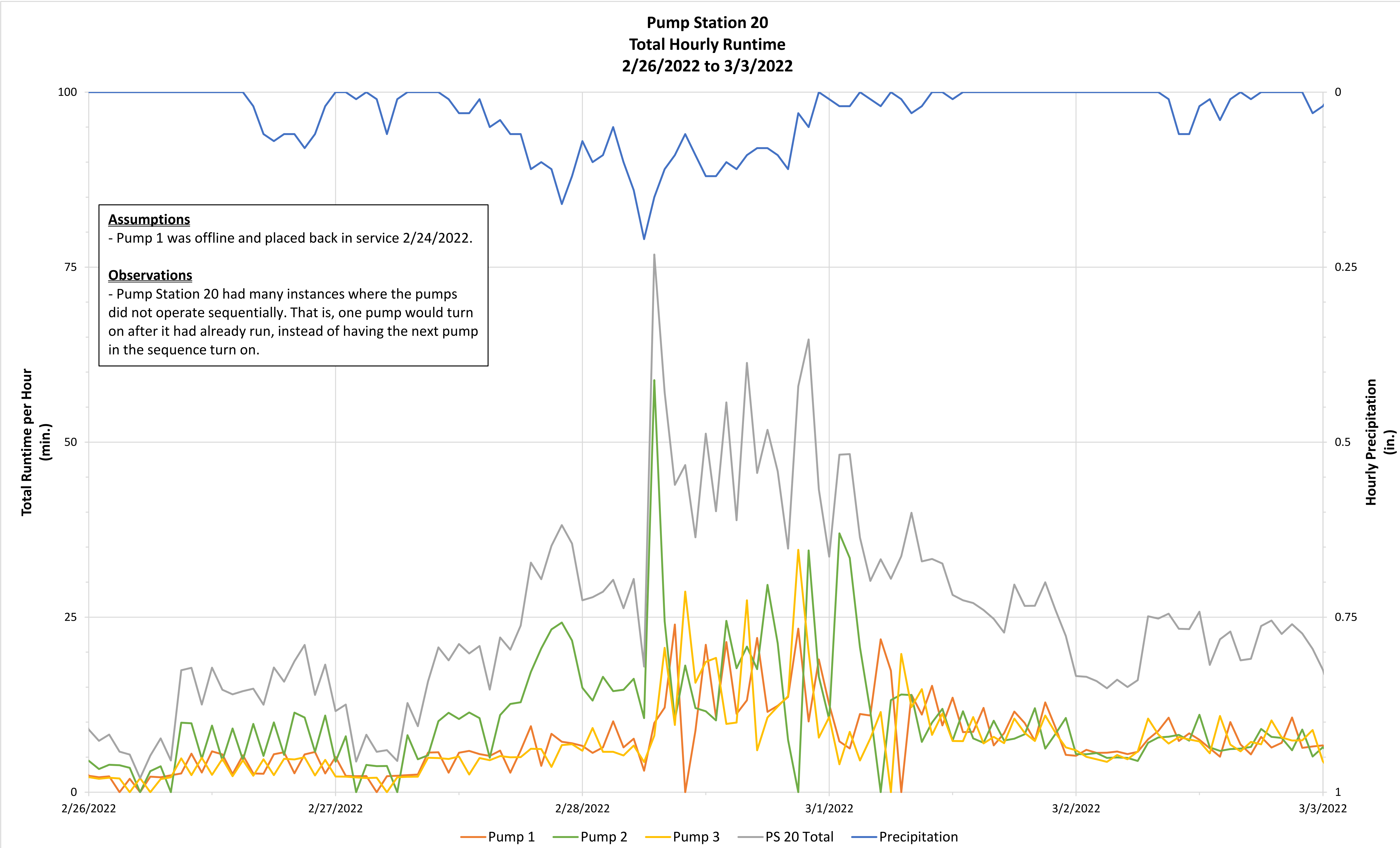

Pump Station 20
Total Hourly Runtime
2/9/2022 to 10/24/2023
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation
Assumptions
- Pump 1 was offline and placed back in service 2/24/2022.
Observations
- Pump Station 20 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.

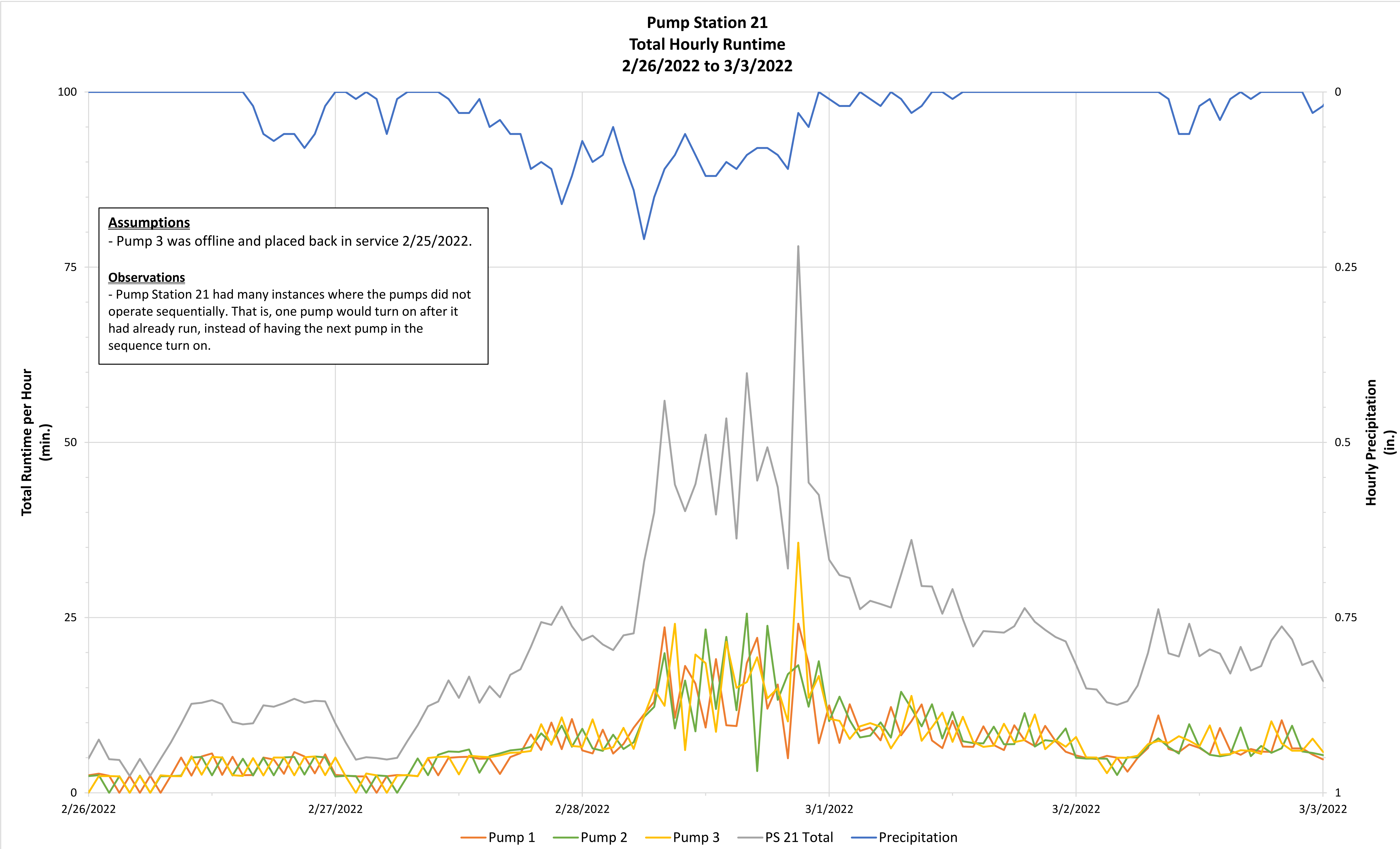

Pump Station 21
Total Hourly Runtime
2/9/2022 to 10/25/2023
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation
Assumptions
- Pump 3 was offline and placed back in service 2/25/2022.
Observations
- Pump Station 21 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.

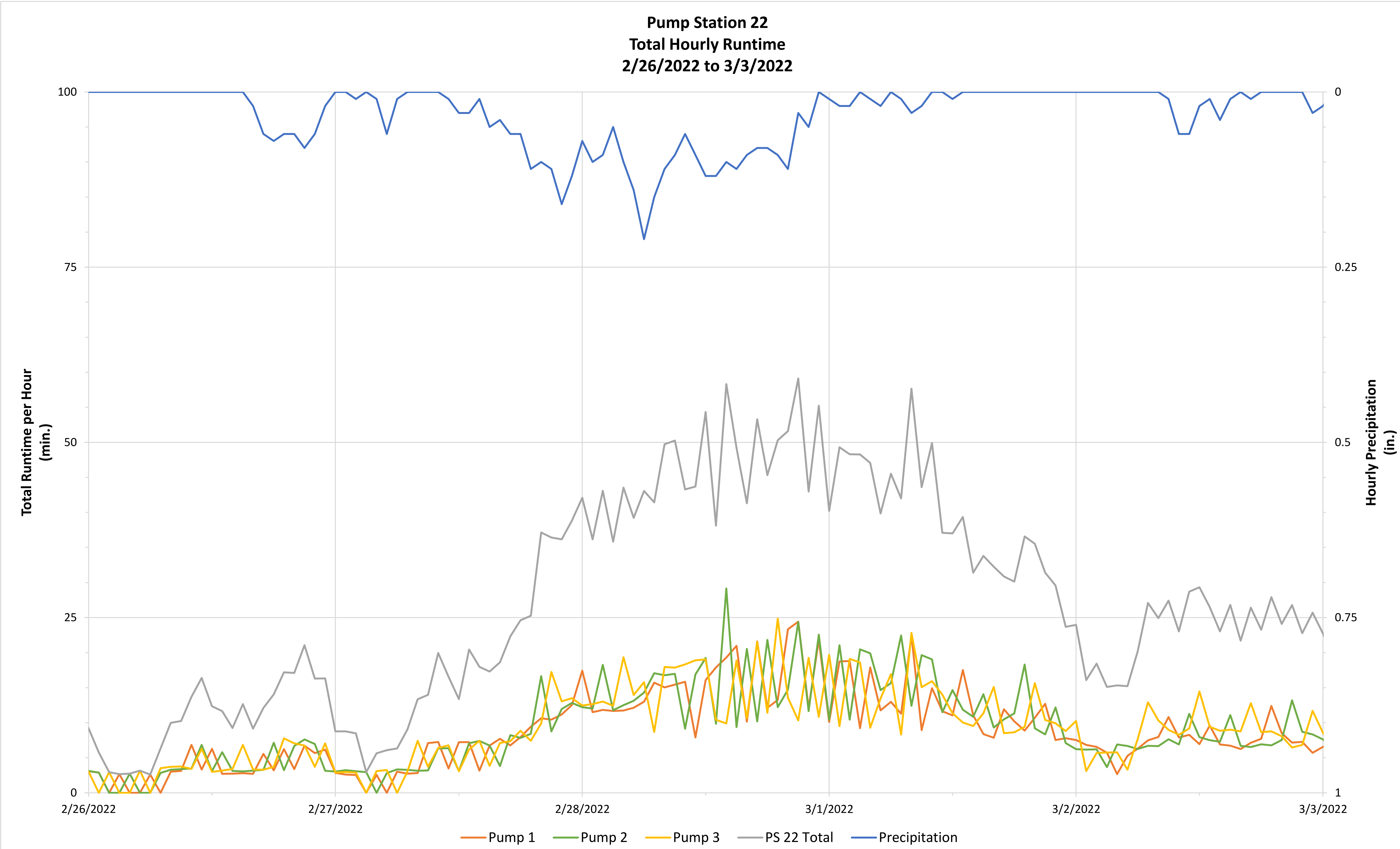

Pump Station 22
Total Hourly Runtime
2/9/2022 to 10/24/2023
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

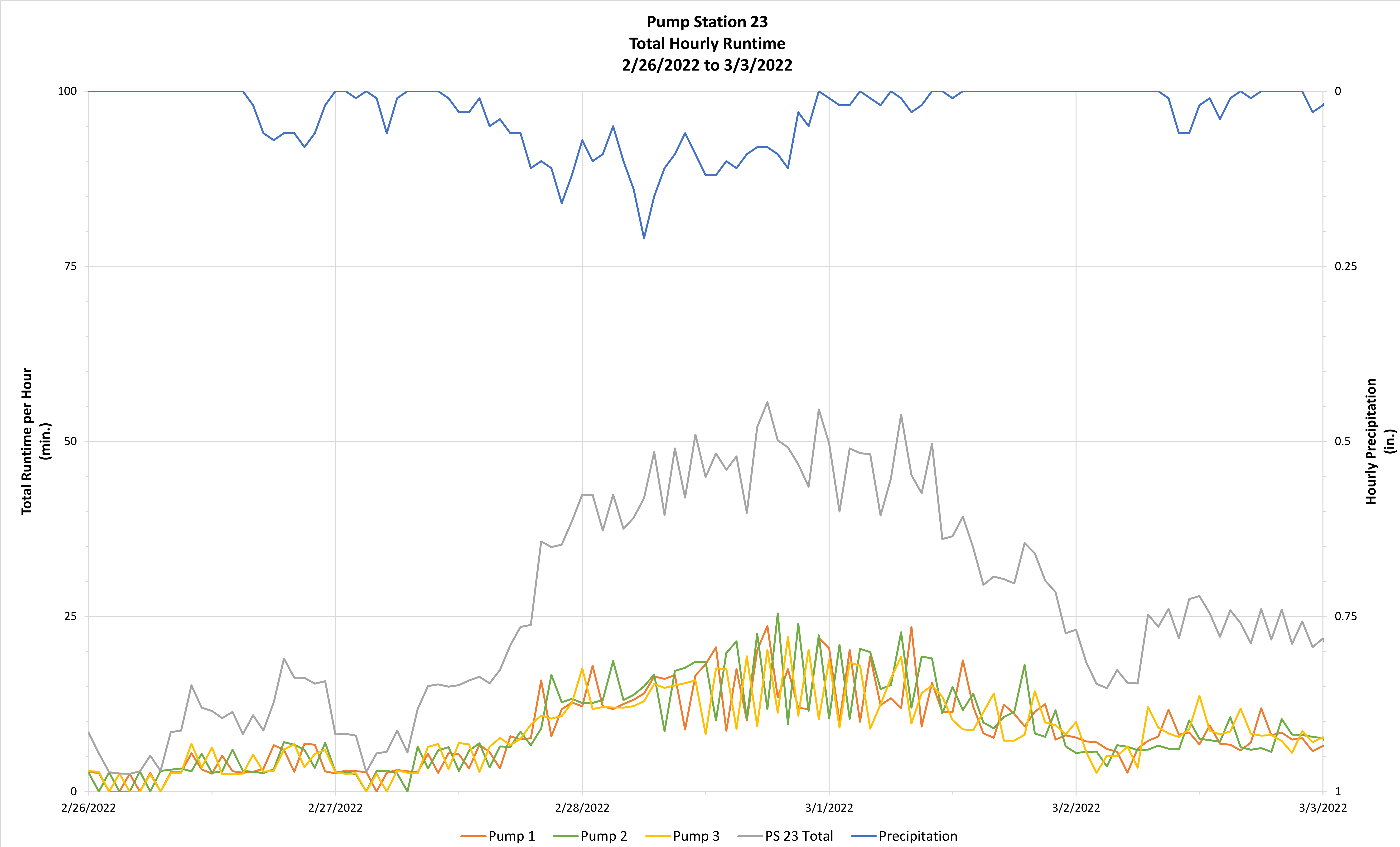

Pump Station 23
Total Hourly Runtime
2/9/2022 to 10/24/2023
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation

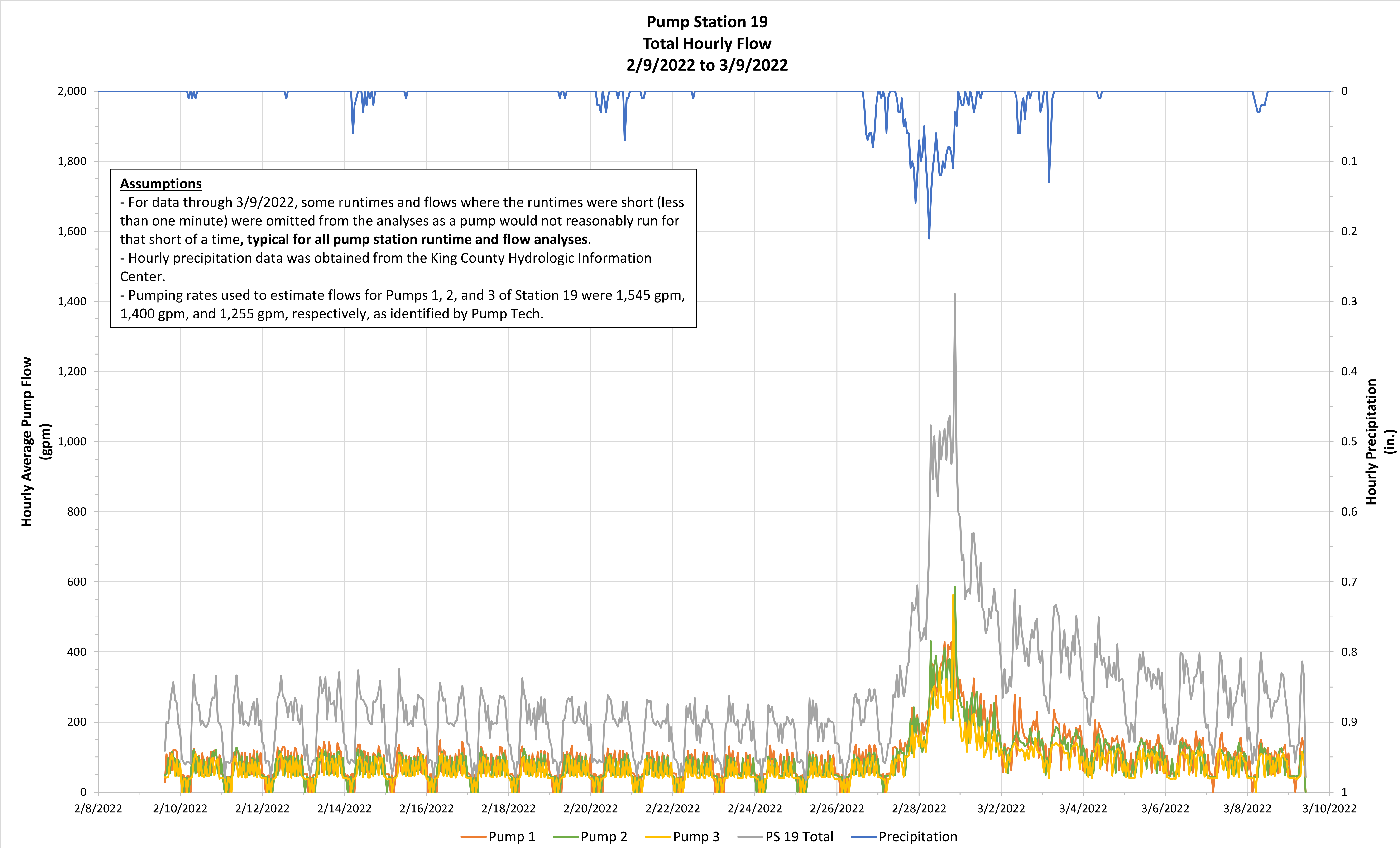

Pump Station 19
Total Hourly Runtime
2/26/2022 to 3/3/2022
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation

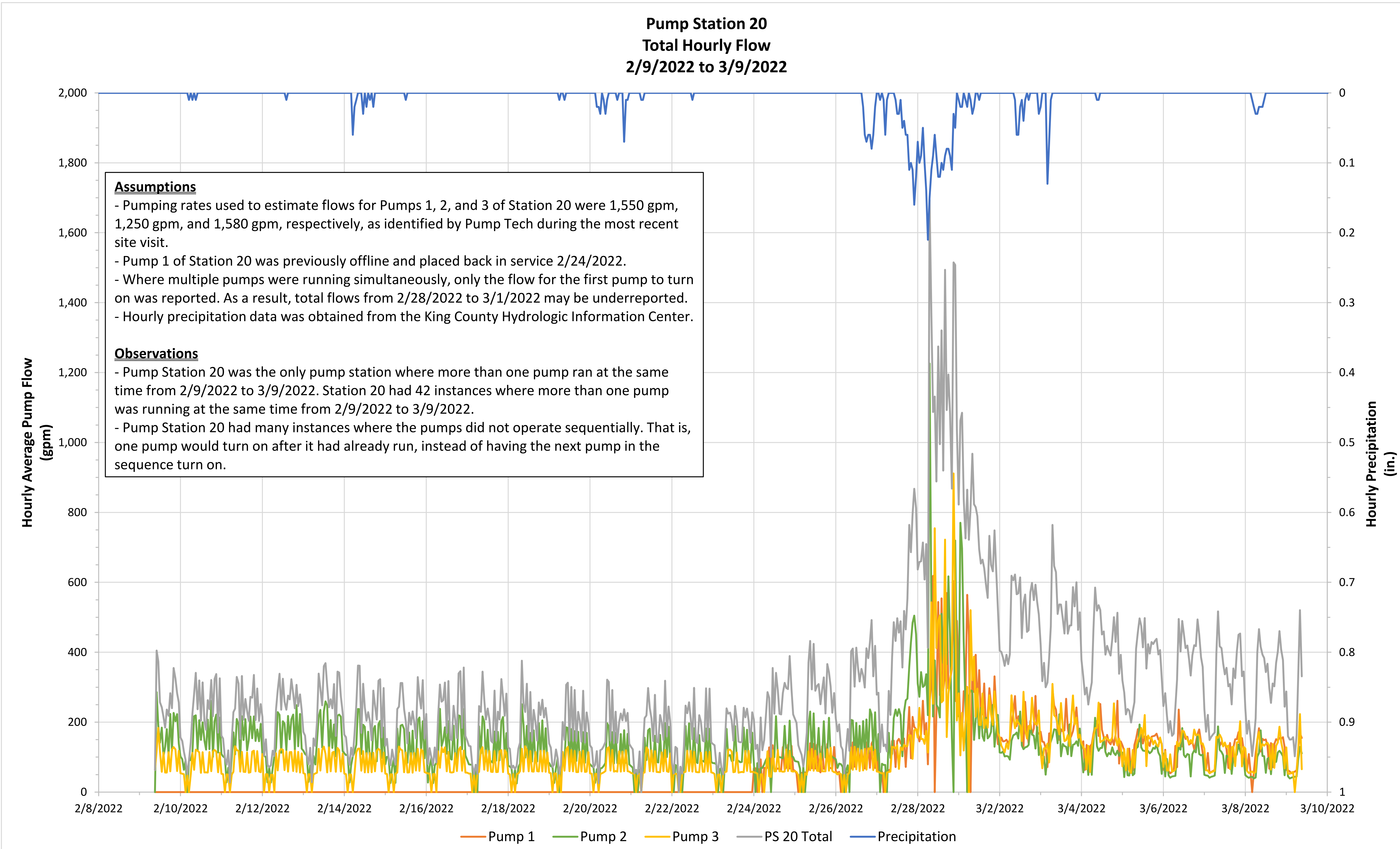

Pump Station 20
Total Hourly Runtime
2/26/2022 to 3/3/2022
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation
Assumptions
- Pump 1 was offline and placed back in service 2/24/2022.
Observations
- Pump Station 20 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.

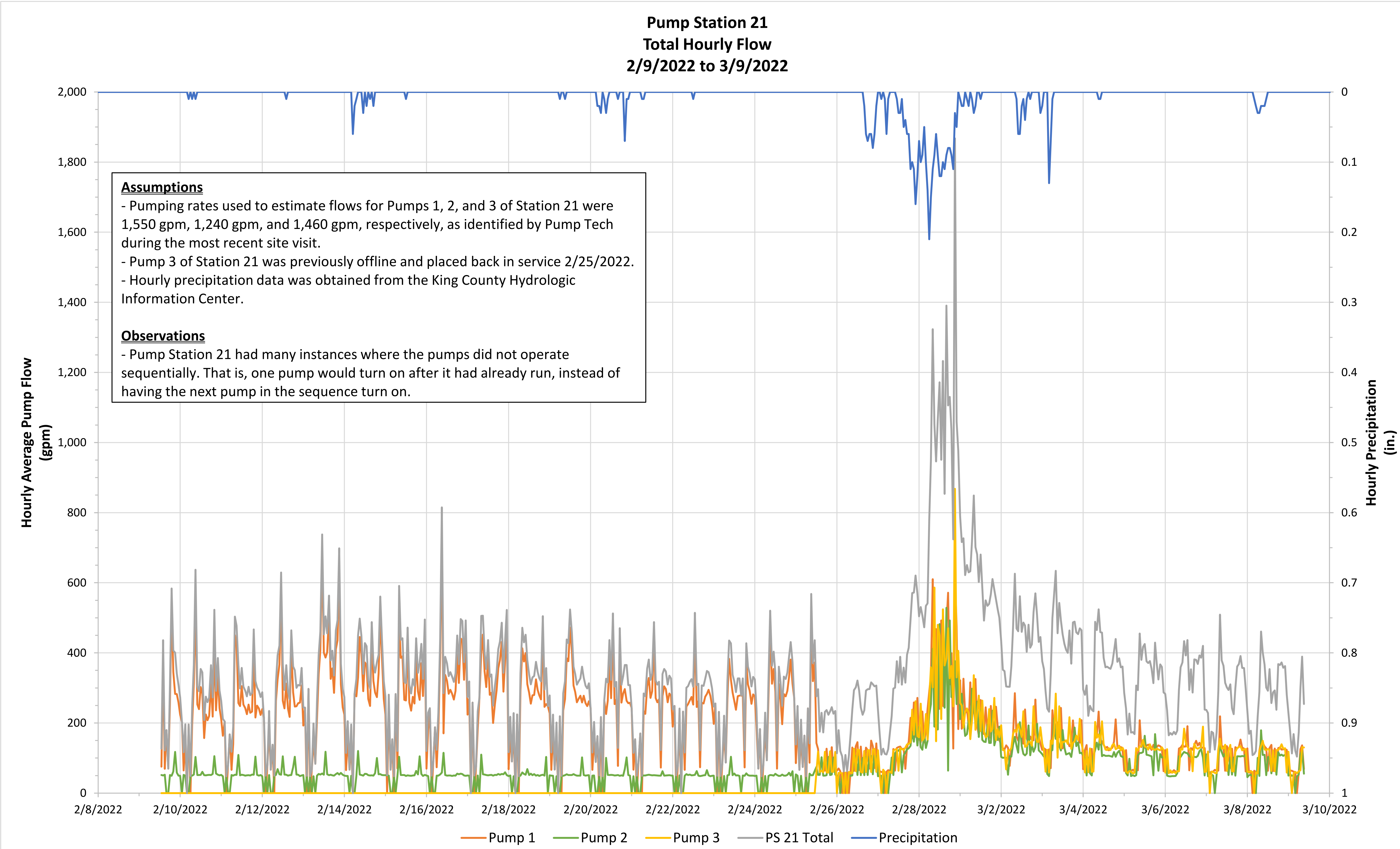

Pump Station 21
Total Hourly Runtime
2/26/2022 to 3/3/2022
Assumptions
- Pump 3 was offline and placed back in service 2/25/2022.
Observations
- Pump Station 21 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation

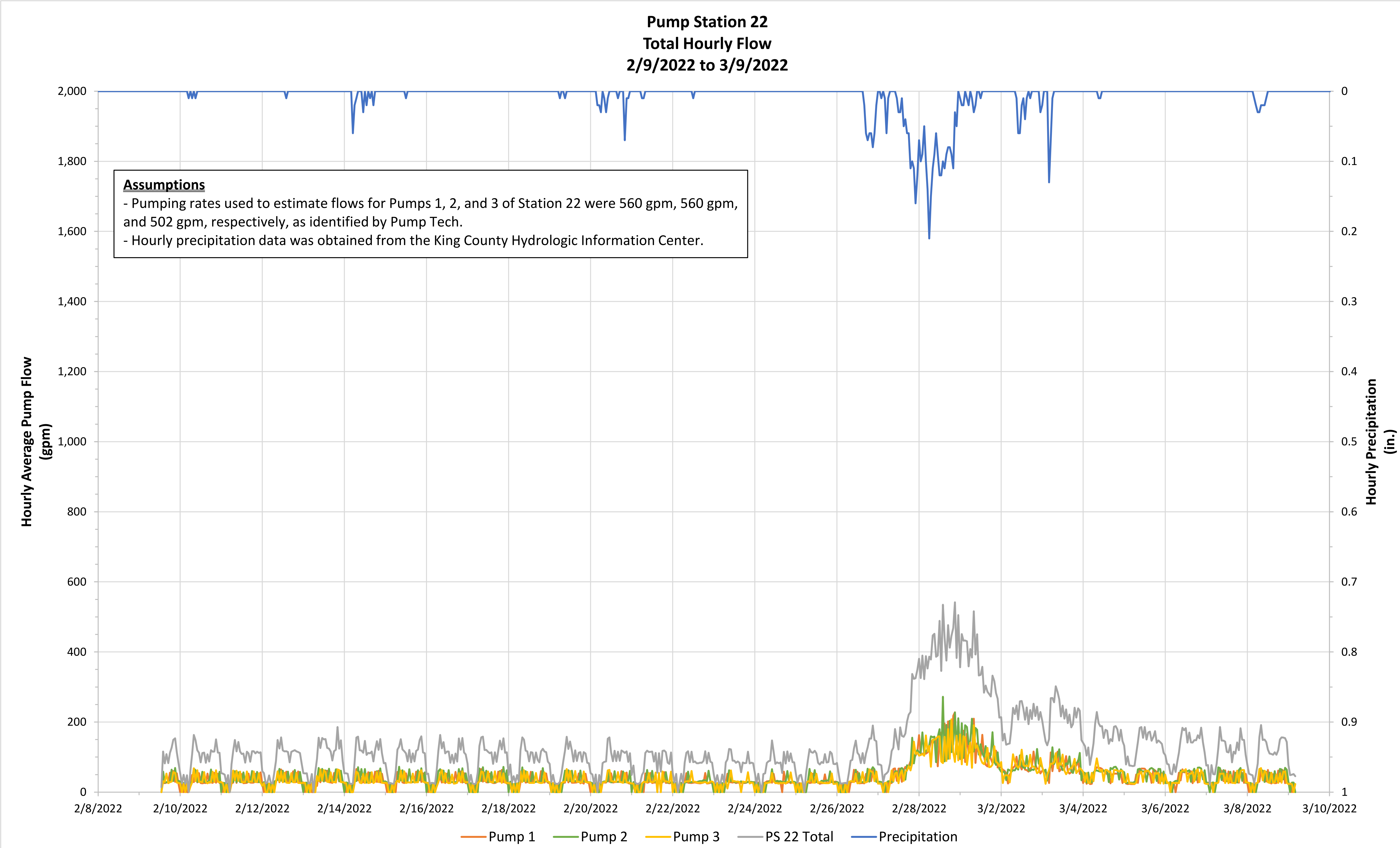

Pump Station 22
Total Hourly Runtime
2/26/2022 to 3/3/2022
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0.25
0.5
0.75
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

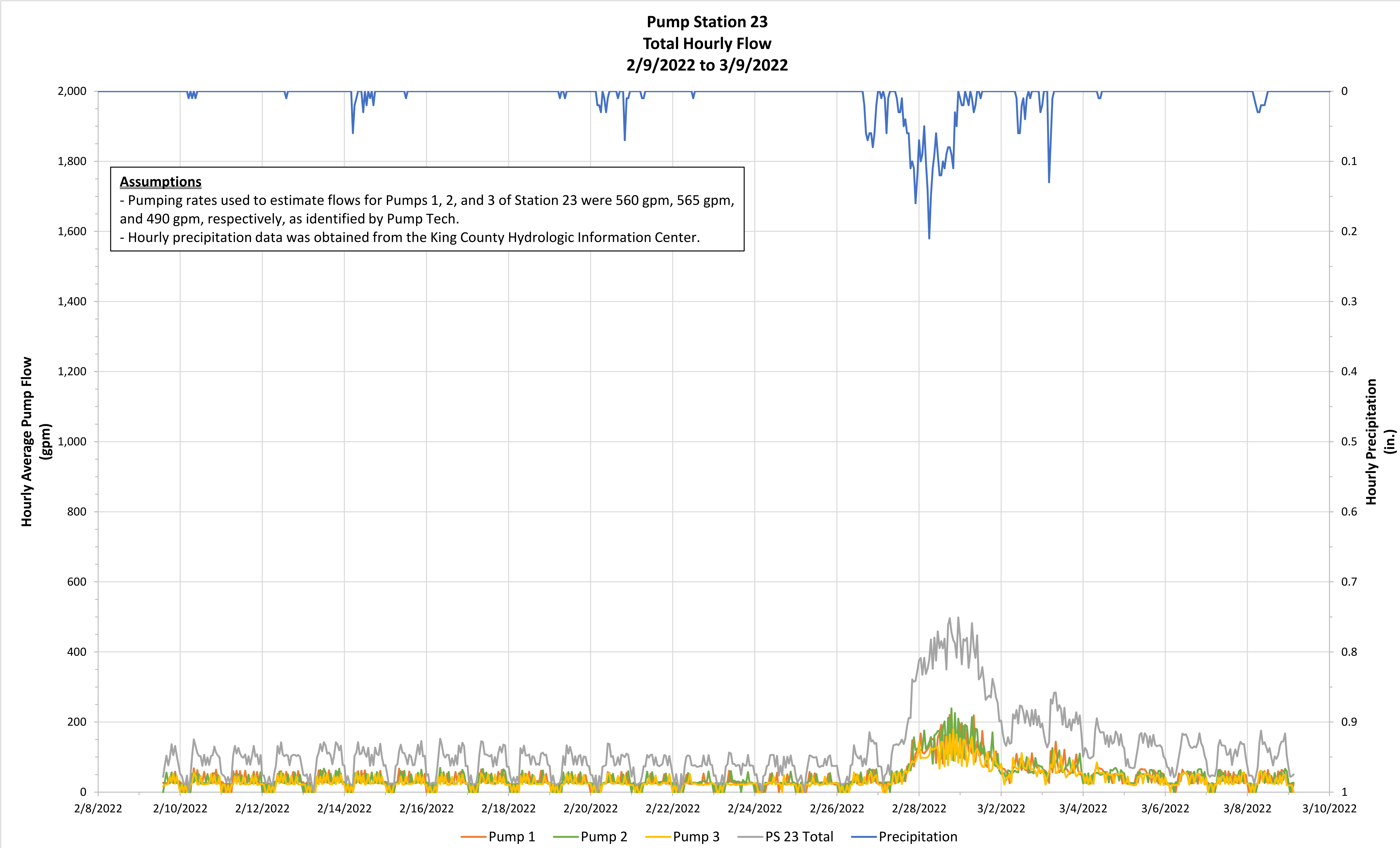

Pump Station 23
Total Hourly Runtime
2/26/2022 to 3/3/2022
Total Runtime per Hour (min.)
Hourly Precipitation (in.)
100
75
50
25
0
0
0.25
0.5
0.75
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation

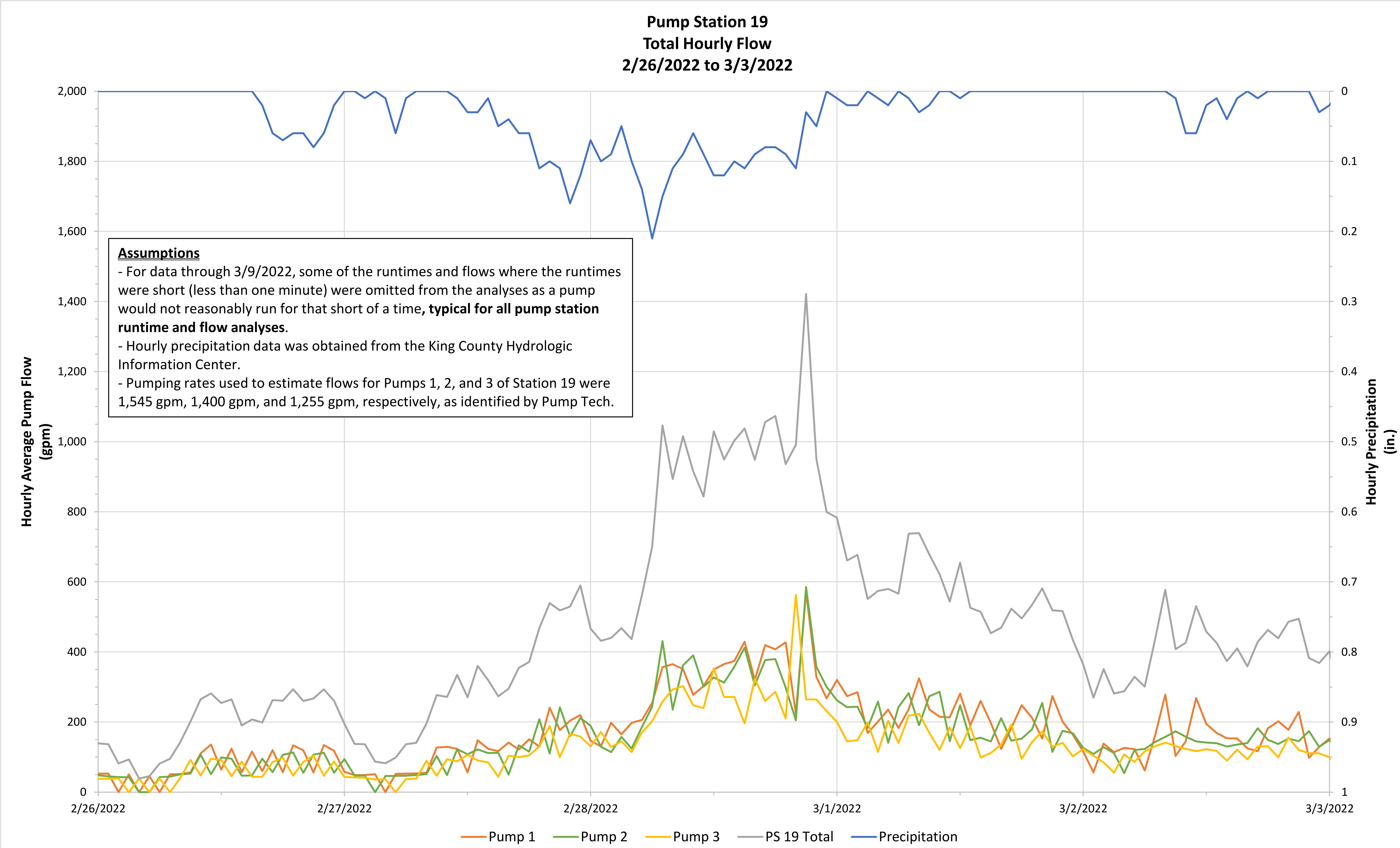

Pump Station 19
Total Hourly Flow
2/9/2022 to 3/9/2022
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/8/2022
2/10/2022
2/12/2022
2/14/2022
2/16/2022
2/18/2022
2/20/2022
2/22/2022
2/24/2022
2/26/2022
2/28/2022
3/2/2022
3/4/2022
3/6/2022
3/8/2022
3/10/2022
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation
Assumptions
- For data through 3/9/2022, some runtimes and flows where the runtimes were short (less than one minute) were omitted from the analyses as a pump would not reasonably run for that short of a time, typical for all pump station runtime and flow analyses.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 19 were 1,545 gpm, 1,400 gpm, and 1,255 gpm, respectively, as identified by Pump Tech.

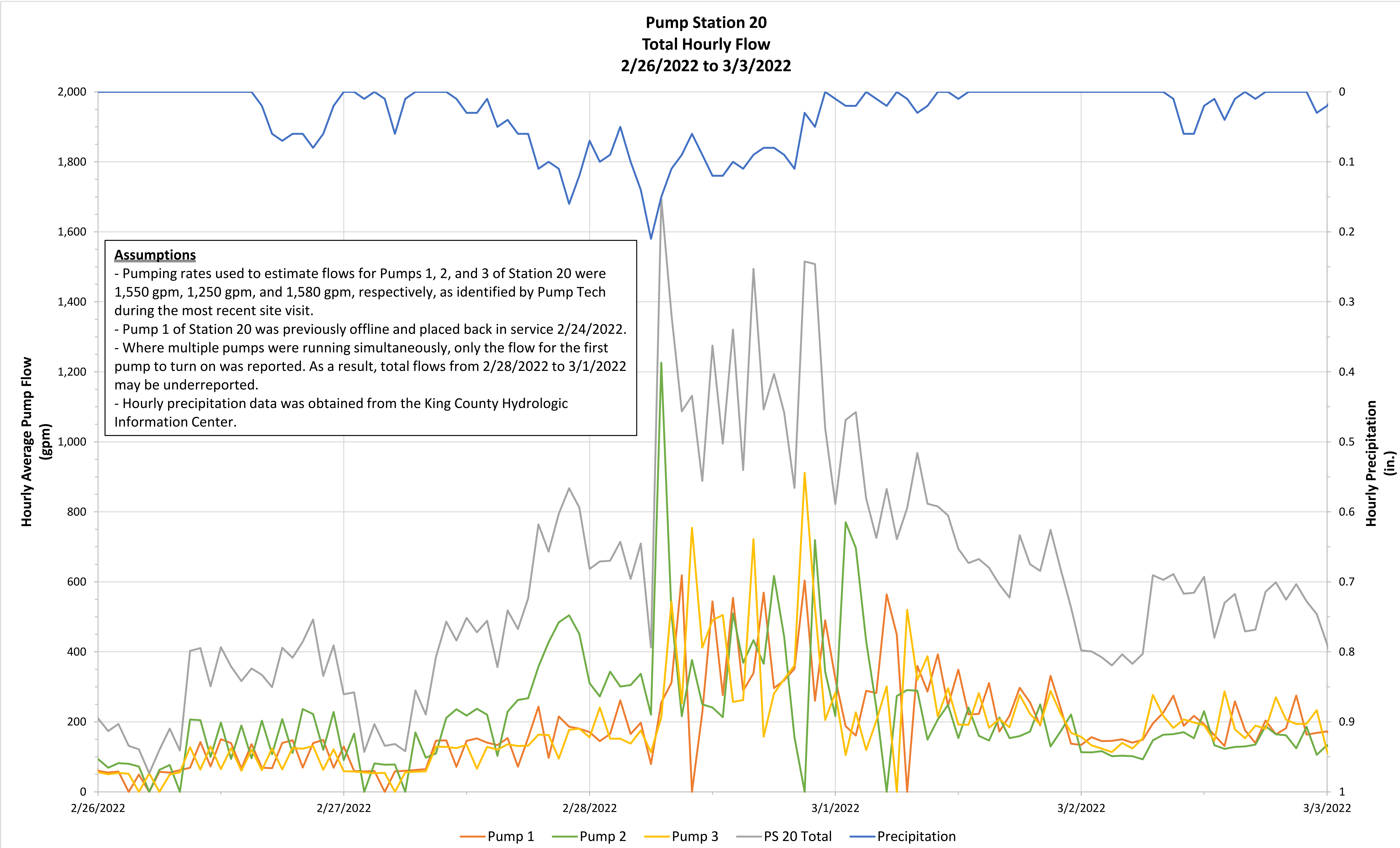

Pump Station 20
Total Hourly Flow
2/9/2022 to 3/9/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 20 were 1,550 gpm, 1,250 gpm, and 1,580 gpm, respectively, as identified by Pump Tech during the most recent site visit.
- Pump 1 of Station 20 was previously offline and placed back in service 2/24/2022.
- Where multiple pumps were running simultaneously, only the flow for the first pump to turn on was reported. As a result, total flows from 2/28/2022 to 3/1/2022 may be underreported.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Observations
- Pump Station 20 was the only pump station where more than one pump ran at the same time from 2/9/2022 to 3/9/2022. Station 20 had 42 instances where more than one pump was running at the same time from 2/9/2022 to 3/9/2022.
- Pump Station 20 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/8/2022
2/10/2022
2/12/2022
2/14/2022
2/16/2022
2/18/2022
2/20/2022
2/22/2022
2/24/2022
2/26/2022
2/28/2022
3/2/2022
3/4/2022
3/6/2022
3/8/2022
3/10/2022
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation

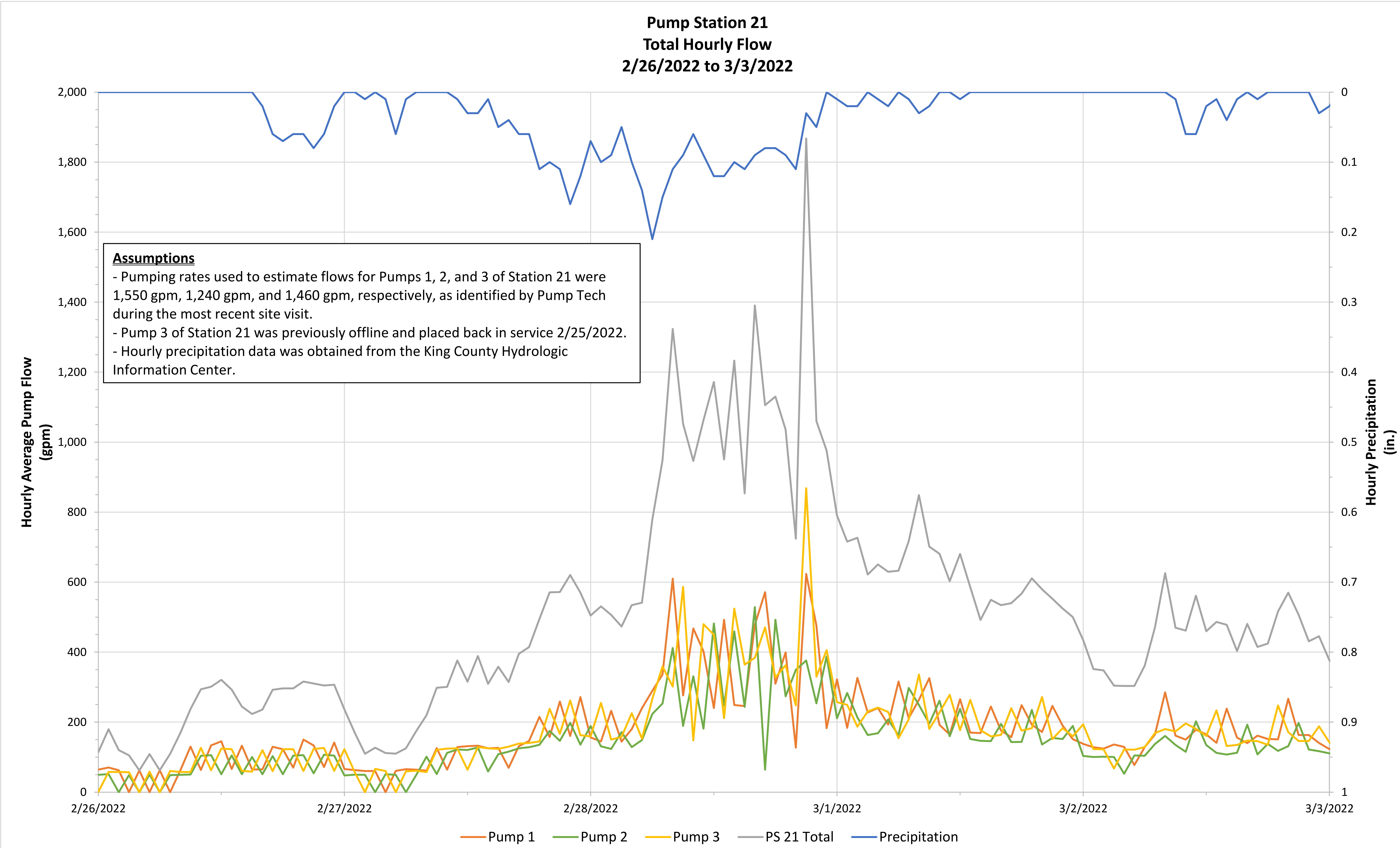

Pump Station 21
Total Hourly Flow
2/9/2022 to 3/9/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 21 were 1,550 gpm, 1,240 gpm, and 1,460 gpm, respectively, as identified by Pump Tech during the most recent site visit.
- Pump 3 of Station 21 was previously offline and placed back in service 2/25/2022.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Observations
- Pump Station 21 had many instances where the pumps did not operate sequentially. That is, one pump would turn on after it had already run, instead of having the next pump in the sequence turn on.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/8/2022
2/10/2022
2/12/2022
2/14/2022
2/16/2022
2/18/2022
2/20/2022
2/22/2022
2/24/2022
2/26/2022
2/28/2022
3/2/2022
3/4/2022
3/6/2022
3/8/2022
3/10/2022
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation

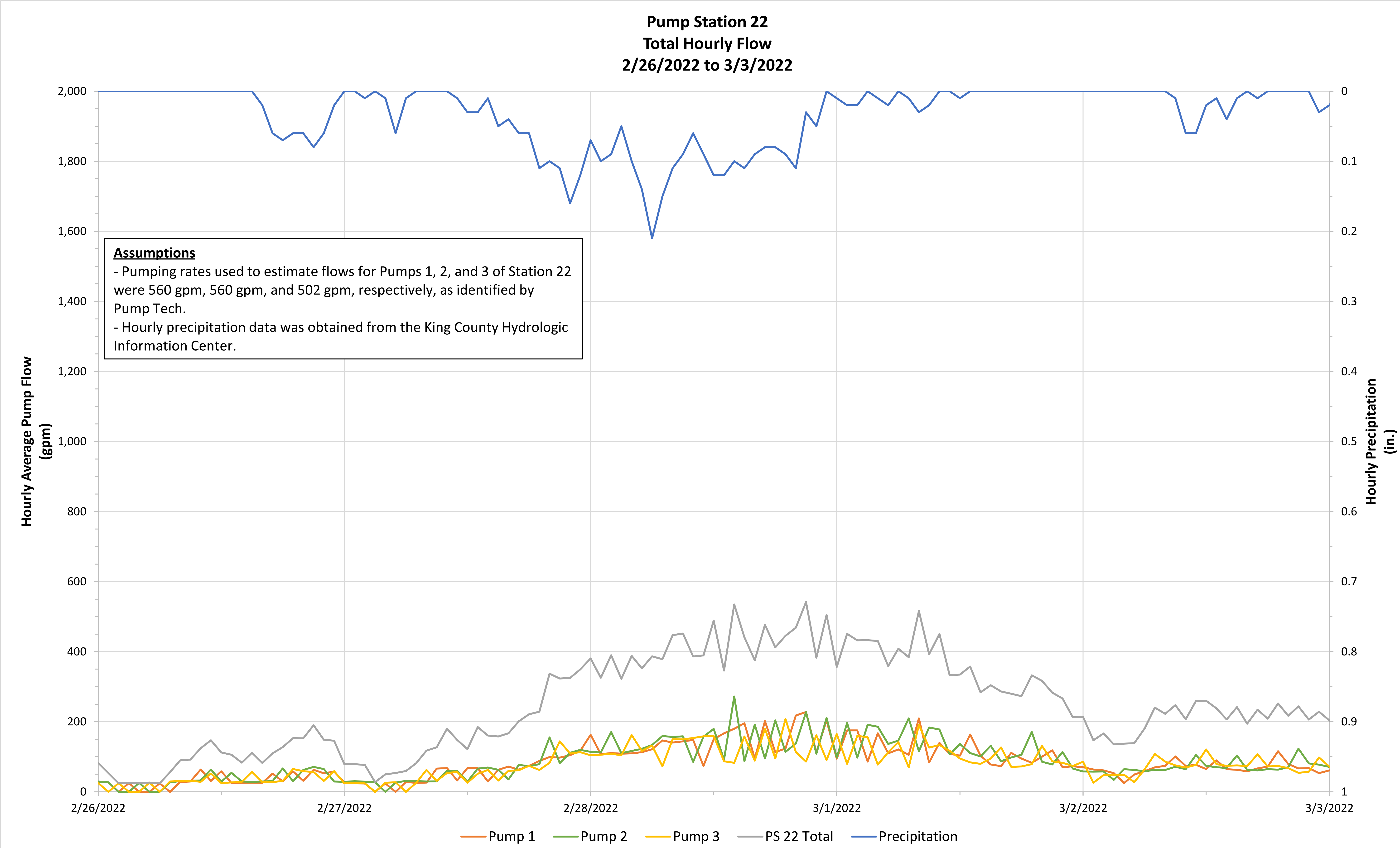

Pump Station 22
Total Hourly Flow
2/9/2022 to 3/9/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 22 were 560 gpm, 560 gpm, and 502 gpm, respectively, as identified by Pump Tech.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/8/2022
2/10/2022
2/12/2022
2/14/2022
2/16/2022
2/18/2022
2/20/2022
2/22/2022
2/24/2022
2/26/2022
2/28/2022
3/2/2022
3/4/2022
3/6/2022
3/8/2022
3/10/2022
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

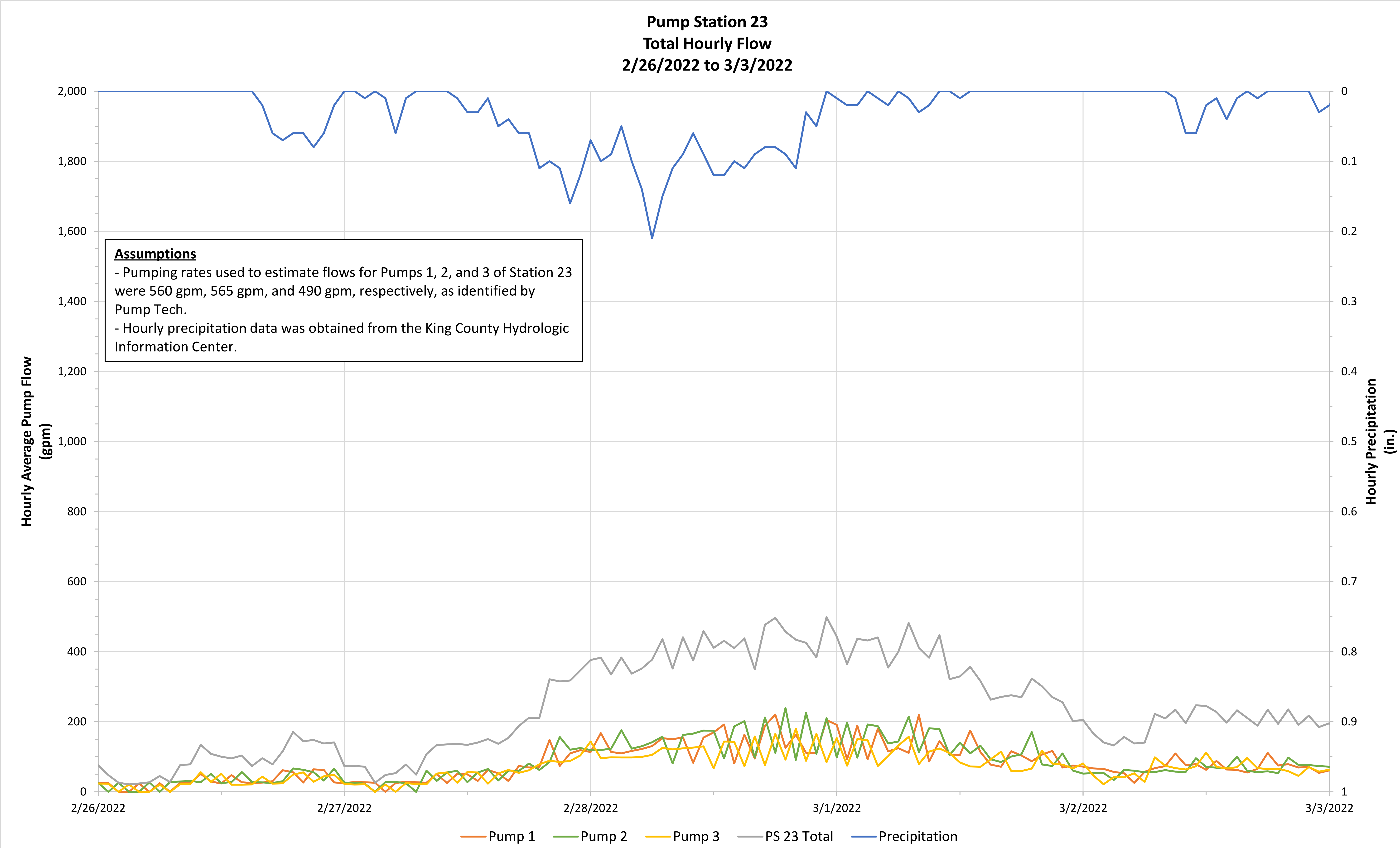

Pump Station 23
Total Hourly Flow
2/9/2022 to 3/9/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 23 were 560 gpm, 565 gpm, and 490 gpm, respectively, as identified by Pump Tech.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/8/2022
2/10/2022
2/12/2022
2/14/2022
2/16/2022
2/18/2022
2/20/2022
2/22/2022
2/24/2022
2/26/2022
2/28/2022
3/2/2022
3/4/2022
3/6/2022
3/8/2022
3/10/2022
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation

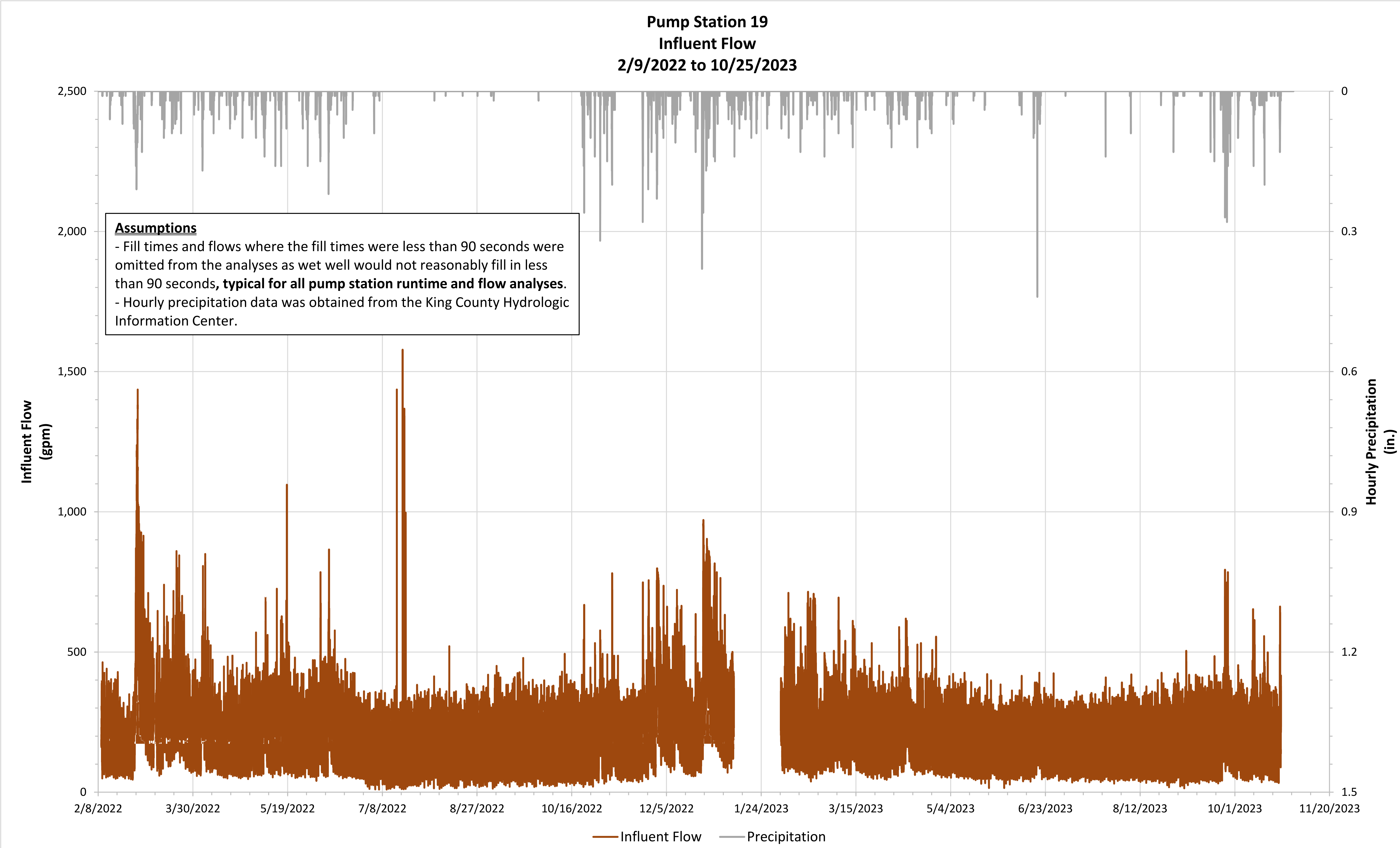

Pump Station 19
Total Hourly Flow
2/26/2022 to 3/3/2022
Assumptions
- For data through 3/9/2022, some of the runtimes and flows where the runtimes were short (less than one minute) were omitted from the analyses as a pump would not reasonably run for that short of a time, typical for all pump station runtime and flow analyses.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 19 were 1,545 gpm, 1,400 gpm, and 1,255 gpm, respectively, as identified by Pump Tech.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 19 Total
Precipitation

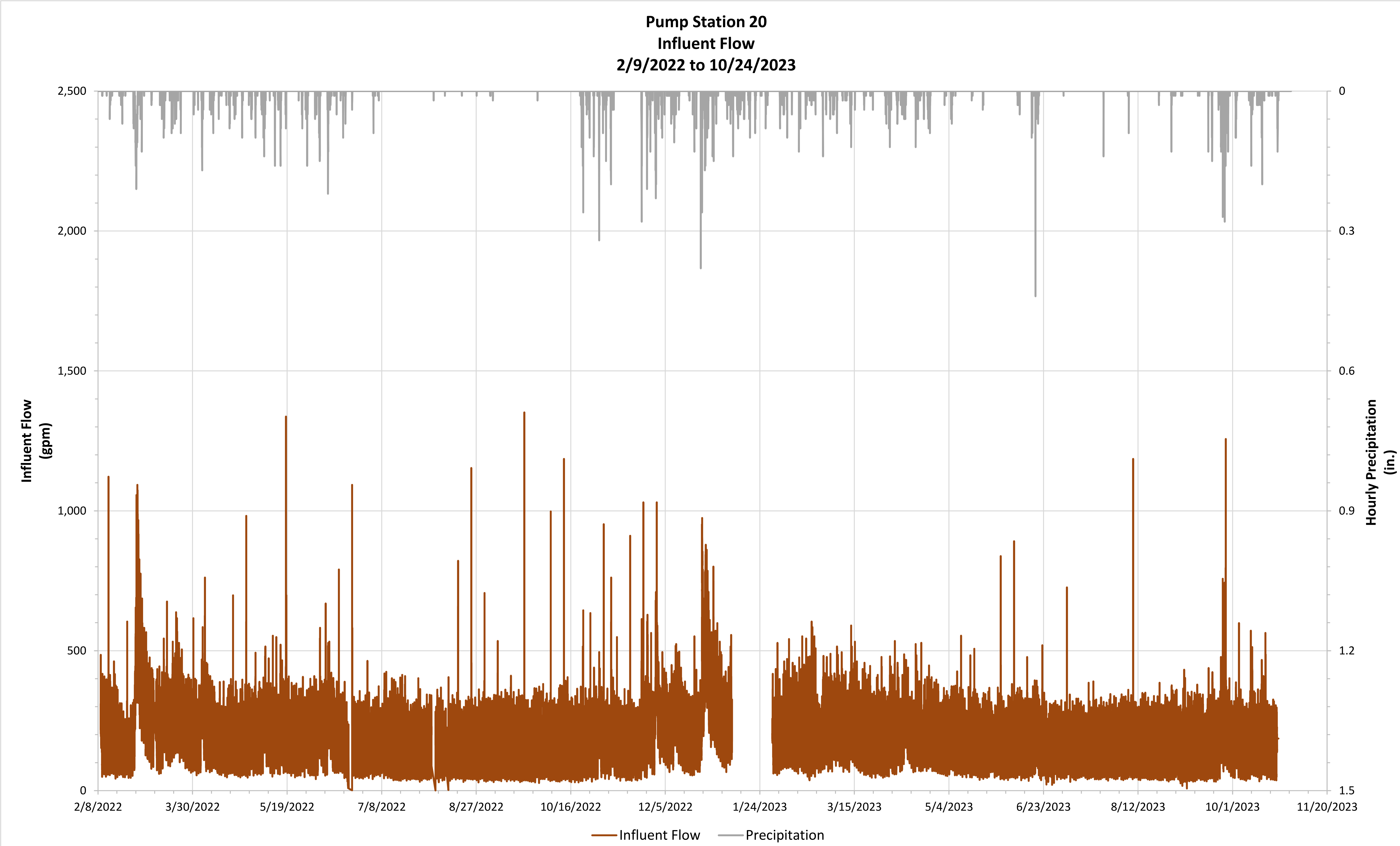

Pump Station 20
Total Hourly Flow
2/26/2022 to 3/3/2022
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 20 were 1,550 gpm, 1,250 gpm, and 1,580 gpm, respectively, as identified by Pump Tech during the most recent site visit.
- Pump 1 of Station 20 was previously offline and placed back in service 2/24/2022.
- Where multiple pumps were running simultaneously, only the flow for the first pump to turn on was reported. As a result, total flows from 2/28/2022 to 3/1/2022 may be underreported.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Pump 1
Pump 2
Pump 3
PS 20 Total
Precipitation

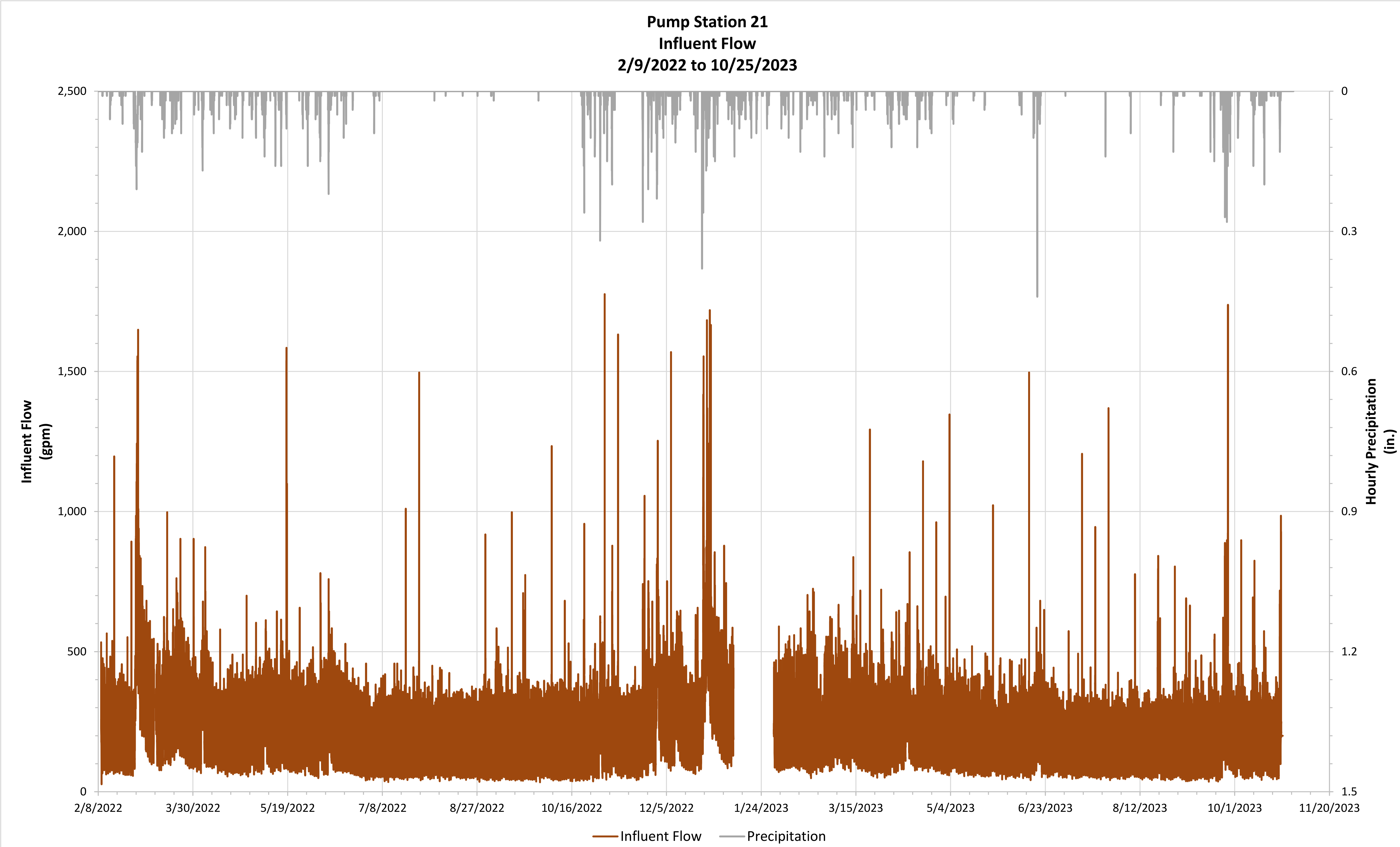

Pump Station 21
Total Hourly Flow
2/26/2022 to 3/3/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 21 were 1,550 gpm, 1,240 gpm, and 1,460 gpm, respectively, as identified by Pump Tech during the most recent site visit.
- Pump 3 of Station 21 was previously offline and placed back in service 2/25/2022.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 21 Total
Precipitation

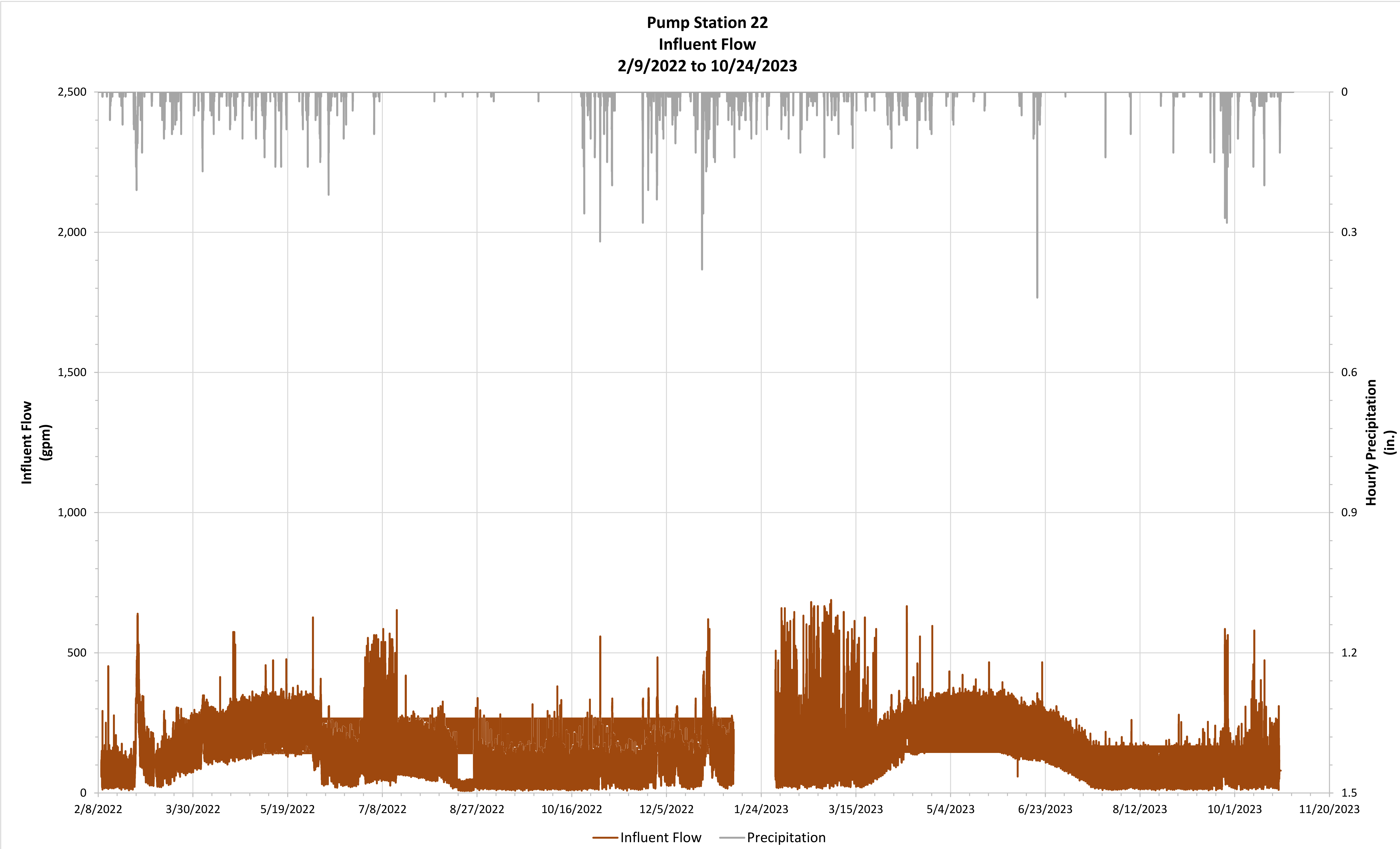

Pump Station 22
Total Hourly Flow
2/26/2022 to 3/3/2022
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 22 were 560 gpm, 560 gpm, and 502 gpm, respectively, as identified by Pump Tech.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 22 Total
Precipitation

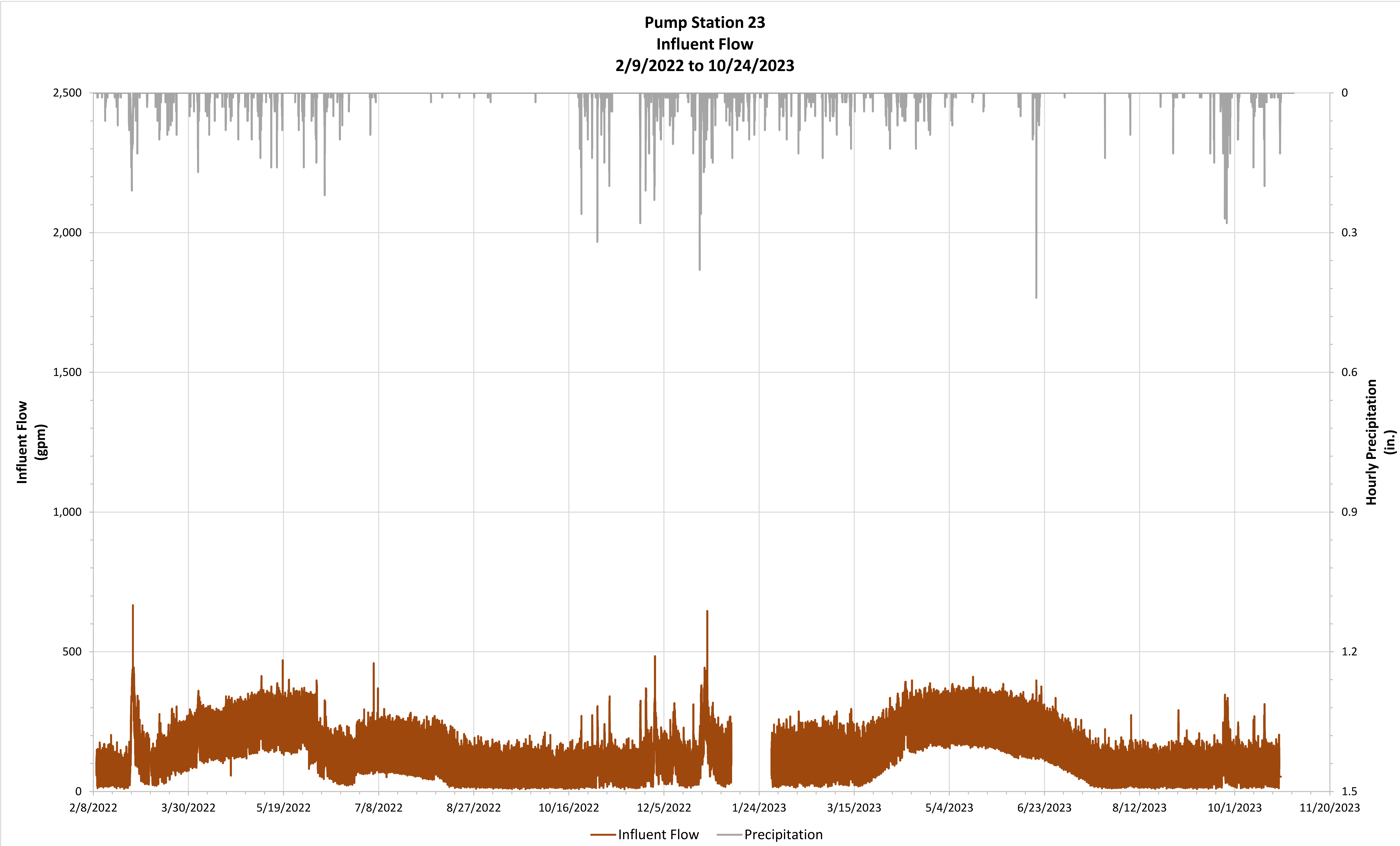

Pump Station 23
Total Hourly Flow
2/26/2022 to 3/3/2022
Hourly Average Pump Flow (gpm)
Hourly Precipitation (in.)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Pump 1
Pump 2
Pump 3
PS 23 Total
Precipitation
Assumptions
- Pumping rates used to estimate flows for Pumps 1, 2, and 3 of Station 23 were 560 gpm, 565 gpm, and 490 gpm, respectively, as identified by Pump Tech.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.

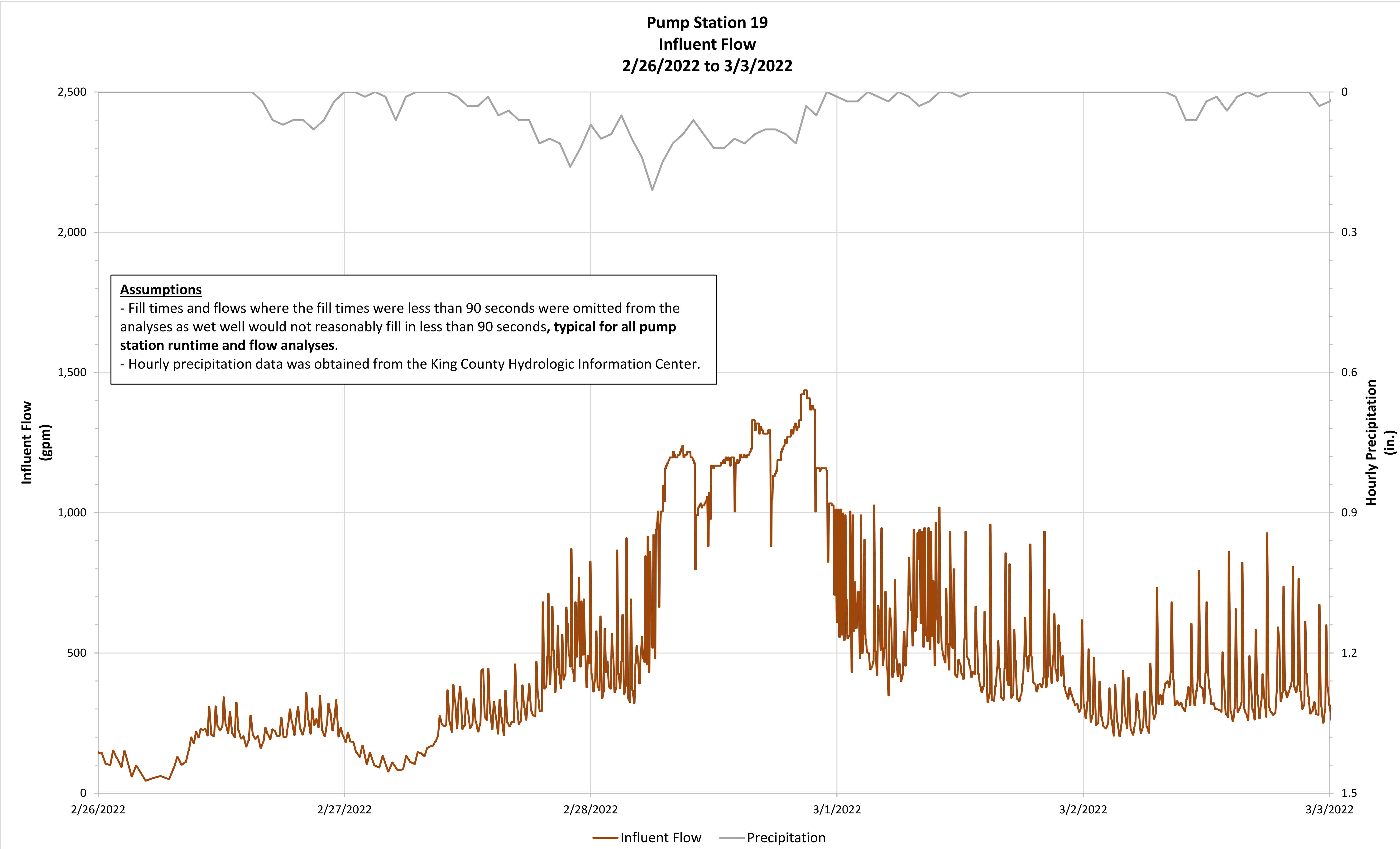

Pump Station 19
Influent Flow
2/9/2022 to 10/25/2023
Assumptions
- Fill times and flows where the fill times were less than 90 seconds were omitted from the analyses as wet well would not reasonably fill in less than 90 seconds, typical for all pump station runtime and flow analyses.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Influent Flow
Precipitation

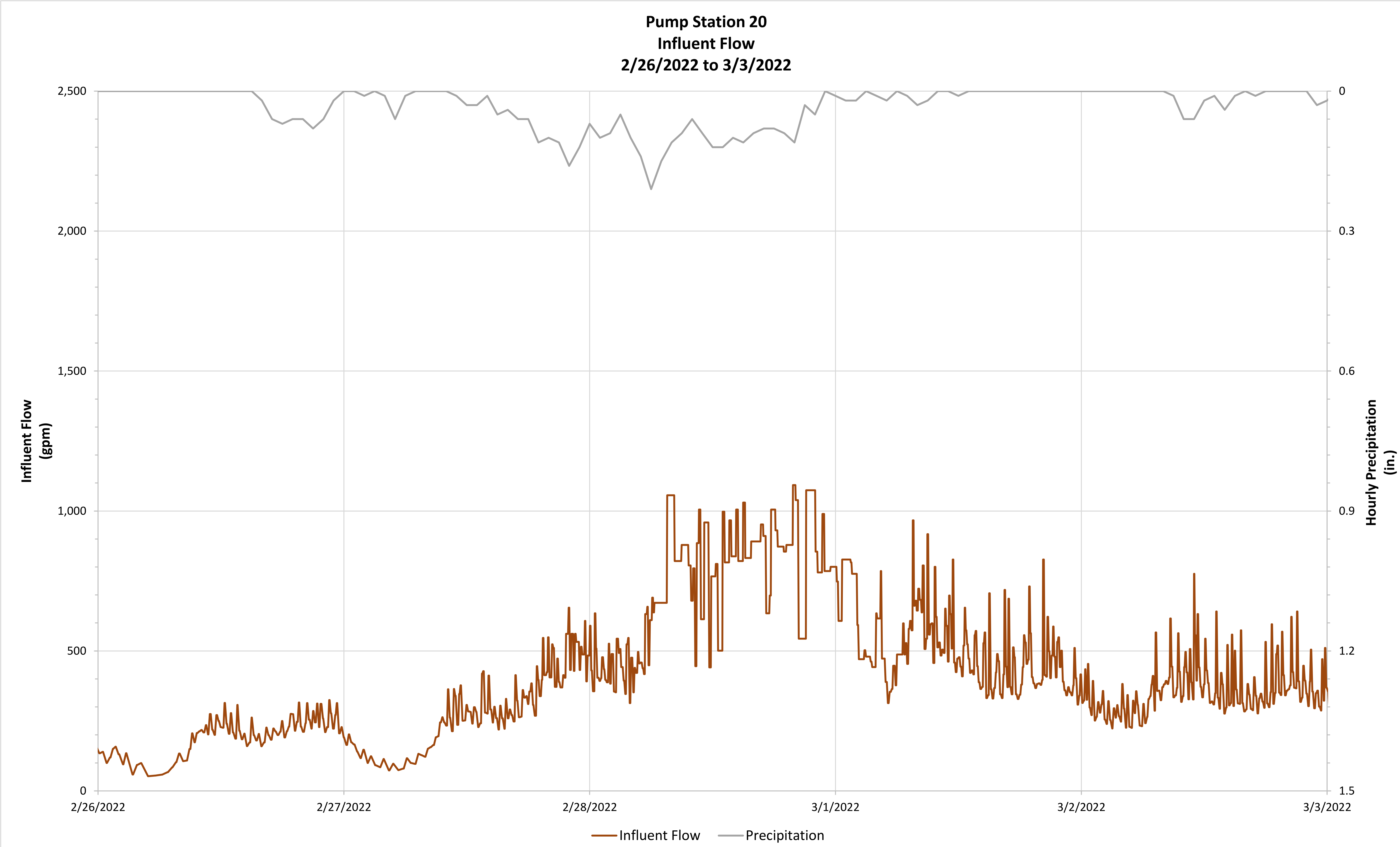

Pump Station 20
Influent Flow
2/9/2022 to 10/24/2023
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Influent Flow
Precipitation

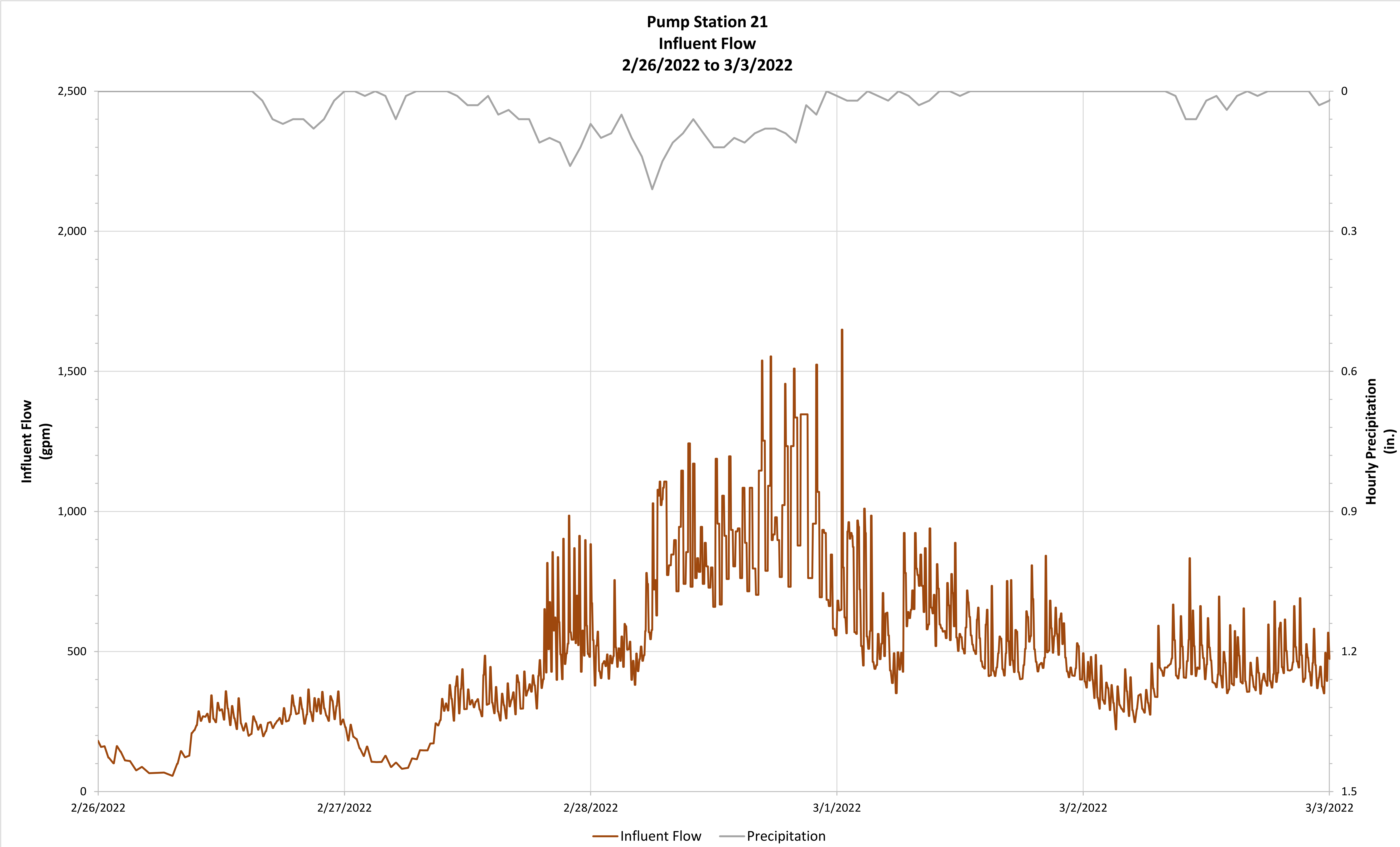

Pump Station 21
Influent Flow
2/9/2022 to 10/25/2023
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Influent Flow
Precipitation

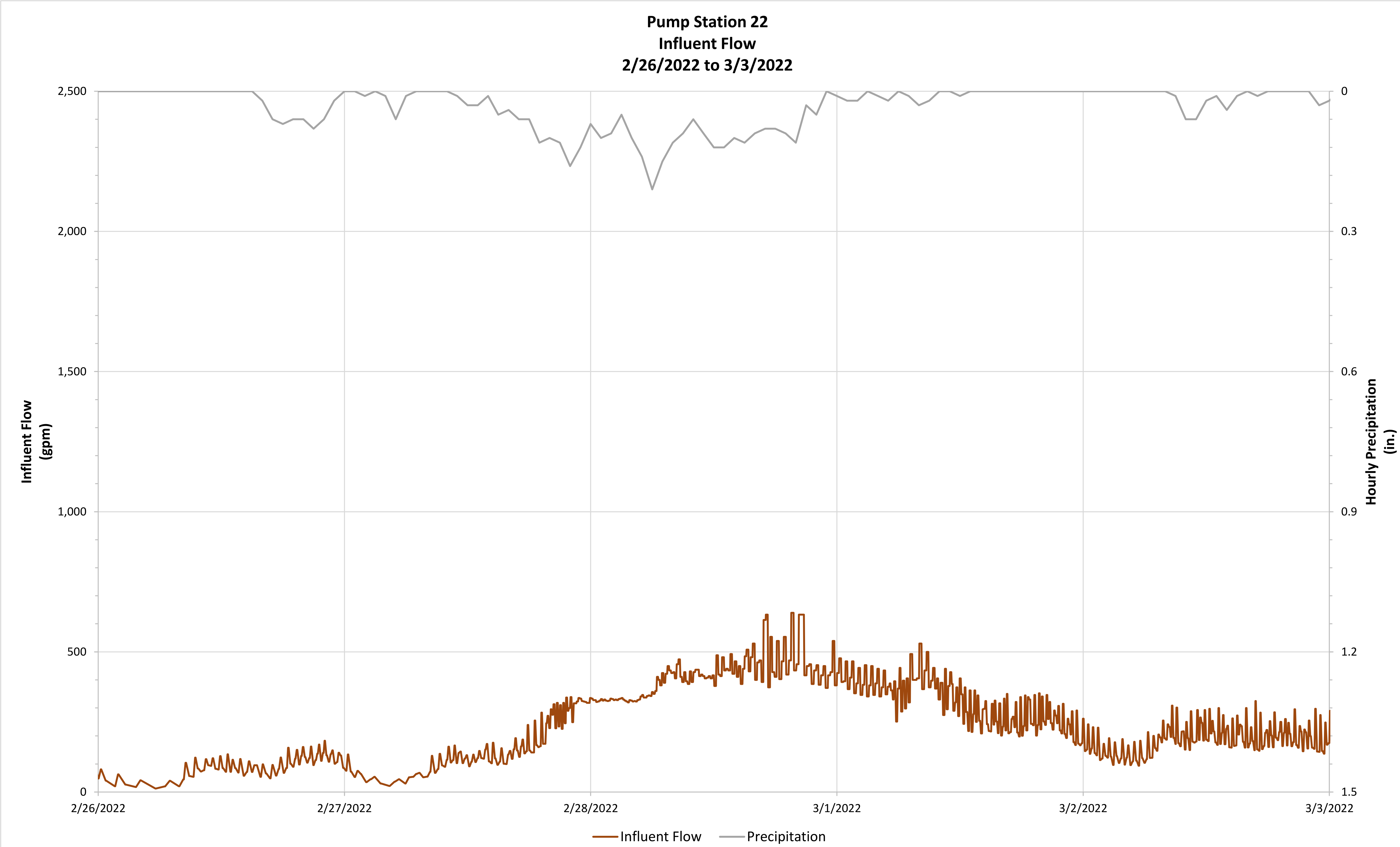

Pump Station 22
Influent Flow
2/9/2022 to 10/24/2023
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Influent Flow
Precipitation

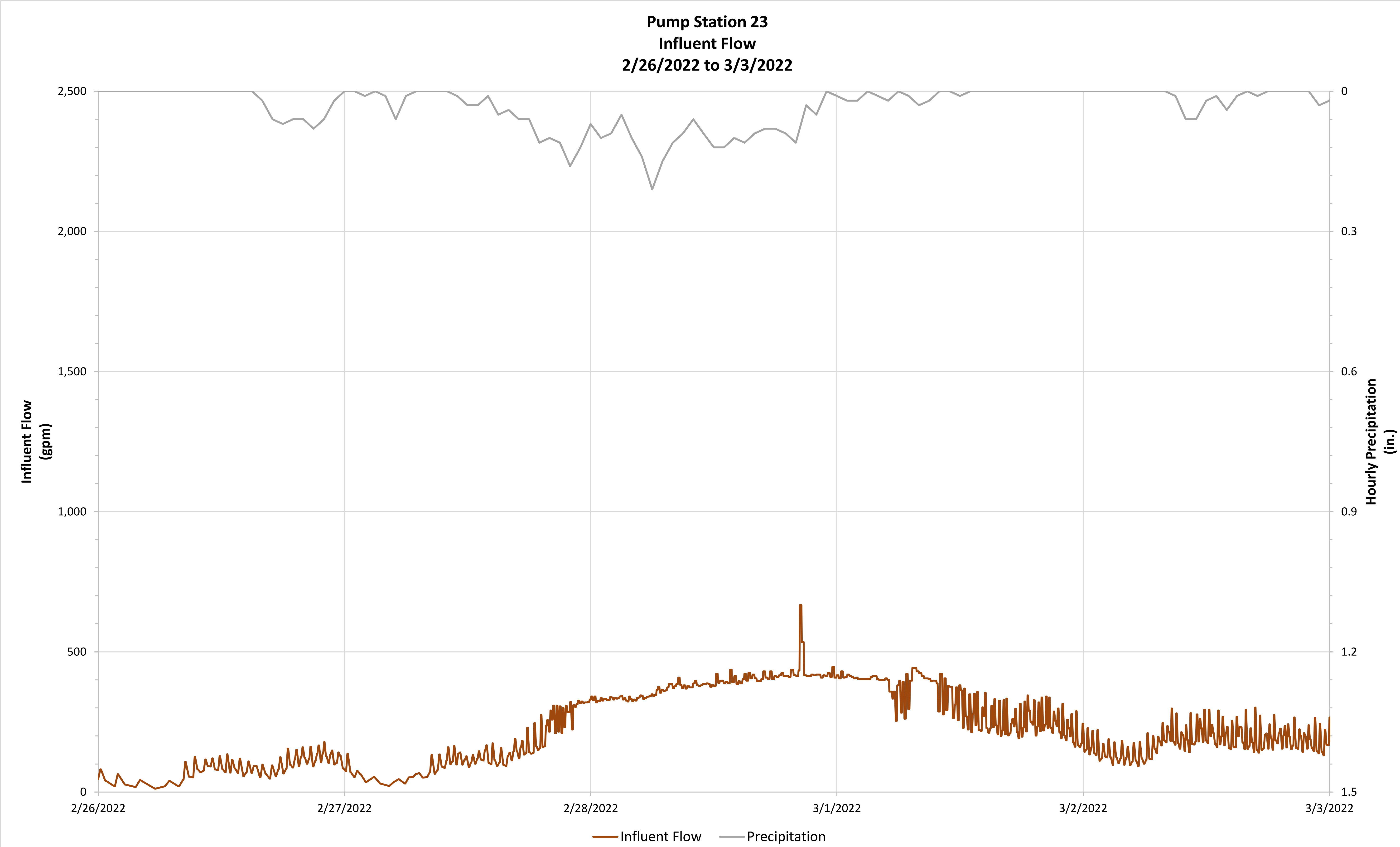

Pump Station 23
Influent Flow
2/9/2022 to 10/24/2023
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
5/4/2023
6/23/2023
8/12/2023
10/1/2023
11/20/2023
Influent Flow
Precipitation


Pump Station 19
Influent Flow
2/26/2022 to 3/3/2022
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Influent Flow
Precipitation
Assumptions
- Fill times and flows where the fill times were less than 90 seconds were omitted from the analyses as wet well would not reasonably fill in less than 90 seconds, typical for all pump station runtime and flow analyses.
- Hourly precipitation data was obtained from the King County Hydrologic Information Center.


Pump Station 20
Influent Flow
2/26/2022 to 3/3/2022
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Influent Flow
Precipitation


Pump Station 21
Influent Flow
2/26/2022 to 3/3/2022
Influent Flow
(gpm)
Hourly Precipitation
(in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Influent Flow
Precipitation


Pump Station 22
Influent Flow
2/26/2022 to 3/3/2022
Influent Flow
(gpm)
Hourly Precipitation
(in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Influent Flow
Precipitation


Pump Station 23
Influent Flow
2/26/2022 to 3/3/2022
Influent Flow (gpm)
Hourly Precipitation (in.)
2,500
2,000
1,500
1,000
500
0
0
0.3
0.6
0.9
1.2
1.5
2/26/2022
2/27/2022
2/28/2022
3/1/2022
3/2/2022
3/3/2022
Influent Flow
Precipitation

Appendix C

PumpTech Service Report

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 19	10/24/2023
Equipment ID:	
Pump #1	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-06	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67152	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:

City of Mercer Island

Job Number:

162240

Station ID:

Lift Station 19

DATE:

10/24/2023

Equipment ID:

Pump #1

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	488	V1-grd	280	**0.60**
V_{2-3}	492	V2-grd	276.5	
V_{1-2}	493	V3-grd	294	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.7	Ω
L_{1-2}	1.7	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 19
DATE:	10/24/2023
Equipment ID:	Pump #1
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	481.0
V_{2-3}	486.4
V_{1-2}	485.0
V1-grd	276.0
V2-grd	272.0
V3-grd	290.0
$V_{average}$	484.13
Imbalance*	**0.65**

AMPS

A_1	14.9
A_2	14.5
A_3	15.0
Imbalance*	**2.03**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	7.0
Estimated Friction	
Gage Height	2.1
Ft	18.3

Data Point	1
TDH	18.3
Flow	1545.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

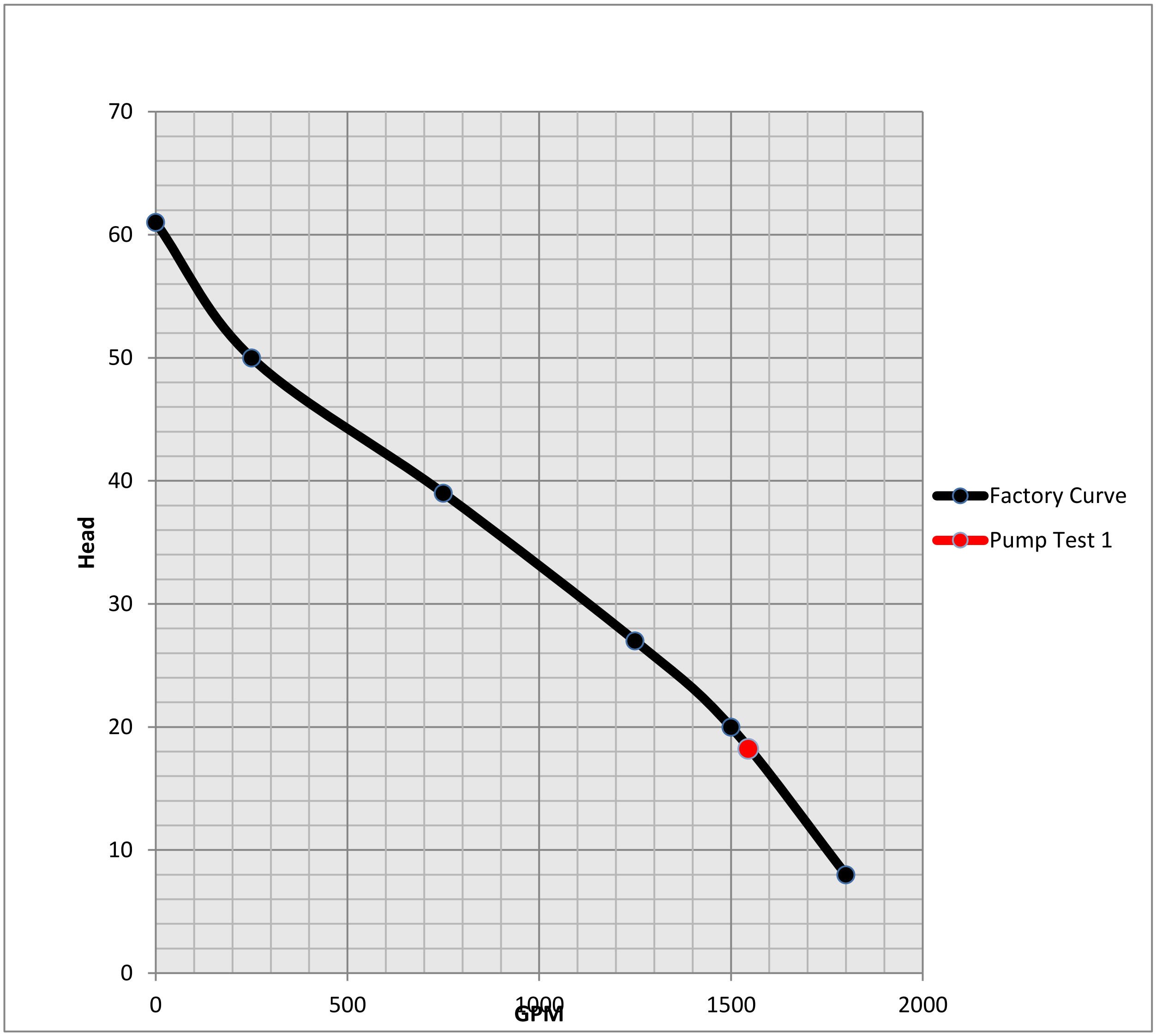
Lift Station 19

DATE:

10/24/2023

Equipment ID:

Pump #1



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 19	10/24/2023

Equipment ID: Pump #2

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-03	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67632	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:

City of Mercer Island

Job Number:

162240

Station ID:

Lift Station 19

DATE:

10/24/2023

Equipment ID:

Pump #2

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

V_{1-3}	488	V1-grd	280	Imbalance
V_{2-3}	492	V2-grd	276.5	**0.60**
V_{1-2}	493	V3-grd	294	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.6	Ω
L_{1-2}	1.6	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 19
DATE:	10/24/2023
Equipment ID:	Pump #2
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	482.0
V_{2-3}	485.0
V_{1-2}	487.0
V1-grd	276.5
V2-grd	272.0
V3-grd	290.5
$V_{average}$	484.67
Imbalance*	**0.55**

AMPS

A_1	15.2
A_2	15.2
A_3	15.9
Imbalance*	**3.02**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	7.0
Estimated Friction	
Gage Height	2.1
Ft	18.3

Data Point	1
TDH	18.3
Flow	1400.0

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FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

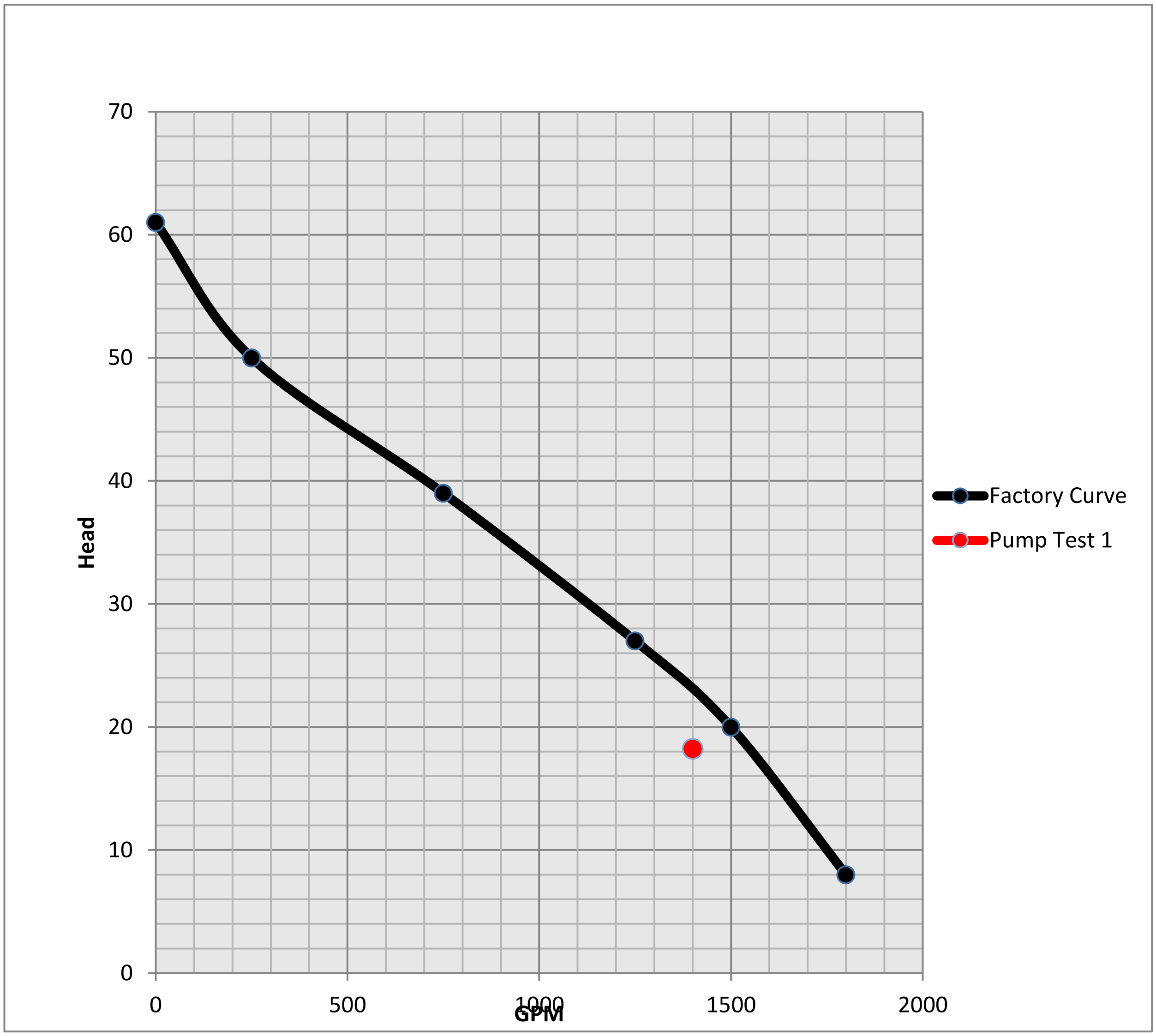
Lift Station 19

DATE:

10/24/2023

Equipment ID:

Pump #2



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 19	10/24/2023

Equipment ID: Pump #3

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-09	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67633	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 19	10/24/2023
Equipment ID:	**Test Criteria**
Pump #3	

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	488	V1-grd	280	**0.60**
V_{2-3}	492	V2-grd	276.5	
V_{1-2}	493	V3-grd	294	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.7	Ω
L_{1-2}	1.6	Ω

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FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 19	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #3	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	481.7
V_{2-3}	485.5
V_{1-2}	486.5
V1-grd	276.0
V2-grd	272.0
V3-grd	290.0
$V_{average}$	484.57
Imbalance*	**0.59**

AMPS

A_1	13.3
A_2	12.8
A_3	13.6
Imbalance*	**3.27**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	6.8
Estimated Friction	
Gage Height	2.1
Ft	17.7

Data Point	1
TDH	17.7
Flow	1255.0

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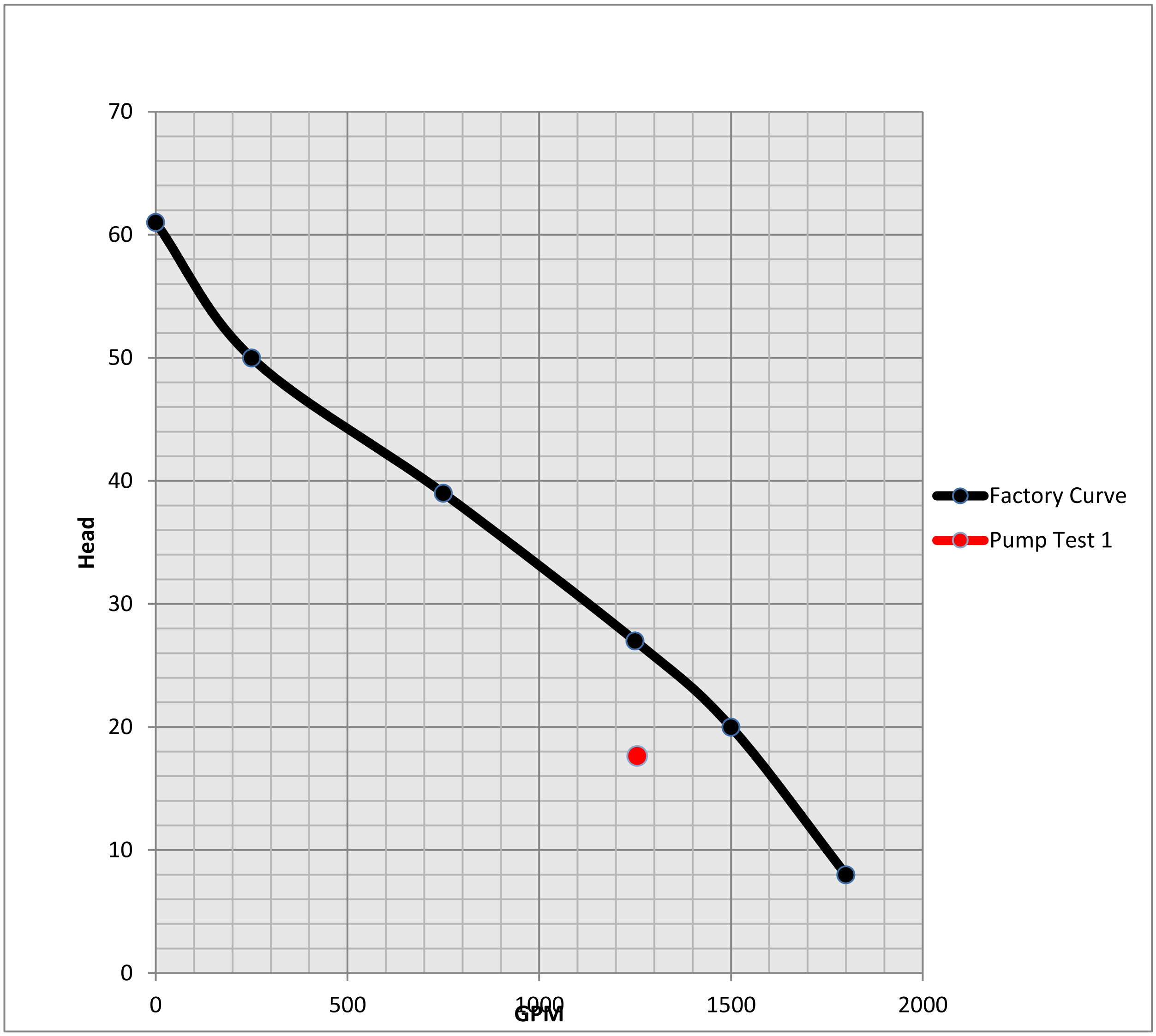
FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:	Job Number
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 19	10/24/2023
Equipment ID:	
Pump #3	



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

PumpTech an impel company

Job Name:

City of Mercer Island

Station ID:

Lift Station 19

Job Number:

162240

DATE:

10/24/2023

	Pump # 1	Pump # 2	Pump # 3
Top Motor X	0.602	0.099	0.415
Top Motor Y	0.233	0.106	0.232
Axial	0.041	0.022	0.027
Bottom Motor X	0.386	0.069	0.268
Bottom Motor Y	0.195	0.036	0.169
Top Pump X	0.321	0.049	0.232
Top Pump Y	0.032	0.020	0.031
Axial	0.031	0.029	0.034
Bottom Pump X	0.222	0.027	0.161
Bottom Pump Y	0.018	0.014	0.033

(green)	Acceptable
(yellow)	Warning
(red)	Above Limit

Hydraulic Institute Vibration Limits	
Motor Below 200 kW	0.20 in/s
Pump Below 25 kW	0.30 in/s

PumpTech an impel company

FIELD TEST REPORT

Summary

Job Name:

City of Mercer Island

Job Number:

162240

Station ID:

Lift Station 19

DATE:

10/24/2023

During our Visit the motors on all 3 pumps were checked electrically and the pumps were tested with a drawdown test for flow. During the pump tests we also tested the pumps and motors for vibration. The vibration levels on Pump # 2 were all below the Hydraulic institute's limits but Pump #1 & 3 have points on the motor that are over the limit, this should be monitored with the elevated vibration levels. The pump curve used is an estimation based off of the original book curves and is to be used for reference only. After a tank calculation it was determined to be 50.3065 gallons per inch of drawdown. Drawdown results were the following:

- Pump #1 drawdown was 2.34' in one minute with a fill rate of .22' in one minute.
- Pump #2 drawdown was 2.15' in one minute with a fill rate of .17' in one minute.
- Pump #3 drawdown was 1.84' in one minute with a fill rate of .24' in one minute.

Pumps #2 & 3 both were falling short of the original curve that is expected with the age of the pumps

Recommendations:

- Schedule to have motor serviced (clean, dip and bake)and bearings replaced, or replace with new premium efficient model.
- Open and inspect the pump, checking for clogs and to measure wear ring clearances.
- Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances.
- Pump and motor should have a detailed inspection to determine if replacement is more viable than a repair.

Pumptech Representative

Ronnie Basinger

Print

Signature Date

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Contractor # 270976

SERVING THE PACIFIC NORTHWEST
PUMP SALES & SERVICE

SERVICE REPORT

Date of Service: 2/9/2022
PumpTech Job Number: 162240
Customer: RH2
Contact Name: Kenny Gomez
Phone: 4259515416

Service Location: Mercer Island
Site Name: Lift Station 20 and 21
Address: 9611 SE 36th St
City, State, Zip: Mercer Island, WA 98040

Equipment Serviced:

Lift Station 20: Pumps 202 and 203 (pump 201 out of service)
Lift Station 21: Pumps 211 and 212

Reason for Service/Scope of Work:

Perform pump inspection and testing

WASHINGTON LOCATIONS

WA CONTRACTORS # PUMPTI*945QG

BELLEVUE BRANCH

12020 SE 32nd St, Suite 2
Bellevue, WA 98005
Ph: 425-644-8501
Fax: 425-562-9213
pumptech@pumptechnw.com

MOSES LAKE BRANCH

209 S Hamilton Rd
Moses Lake, WA 98837
Ph: 509-766-6330
Fax: 509-766-6331
moseslake@pumptechnw.com

OREGON LOCATION

OR CONTRACTORS # 154997

CANBY BRANCH

321 S. Sequoia Parkway
Canby, OR 97013
Ph: 503-659-6230
Fax: 503-659-8718
inquiries@pumptechnw.com

IDAHO LOCATION

CALDWELL BRANCH

116 W Kearney
Caldwell, ID 83605
Ph: 208-353-7688
Fax: 509-766-6331
boise@pumptechnw.com

Test Set Up - Stations 20 & 21

Per RH2 request, the stations were equipped with devices to monitor pump cycles and discharge pressure. Discharge pressure recorder mounted on the discharge of one pump, downstream of the check valve.

None of the stations are equipped with flow meters. Flow is estimated by measuring the level change during fill and pump down cycles. Manometer is plumbed to the suction of the pump not being tested. Level rate changes are compared between the manometer and the station's level control.

Volume estimated by tank dimensions taken from the as built drawings.

1. 15' X 5'4"
2. 598.4 gallons per foot
3. 49.9 gallons per inch

Suction pressure is determined from the tank level measured by the manometer.

Discharge pressure is measured at a 1" valve on the vertical rise between the check valve and the discharge valve. Additional friction loss was estimated in the test data using the following values:

1. Discharge (Calculated for 6" steel sch 40 pipe at estimated flow rate)
    a. 6" Swing Check Valve – 40'
    b. 6" Long Radius Bend – 11'
    c. 6" 45 Bend – 8'
    d. 8" X 6" Reducer – 3.5 '
    e. **Total Equivalent fitting friction length = 61.5'**
2. Suction (Calculated for 8" steel sch 40 pipe at estimated flow rate)
    a. 8" Gate vale – 4.5'
    b. 8' Long Radius 90 Bend – 14.5"
    c. **Total Equivalent fitting friction length = 19'**

These value equate to approximately 3.9' of friction loss in Station 20 and 7.1' of Friction loss for Station 21 and are included in our test data and curves.

STANDARDS:

ISO vibration tolerance is warning @.28 in/sec rms and critical @ .43 in/sec rms.

Hydraulic Institute tolerance is .3 in/sec rms at the top of the pump.

Lift Station 20

1. Pump Control Panel
    a. Looks to be original equipment
    b. Panel is clean and dry.
    c. Gray powder below contactors.
2. Pump RSP 201
    a. Pump had a leaking mechanical seal and was removed at the time of testing.
    b. Electrical checks performed on the motor.
        - Winding Insulation resistance: 410 Mohms (this is low and indicates potential failure of the insulation in the motor windings.
        - Winding resistance: 1.5 ohms
    c. Motor should be taken in for service (Clean, dip, bake, replace bearings) or replaced with a new higher efficiency model. The lower insulation readings are indicators of windings that are dirty and /or failing.
3. Pump RSP 202
    a. Pump has a minor seal leak
    b. Pump has excessive vibration
    c. Pump down rate is noticeably slower than Pump 3
    d. Check valve has a leak on the stem
    e. See attached documents for details
4. Pump RSP 203
    a. Check valve chatters during operation. May be signs that valve components are loosening.
    b. Discharge valve has a significant leak at the stem
    c. See attached documents for details

General:

1. The pump station dry well looks to be in relatively good condition for the age of the station.
2. There is some minor surface corrosion where paint is missing.
3. Flow estimates were difficult to obtain. Fill and pump down rates were erratic. One test would fill at .3 ft/min, the next would be at .9 ft /min. Suspect this erratic fill rate may be the cause behind the performance test results being so far off the curve.
4. Unable to determine if the gate valves are properly seating. Would need more testing to determine how well they hold when closed. Due to their age, replacement should be considered with a type better designed for sewage.
5. The check valves should also be inspected and consider replacing due to their age.

Pump Control Panel:

1. Incoming power is 480v, 3 phase with high leg to ground
2. Unloaded voltage is balanced
3. The gray dust below the contacts is usually from arcing contacts indicating wear.
4. Arcing reduces the performance of the contact and increases circuit resistance
5. This may explain higher than expected motor current
6. Parts for older contacts are getting harder to find. Would recommend considering replacing them with current models or upgrading the entire panel to increase reliability.

PUMP RSP 202

Test Results

1. Electrical
    a. Motor tests: Unloaded
        i. Motor insulation tested good at 2.2 Giga-ohms, all legs
        ii. Motor winding resistance even between all legs at 1.9 ohms
    b. Motor test: Loaded
        i. Voltage Balanced at .44%
        ii. Amperage is above the 14.5 FLA at an average of 15.1
2. Hydraulic
    a. Shutoff test fell well short the factory curve
    b. Dynamic test also fell short of the factory curve
3. Vibration
    a. Pump has excessive vibration
    b. Highest overall is 1.28 @ Motor Top, perpendicular to discharge
    c. Simple spectrum shows high X1 (unbalance) with harmonics indicating lower motor bearing contributing.
4. Thermal Imaging and temperature readings at bearings did not show areas of concern
    a. Bearing Temps
        i. Motor Top – 58
        ii. Motor Bottom – 60
        iii. Pump Top – 78
        iv. Pump Bottom - 71

Conclusions

The results of the test indicate there are several issues. The cause of the high vibration readings needs to be identified. It is doubtful the imbalance is from the motor and more likely from the pump. A partial blockage could cause the low flow, higher than expected amps, and an unbalance condition. The bearing fault seen in the spectrum indicates there may be a bearing failing in the motor.

Failure to achieve the shutoff head could be contributed to impeller and casing wear and/or due to the discharge valve not closing fully.

Recommendations

1. Finding and correcting the source of the excessive vibration is critical. The present vibration levels will quickly lead to damage throughout the pump.
2. Open and inspect the pump. Check for clogs and measure wear ring clearances.
3. Uncouple and run the motor alone, measure unloaded amps and check vibration
4. Schedule to have motor serviced (clean, dip and bake) and bearings replaced. Or replace with new premium efficient model.
5. Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances. Pump and motor should have a detailed inspection to determine if replacement is more viable to repair.
6. Higher level of vibration analysis may be required if source of vibration cannot be determined through visual inspections

PUMP RSP 203

1. Electrical
    a. Motor tests: Unloaded
        i. Motor insulation tested good at 2.2 Giga-ohms, all legs
        ii. Motor winding resistance even between all legs at 1.7 ohms
    b. Motor test: Loaded
        i. Voltage Balanced at .35%
        ii. Amperage is above the 14.5 FLA at an average of 15.0
2. Hydraulic
    a. Shutoff fell short of the factory curve
    b. Dynamic test results show pump is performing within normal boundaries for its age and service.
3. Vibration
    a. Vibration at the top of the motor is at the high limit for continuous operation
    b. Highest overall is .38 @ Motor Top, perpendicular to discharge
    c. Simple spectrum shows high X1 (unbalance)
4. Thermal Imaging and temperature readings at bearings did not show areas of concern
    a. Bearing Temps
        i. Motor Top – 56
        ii. Motor Bottom – 60
        iii. Pump Top – 72
        iv. Pump Bottom - 65

Conclusions

The tests and observations show this pump to be performing OK when pumping to the system. Failure to reach proper shutoff head should be investigated to find the cause. One of the test results is likely incorrect as the test points do not follow a curve similar to the factory curve.

Recommendations

1. Vibration should be addressed and lowered
2. Open and inspect the pump and measure wear ring clearances
3. Uncouple and run the motor alone, measure unloaded amps and check vibration
4. Schedule to have motor serviced and bearings replaced. Or replace with new premium efficient model.
5. Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances. Pump and motor should have a detailed inspection to determine if replacement is more viable than repair.
6. Higher level of vibration analysis may be required if source of vibration cannot be determined through visual inspections

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240
Station ID:	**DATE:**
Lift Station 20	2/9/2022
Equipment ID:	
RSP 202	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Maraton Electric	10	B	256HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-02	460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
WJ256TTCR7798NW	14.5	B	VERT	
Specification Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
NA	1160	NA	6208	GREASE
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
CONT/40C	1.15		6309	GREASE
Starting Method	**PF**	**Efficiency**		
ACROSS THE LINE	81.5	85.5		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	NA	NA	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA-6VC-RH	10.88	NA	6
Serial or ID Number	**Stages**		**Shaft Size**
67438	1		NA

FIELD TEST REPORT

Conditions

Job Name:	RH2/Mercer Island, City of
Job Number:	162240
Station ID:	Lift Station 20
DATE:	2/9/2022
Equipment ID:	RSP 202

Test Criteria

Suction/Water Level

psi/In mg	0
Gage Correction	4
ft of H_2O	4.0

Discharge

psi	4.5
Gage Correction	2.15
ft of H_2O	12.5

Unloaded Voltage

Three Phase

V_{1-3}	483.9	V1-grd	243.4
V_{2-3}	485	V2-grd	418.9
V_{1-2}	484.5	V3-grd	242.8
Imbalance	**0.12**		

Single Phase

V_{1-2}	NA	V1-grd	NA
		V2-grd	NA

Megger

Lead to Ground		Heat Sensor	
L_1	2.2gohm	Lead 1	NA
L_2	2.2gohm	Lead 2	NA
L_3	2.2gohm		

Winding Resistance		**Heat Sensor Resistance**	
L_{1-3}	1.9	Lead 1	NA
L_{2-3}	1.9	Lead 2	NA
L_{1-2}	1.9		

FIELD TEST REPORT

PerformanceTesting Data Sheet

Job Name:	RH2/Mercer Island, City of
Job Number:	162240
Station ID:	Lift Station 20
DATE:	2/9/2022
Equipment ID:	RSP 202
Test Speed:	
PumpTest Curve No.	1

HYDRAULICS

	Shutoff
Suction Pressure	0.0
Estimated Friction	0.0
Gage Correct	4.0
Ft	4.0
Discharge Pressure	22.0
Estimated Friction	0.0
Gage Correct	2.2
Ft	53.0

Data Point	Shutoff
TDH	49.0
Flow	0.0

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240

Station ID:	DATE:
Lift Station 20	2/9/2022

Equipment ID:	Test Speed:	PumpTest Curve No.
RSP 202	1160	2

VOLTS

TEST Time/Condition	To System
V_{1-3}	483.1
V_{2-3}	480.4
V_{1-2}	479.5
V1-grd	242.6
V2-grd	415.7
V3-grd	240.8
Imbalance*	**0.44**

AMPS

A_1	15.4
A_2	15.1
A_3	14.9
Imbalance*	**1.54**

HYDRAULICS

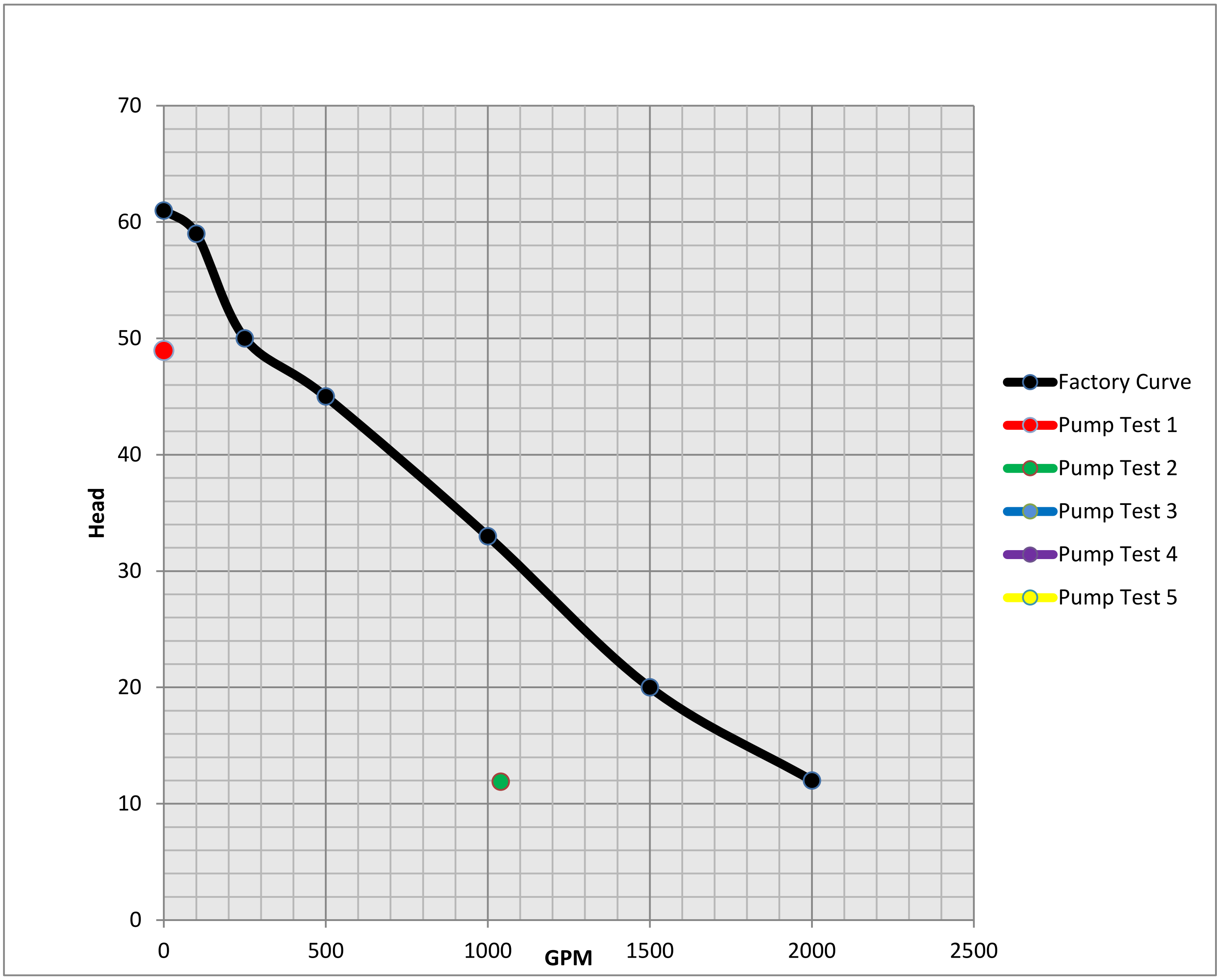
Suction Pressure	0.0
Estimated Friction	0.7
Gage Correct	5.0
Ft	5.7
Discharge Pressure	5.0
Estimated Friction	3.9
Gage Correct	2.2
Ft	17.6

Data Point	Shutoff
TDH	11.9
Flow	1040.0

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240
Station ID:	DATE:
Lift Station 20	2/9/2022
Equipment ID:	
RSP 202	



Factory Curve Data

(obtained from factory tests report or book curve)

	Shutoff	1	2	3	4	5	6
Head	61	59	50	45	33	20	12
Flow	0	100	250	500	1000	1500	2000

Asset Manager : Mercer Island, City of : Lift Station 20 : LS20-Pump 202

LS20-Pump 202 - Vib Points Overview

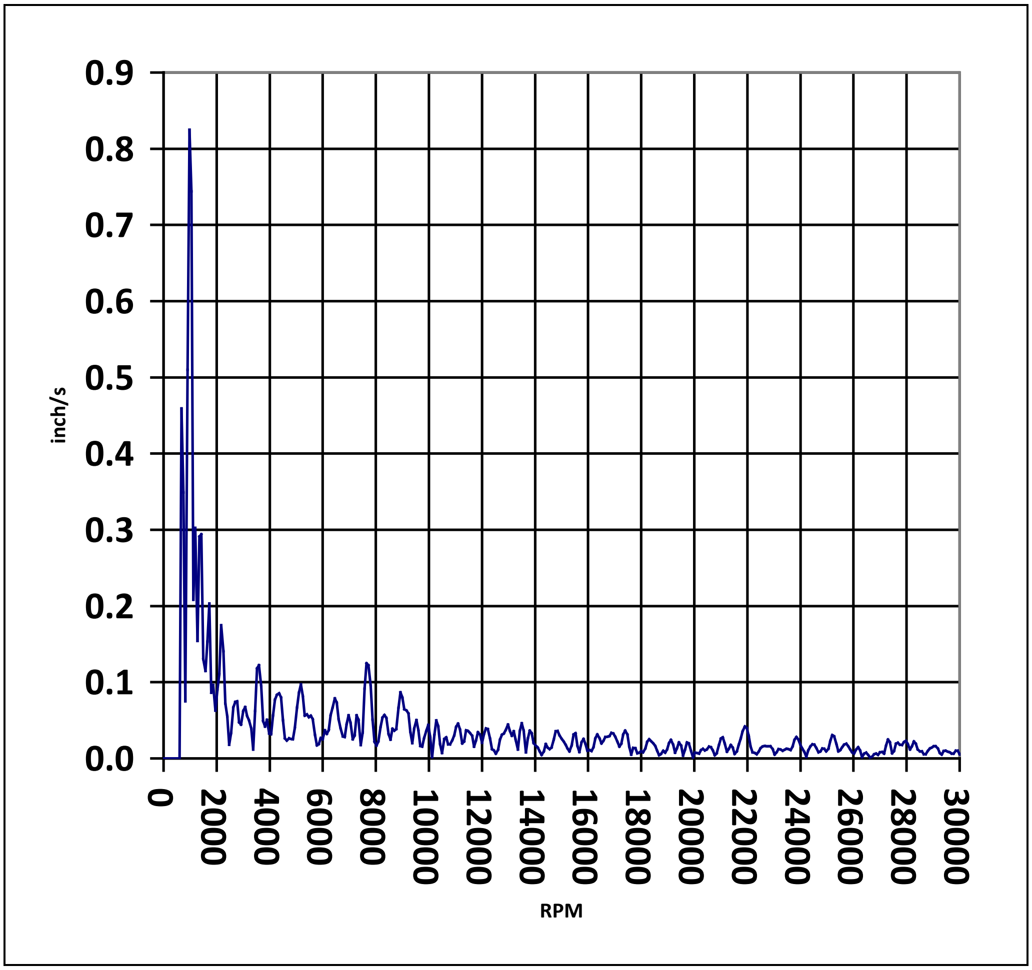
Vib Name	Status	Date Taken	ISO (inch/s)	Brg. Noise (BDU)
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Motor Top X	Warning	2/9/2022 11:33:58	0.36	65
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Motor Top Y	Critical	2/9/2022 11:34:22	1.28	113
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Motor Bottom X	Warning	2/9/2022 11:34:39	0.34	22
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Motor Bottom Y	Critical	2/9/2022 11:34:54	0.77	13
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Motor Axial	OK	2/9/2022 11:35:10	0.12	23
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Pump Top X	Critical	2/9/2022 11:35:28	0.47	16
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Pump Top Y	Warning	2/9/2022 11:35:40	0.40	12
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Pump Bottom X	Warning	2/9/2022 11:35:56	0.34	14
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Pump Bottom Y	OK	2/9/2022 11:36:07	0.24	21
Mercer Island, City of : Lift Station 20 : LS20-Pump 202				
Pump Axial	OK	2/9/2022 11:36:26	0.06	16

Date Taken: 2/9/2022 11:34:22

Mercer Island, City of : Lift Station 20 : LS20-Pump 202

Motor Top Y Detail

ISO FFT (inch/s), Run Speed = 1,159.80RPM



FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240
Station ID:	DATE:
Lift Station 20	2/9/2022
Equipment ID:	
RSP 203	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Maraton Electric	10	B	256HPV	
Serial or ID Number	Volts	Code	Enclosure	
11-94402-8/2-04	460	G	DP	
Catalog Number	FLA	Des	Orientation	
WJ256TTCR7798NW	14.5	B	VERT	
Specification Number	RPM	Weight	ODE Bearing	Lubrication
NA	1160	NA	6208	GREASE
Rating/Max Ambient	SF		DE Bearing	Lubrication
CONT/40C	1.15		6309	GREASE
Starting Method	PF	Efficiency		
ACROSS THE LINE	81.5	85.5		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	NA	NA	8
Model	Imp Dia	Date Code	Discharge Size
6NHTA-6VC-RH	10.88	NA	6
Serial or ID Number	Stages		Shaft Size
67433	1		NA

FIELD TEST REPORT

Conditions

Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 20

DATE: 2/9/2022

Equipment ID: RSP 203

Test Criteria

Suction/Water Level

psi/In mg	0
Gage Correction	4
ft of H_2O	4.0

Discharge

psi	4.5
Gage Correction	2.15
ft of H_2O	12.5

Unloaded Voltage

Three Phase

V_{1-3}	483.9	V1-grd	243.4
V_{2-3}	485	V2-grd	418.9
V_{1-2}	484.5	V3-grd	242.8
Imbalance	**0.12**		

Single Phase

V_{1-2}	NA	V1-grd	NA
		V2-grd	NA

Megger

Lead to Ground		Heat Sensor	
L_1	2.2 Gohms	Lead 1	NA
L_2	2.2 Gohms	Lead 2	NA
L_3	2.2 Gohms		

Winding Resistance

L_{1-3}	1.7 Ohms
L_{2-3}	1.7 Ohms
L_{1-2}	1.7 Ohms

Heat Sensor Resistance

Lead 1	NA
Lead 2	NA

FIELD TEST REPORT

PerformanceTesting Data Sheet

Job Name:			Job Number:
RH2/Mercer Island, City of			162240
Station ID:			DATE:
Lift Station 20			2/9/2022
Equipment ID:	Test Speed:		PumpTest Curve No.
RSP 203			1

HYDRAULICS

	Shutoff
Suction Pressure	0.0
Estimated Friction	0.0
Gage Correct	4.5
Ft	4.5
Discharge Pressure	18.0
Estimated Friction	0.0
Gage Correct	2.2
Ft	43.7

Data Point	Shutoff
TDH	39.2
Flow	0.0

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240
Station ID:	**DATE:**
Lift Station 20	2/9/2022

Equipment ID:	Test Speed:	PumpTest Curve No.
RSP 203	1160	2

VOLTS

TEST Time/Condition	To System
V_{1-3}	482.6
V_{2-3}	479.7
V_{1-2}	480.5
V1-grd	242.0
V2-grd	416.1
V3-grd	240.4
Imbalance*	**0.35**

AMPS

A_1	15.3
A_2	15.0
A_3	14.7
Imbalance*	**2.00**

HYDRAULICS

Suction Pressure	0.0
Estimated Friction	0.2
Gage Correct	6.0
Ft	6.2
Discharge Pressure	5.5
Estimated Friction	8.6
Gage Correct	2.2
Ft	23.5

Data Point	Shutoff
TDH	17.3
Flow	1550.0

FIELD TEST REPORT

Data Point Plotting Worksheet

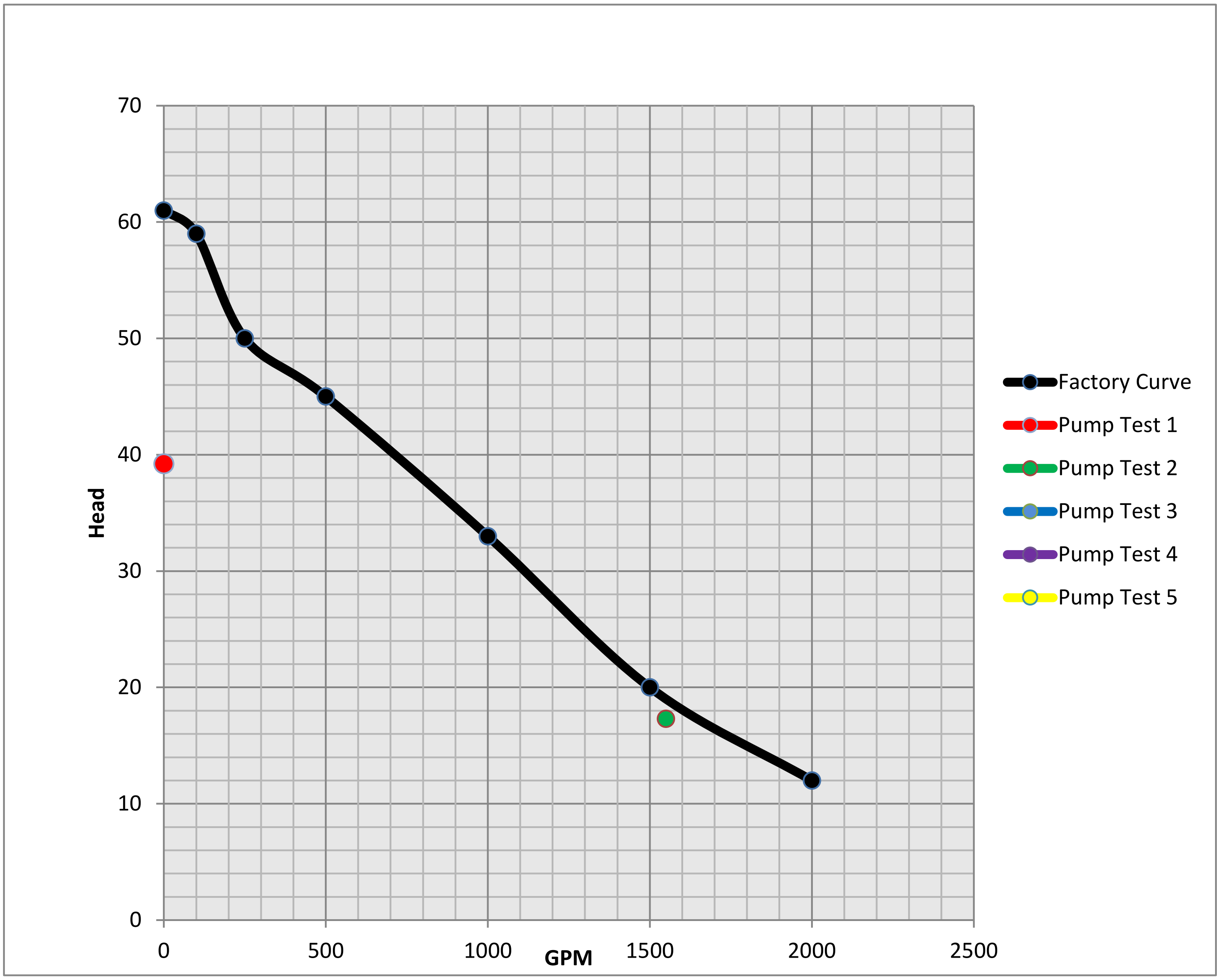
Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 20

DATE: 2/9/2022

Equipment ID: RSP 203



Factory Curve Data

(obtained from factory tests report or book curve)

	Shutoff	1	2	3	4	5	6
Head	61	59	50	45	33	20	12
Flow	0	100	250	500	1000	1500	2000

Asset Manager : Mercer Island, City of : Lift Station 20 : LS20-Pump 203

LS20-Pump 203 - Vib Points Overview

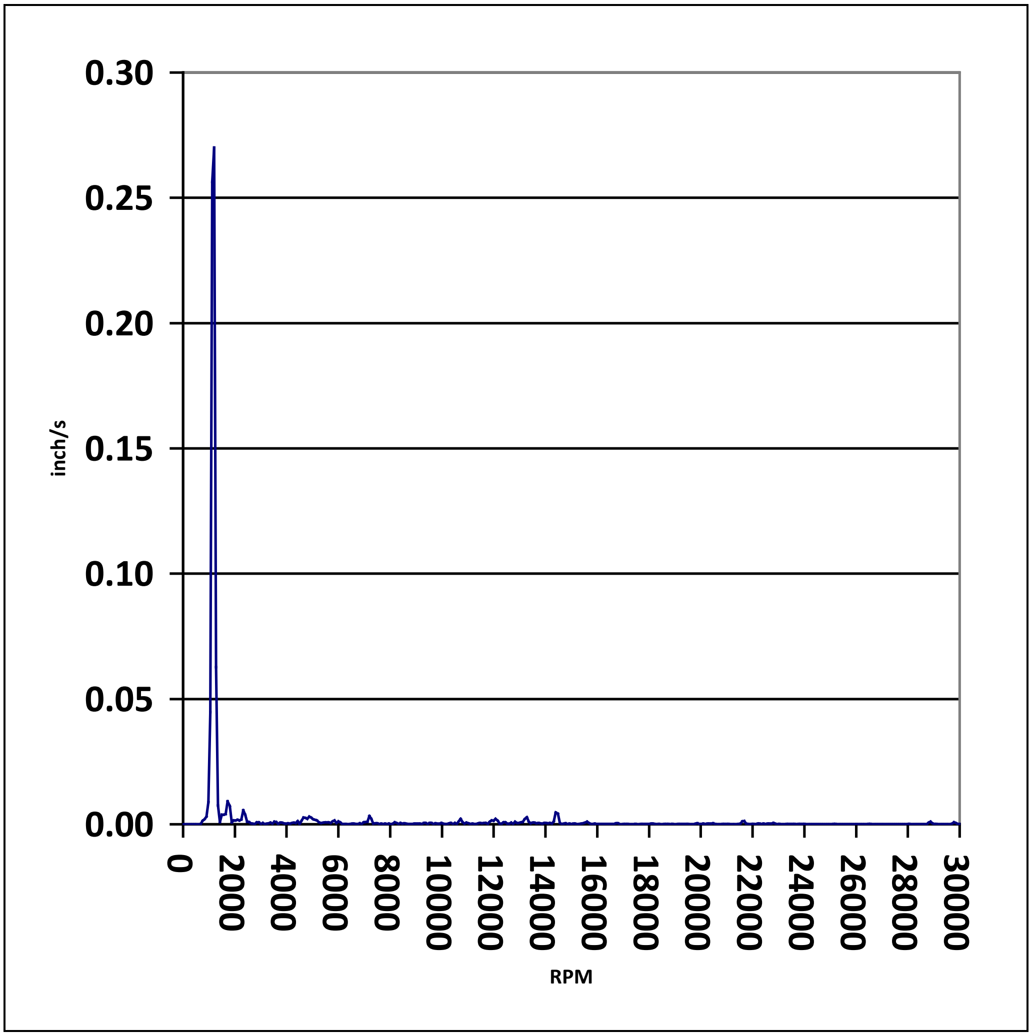
Vib Name	Status	Date Taken	ISO (inch/s)	Brg. Noise (BDU)
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Motor Top X**	OK	2/9/2022 10:52:34	0.18	46
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Motor Top Y**	Warning	2/9/2022 10:52:49	0.38	26
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Motor Bottom X**	OK	2/9/2022 10:53:07	0.12	13
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Motor Bottom Y**	Warning	2/9/2022 10:53:22	0.30	27
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Motor Axial**	OK	2/9/2022 10:53:39	0.02	48
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Pump Top X**	OK	2/9/2022 10:53:52	0.20	12
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Pump Top Y**	OK	2/9/2022 10:54:04	0.04	12
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Pump Bottom X**	OK	2/9/2022 11:01:24	0.13	12
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Pump Bottom Y**	OK	2/9/2022 11:01:40	0.09	14
Mercer Island, City of : Lift Station 20 : LS20-Pump 203 **Pump Axial**	OK	2/9/2022 11:02:03	0.02	19

Date Taken: 2/9/2022 10:52:49

Mercer Island, City of : Lift Station 20 : LS20-Pump 203

Motor Top Y Detail

ISO FFT (inch/s), Run Speed = 1,159.80RPM



Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Mercer Island, City of
LS20 P202
2/17/22, 1:06 PM
12

Ungrouped Items

(1)

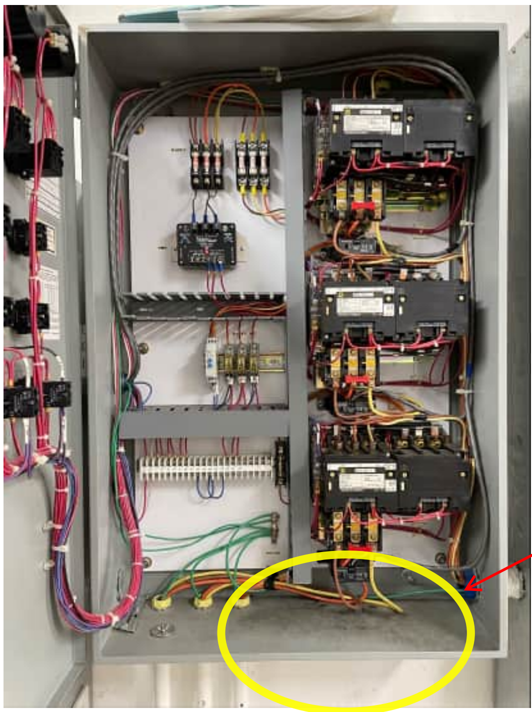
Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Control Panel

(2)

Control Panel
Front of the pump control panel

(3)



Control Panel
Interior of the pump control panel

Dust below contactors

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Mercer Island, City of
LS20 P202
2/17/22, 1:06 PM
12

Pump 1

(4)

Pump 1

Pump was taken out of service at the time of testing due to a mechanical seal leak.

(5)

Pump 1

Motor nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

(6)

Pump 1

Pump nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Pump 2

(7)

Pump 2

(8)

Pump 2
Motor nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Mercer Island, City of
LS20 P202
2/17/22, 1:06 PM
12

(9)

Pump 2
Pump nameplate

Pump 3

(10)

Pump 3

(11)

Pump 3
Motor nameplate

(12)

Pump 3
Pump nameplate

Lift Station 21

Pump Control Panel

   a. Looks to be original equipment
   b. Panel is clean and dry.
   c. Gray powder below contactors
2. Pump RSP 211
   a. Vibration at the warning level
   b. Pump down rate much less than RSP 212
   c. Discharge valve stem leak
3. Pump RSP 212
   a. Check valve rattles when pump is running
   b. Vibration at the warning level with indication of bearing damage
   c. Discharge valve will not fully close
4. Pump RSP 213
   a. Out of service at time of test
   b. Check valve leaks by

General:

1. The dry pit looks to be in relatively good condition for the age of the station.
2. Some minor surface corrosion where paint is missing.
3. Flow estimates were difficult to obtain. Fill and pump down rates were erratic. One test would fill at .16 ft/min, the next would be at .8 ft /min. An invert is in the middle of the pumping range. Testing was limited to levels above and below the invert. Suspect this may be the cause behind the performance test results being so far off the curve.
4. Unable to determine if the gate valves are properly seating. Would more testing to determine how well they hold. Due to their age, replacement should be considered with a type better designed for sewage.
5. The check valves should also be inspected and consider replacing due to their age.

Pump Control Panel:

1. Incoming power is 480v, 3 phase with a dead leg to ground
2. Unloaded voltage is balanced
3. The gray dust below the contacts is usually from arcing contacts.
4. Arcing reduces the performance of the contact and increases circuit resistance
5. May explain higher than expected motor current
6. Parts for older contacts are getting harder to find. Would recommend considering replacing them with current models or upgrading the entire panel to increase reliability.

PUMP RSP 211

1. Electrical
    a. Motor tests: Unloaded
        i. Motor insulation tested good at 2.2 Giga-ohms, all legs
        ii. Motor winding resistance even between all legs at 1.8 ohms
    b. Motor test: Loaded
        i. Voltage Balanced at .25%
        ii. Amperage is at the 14.5. Which is at the 14.5 FLA
2. Hydraulic
    a. Shutoff test fell well short the factory curve
    b. Dynamic test also fell short of the factory curve
3. Vibration
    a. Pump is just above the limit for continuous operation
    b. Highest overall is .41 in/sec rms @ Motor Top, perpendicular to discharge
    c. Simple Spectrum shows high X1 (unbalance) is most dominant with some indication of early bearing faults.
4. Thermal Imaging and temperature readings at bearings did not show areas of concern
    a. Bearing Temps
        i. Motor Top – 60
        ii. Motor Bottom – 66
        iii. Pump Top – 69
        iv. Pump Bottom - 68

Conclusions

The tests and observations of this pump show this pump does not perform as well as RSP 212. Its pumping rate is much less. Amp draw is higher than expected for flow rate.

Recommendations

1. Vibration should be addressed and lowered
2. Open and inspect the pump and measure wear ring clearances
3. Uncouple and run the motor alone, measure unloaded amps and check vibration
4. Schedule to have motor serviced and bearings replaced. Or replace with new premium efficient model.
5. Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances. Pump and motor should have a detailed inspection to determine if repair is more viable to replacement.
6. Higher level of vibration analysis may be required if source of vibration cannot be determined through visual inspections

PUMP RSP 212

1. Electrical
    a. Motor tests: Unloaded
        i. Motor insulation tested good at 2.2 Giga-ohms, all legs
        ii. Motor winding resistance even between all legs at 1.6 ohms
    b. Motor test: Loaded
        i. Voltage Balanced at .3%
        ii. Amperage is at the 14.3. Just under 14.5 FLA
2. Hydraulic
    c. Shutoff test fell well short the factory curve
    d. Dynamic test was also lower than the factory curve
3. Vibration
    e. Pump is just above the limit for continuous operation.
    f. Highest overall is .31 in/sec rms @ Motor Top, perpendicular to discharge
    g. Simple Spectrum shows high X1 (unbalance) is most dominant with some indication of early bearing faults.
4. Thermal Imaging and temperature readings at bearings did not show areas of concern
    a. Bearing Temps
        i. Motor Top – 56
        ii. Motor Bottom – 55
        iii. Pump Top – 63
        iv. Pump Bottom - 58

Conclusions

The tests and observations show this pump to be performing OK when pumping to the system. Failure to reach proper shutoff head should be investigated to find the cause. One of these results is likely incorrect as the test points do not follow a curve similar to the factory curve.

The elevated bearing fault signatures seen in the spectrum (Motor Top X) shows that a bearing or bearings are damaged.

Recommendation

1. Vibration should be addressed and lowered
2. Open and inspect the pump and measure wear ring clearances
3. Uncouple and run the motor alone, measure unloaded amps and check vibration
4. Schedule to have motor serviced and bearings replaced. Or replace with new premium efficient model.
5. Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances. Pump and motor should have a detailed inspection to determine if repair is more viable to replacement.
6. Higher level of vibration analysis may be required if source of vibration cannot be determined through visual inspections

Summary

The equipment in both stations tested are showing their age. The varying flow rates between pumps says that some are worn more than others. Not having a good way to measure flow rate makes testing and performance confirmation difficult, but observation of proves that a pump is performing better than the another across multiple test cycles.

Vibration levels at or above the high tolerance requires a deeper inspection of the effected unit. There indications of bearing and unbalance problems to some degree in all pumps tested.

The best recommendation from a maintenance standpoint would be:

1. P202 has excessive vibration and low performance.
    a. Open and inspect this pump. See if there is something in the impeller/volute causing the unbalance. Debris, broken impeller, etc. If nothing is found, move to uncoupling the motor and running it alone.
    b. If no cause can be found, this pump should be removed, and an in-depth inspection performed to identify the cause
2. P211 has low performance also. Again, open and inspect the volute for blockage.
3. Due to the age and the results, an in-depth inspection should be done on each of these pumps. Bearing fits, face runout, casing fits, impeller inspections, volute/cutwater inspections, wear ring clearances should all be looked at to determine whether repair or replacement is more cost effective.
4. Motors that need to be serviced should be considered for replacement. A higher efficient motor will pay for itself with the amount time these pumps are running.
5. Most of the isolation valves leaked at the stem when operated or questionable that they sealed when shut. All the gate valves should be replaced. A valve more suited for sewage should be considered.
6. A couple of the check valves had stem leaks or rattled during operation. The rattling is usually a sign that something is wearing or loosening. Failure is the next step. Those that are rattling should be opened and checked for loose components.

FIELD TEST REPORT

Equipment Information Sheet

Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 21

DATE: 2/9/2022

Equipment ID: RSP 211

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Maraton Electric	10	B	256HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-07	460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
WJ256TTCR7798NW	14.5	B	VERT	
Specification Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
NA	1160	NA	6208	GREASE
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
CONT/40C	1.15		6309	GREASE
Starting Method	**PF**	**Efficiency**		
ACROSS THE LINE	81.5	85.5		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	NA	NA	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA-6VC-RH	10.88	NA	6
Serial or ID Number	**Stages**		**Shaft Size**
67631	1		NA

FIELD TEST REPORT

Conditions

Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 21

DATE: 2/9/2022

Equipment ID: RSP 211

Test Criteria

Suction/Water Level

psi/In mg	0
Gage Correction	4.5
ft of H_2O	4.5

Discharge

psi	4.5
Gage Correction	2.15
ft of H_2O	12.5

Unloaded Voltage

Three Phase

V_{1-3}	484.7	V1-grd	486
V_{2-3}	482.6	V2-grd	0
V_{1-2}	486.2	V3-grd	487.1
Imbalance	**0.39**		

Single Phase

V_{1-2}	NA	V1-grd	NA
		V2-grd	NA

Megger

Lead to Ground		Heat Sensor	
L_1	2.2 G-ohm	Lead 1	NA
L_2	2.2 G-ohm	Lead 2	NA
L_3	2.2 G-ohm		

Winding Resistance		**Heat Sensor Resistance**	
L_{1-3}	1.8	Lead 1	NA
L_{2-3}	1.8	Lead 2	NA
L_{1-2}	1.8		

FIELD TEST REPORT

Performance Testing Data Sheet

Job Name:		Job Number:
RH2/Mercer Island, City of		162240
Station ID:		DATE:
Lift Station 21		2/9/2022
Equipment ID:	Test Speed:	PumpTest Curve No.
RSP 211	1160	1

HYDRAULICS

	Shutoff
Suction Pressure	0.0
Estimated Friction	0.0
Gage Correct	5.8
Ft	5.8
Discharge Pressure	19.0
Estimated Friction	0.0
Gage Correct	2.2
Ft	46.0

Data Point	Shutoff
TDH	40.3
Flow	0.0

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240

Station ID:	DATE:
Lift Station 21	2/9/2022

Equipment ID:	Test Speed:	PumpTest Curve No.
RSP 211	1160	2

VOLTS

TEST Time/Condition	To System
V_{1-3}	476.2
V_{2-3}	477.7
V_{1-2}	478.3
V1-grd	479.3
V2-grd	0.0
V3-grd	479.9
Imbalance*	**0.25**

AMPS

A_1	14.2
A_2	14.9
A_3	14.7
Imbalance*	**2.05**

HYDRAULICS

Suction Pressure	0.0
Estimated Friction	0.1
Gage Correct	4.7
Ft	4.8
Discharge Pressure	5.0
Estimated Friction	2.8
Gage Correct	2.2
Ft	16.5

Data Point	Shutoff
TDH	11.8
Flow	840.0

FIELD TEST REPORT

Data Point Plotting Worksheet

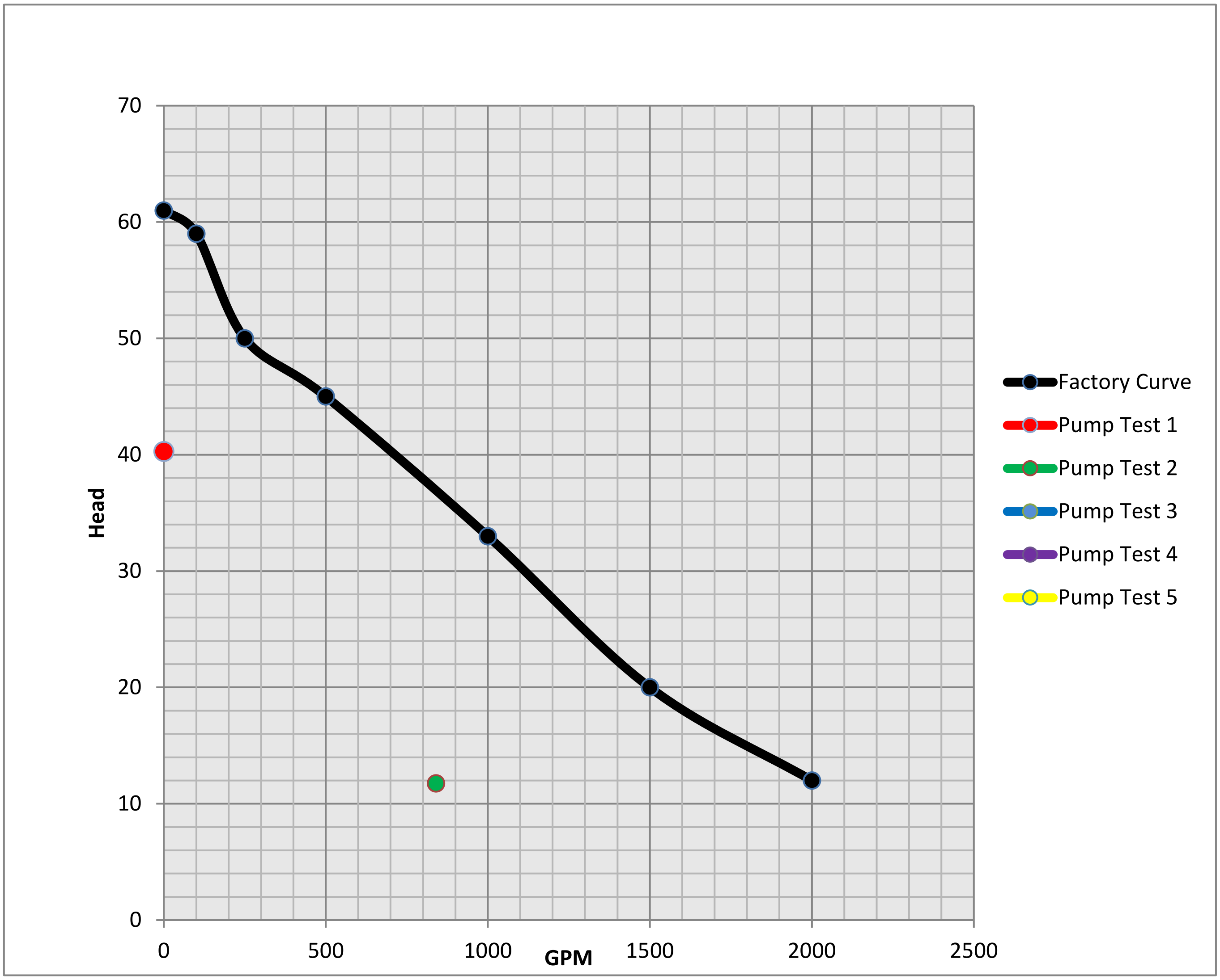
Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 21

DATE: 2/9/2022

Equipment ID: RSP 211



Factory Curve Data

(obtained from factory tests report or book curve)

	Shutoff	1	2	3	4	5	6
Head	61	59	50	45	33	20	12
Flow	0	100	250	500	1000	1500	2000

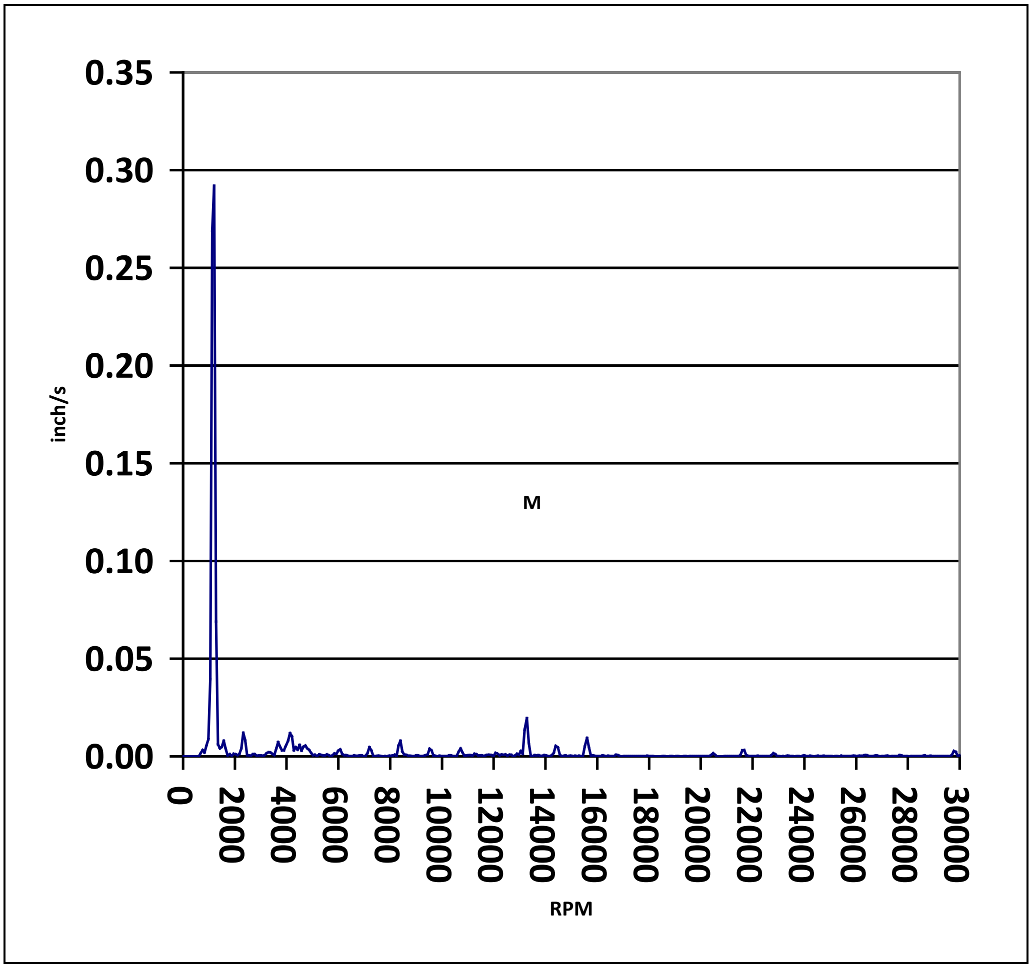
Asset Manager : Mercer Island, City of : Lift Station 21 : LS21-Pump 211

LS21-Pump 211 - Vib Points Overview

Vib Name	Status	Date Taken	ISO (inch/s)	Brg. Noise (BDU)
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Motor Top X**	OK	2/9/2022 16:19:46	0.13	34
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Motor Top Y**	Warning	2/9/2022 16:20:03	0.41	33
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Motor Bottom X**	OK	2/9/2022 16:20:16	0.08	15
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Motor Bottom Y**	Warning	2/9/2022 16:20:33	0.28	17
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Motor Axial**	OK	2/9/2022 16:20:42	0.05	21
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Pump Top X**	OK	2/9/2022 16:21:01	0.22	10
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Pump Top Y**	OK	2/9/2022 16:21:13	0.17	12
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Pump Bottom X**	OK	2/9/2022 16:21:36	0.15	11
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Pump Bottom Y**	OK	2/9/2022 16:21:48	0.09	9
Mercer Island, City of : Lift Station 21 : LS21-Pump 211 **Pump Axial**	OK	2/9/2022 16:22:08	0.04	14

Motor Top Y Detail

ISO FFT (inch/s), Run Speed = 1,159.80RPM



FIELD TEST REPORT

Equipment Information Sheet

Job Name:	RH2/Mercer Island, City of
Job Number:	162240
Station ID:	Lift Station 21
DATE:	2/9/2022
Equipment ID:	RSP 212

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Maraton Electric	10	B	256HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-05	460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
WJ256TTCR7798NW	14.5	B	VERT	
Specification Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
NA	1160	NA	6208	GREASE
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
CONT/40C	1.15		6309	GREASE
Starting Method	**PF**	**Efficiency**		
ACROSS THE LINE	81.5	85.5		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	NA	NA	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA-6VC-RH	10.88	NA	6
Serial or ID Number	**Stages**		**Shaft Size**
67450	1		NA

FIELD TEST REPORT

Conditions

Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 21

DATE: 2/9/2022

Equipment ID: RSP 212

Test Criteria

Suction/Water Level

psi/In mg	0
Gage Correction	4.5
ft of H_2O	4.5

Discharge

psi	4.5
Gage Correction	2.15
ft of H_2O	12.5

Unloaded Voltage

Three Phase

V_{1-3}	484.7	V1-grd	486
V_{2-3}	482.6	V2-grd	0
V_{1-2}	486.2	V3-grd	487.1
Imbalance	**0.39**		

Single Phase

V_{1-2}	NA	V1-grd	NA
		V2-grd	NA

Megger

Lead to Ground		Heat Sensor	
L_1	2.2 G-ohms	Lead 1	NA
L_2	2.2 G-ohms	Lead 2	NA
L_3	2.2 G-ohms		

Winding Resistance

L_{1-3}	1.6 ohms
L_{2-3}	1.6 ohms
L_{1-2}	1.6 ohms

Heat Sensor Resistance

Lead 1	NA
Lead 2	NA

FIELD TEST REPORT

PerformanceTesting Data Sheet

Job Name:	RH2/Mercer Island, City of
Job Number:	162240
Station ID:	Lift Station 21
DATE:	2/9/2022
Equipment ID:	RSP 212
Test Speed:	1160
PumpTest Curve No.	1

HYDRAULICS

	Shutoff
Suction Pressure	0.0
Estimated Friction	0.0
Gage Correct	3.5
Ft	3.5
Discharge Pressure	17.0
Estimated Friction	0.0
Gage Correct	2.2
Ft	41.4

Data Point	Shutoff
TDH	37.9
Flow	0.0

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
RH2/Mercer Island, City of	162240
Station ID:	DATE:
Lift Station 21	2/9/2022

Equipment ID:	Test Speed:	PumpTest Curve No.
RSP 212	1160	2

VOLTS

TEST Time/Condition	To System
V_{1-3}	476.8
V_{2-3}	476.5
V_{1-2}	478.8
V1-grd	478.3
V2-grd	0.0
V3-grd	479.3
Imbalance*	**0.30**

AMPS

A_1	14.4
A_2	14.5
A_3	14.0
Imbalance*	**2.10**

HYDRAULICS

	Shutoff
Suction Pressure	0.0
Estimated Friction	0.1
Gage Correct	4.0
Ft	4.1
Discharge Pressure	5.5
Estimated Friction	7.1
Gage Correct	2.2
Ft	22.0

Data Point	Shutoff
TDH	17.9
Flow	1376.0

FIELD TEST REPORT

Data Point Plotting Worksheet

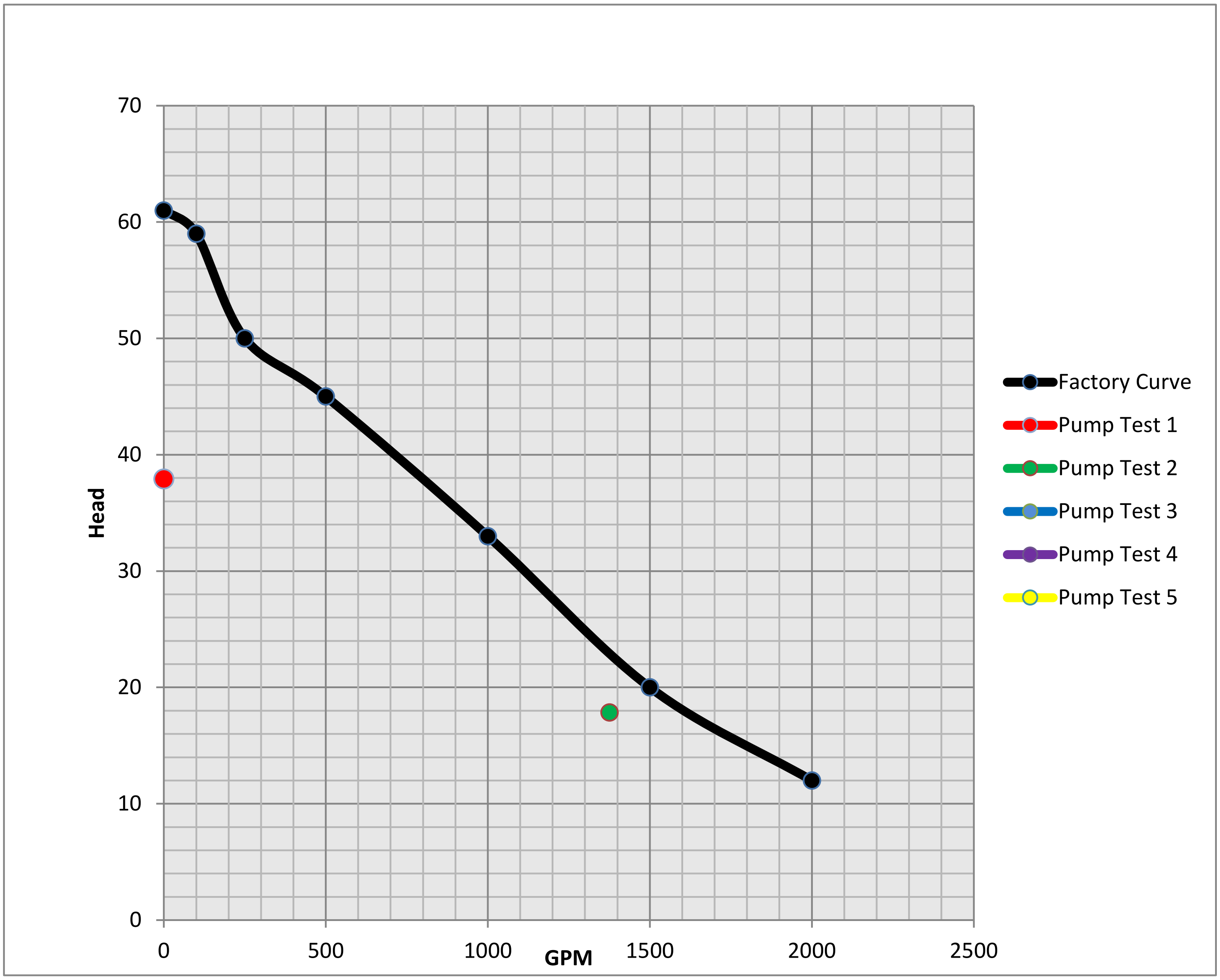
Job Name: RH2/Mercer Island, City of

Job Number: 162240

Station ID: Lift Station 21

DATE: 2/9/2022

Equipment ID: RSP 212



Factory Curve Data

(obtained from factory tests report or book curve)

	Shutoff	1	2	3	4	5	6
Head	61	59	50	45	33	20	12
Flow	0	100	250	500	1000	1500	2000

Asset Manager : Mercer Island, City of : Lift Station 21 : LS21-Pump 212

LS21-Pump 212 - Vib Points Overview

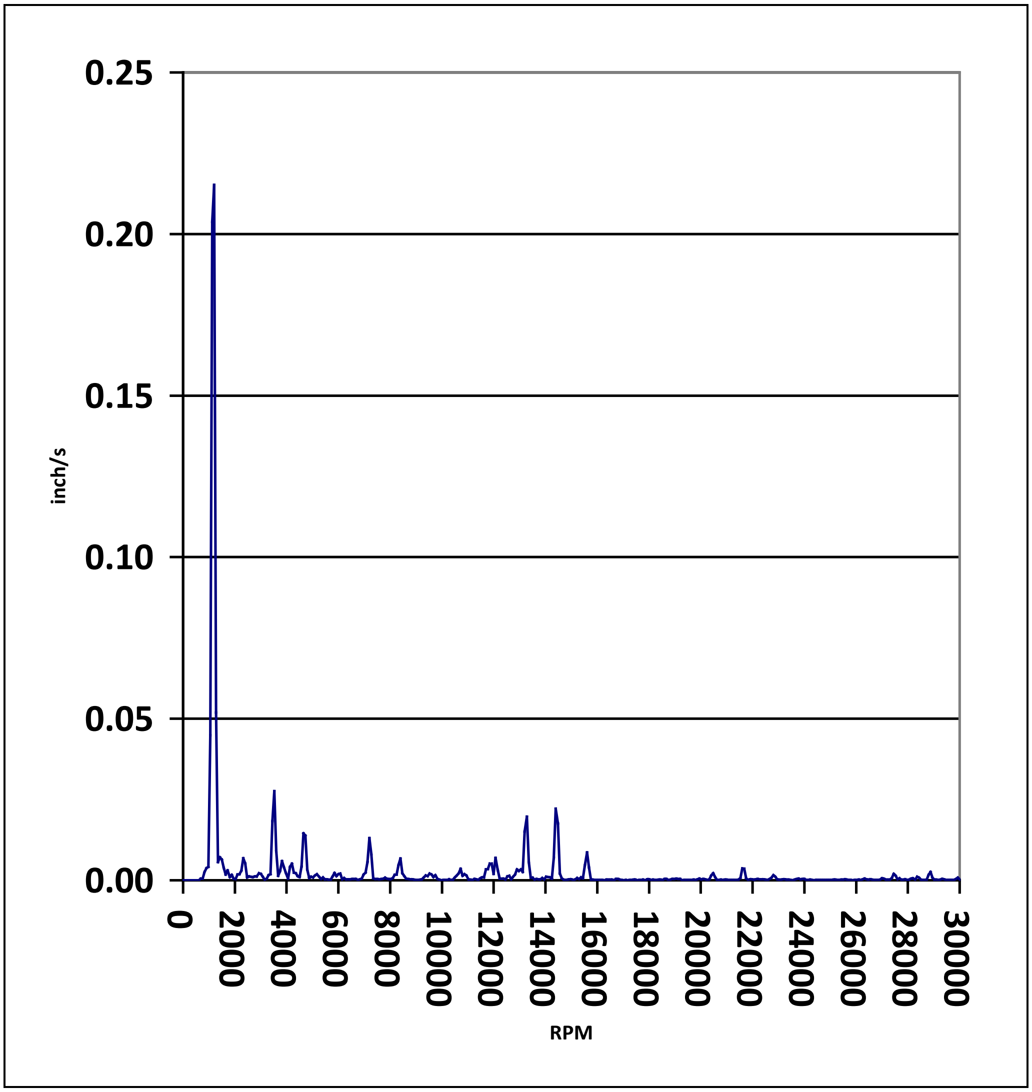
Vib Name	Status	Date Taken	ISO (inch/s)	Brg. Noise (BDU)
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Motor Top X**	Warning	2/9/2022 16:37:28	0.08	73
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Motor Top Y**	Warning	2/9/2022 16:37:41	0.31	50
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Motor Bottom X**	OK	2/9/2022 16:37:57	0.05	18
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Motor Bottom Y**	OK	2/9/2022 16:38:06	0.15	21
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Motor Axial**	OK	2/9/2022 16:38:28	0.05	33
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Pump Top X**	Warning	2/9/2022 16:38:38	0.07	55
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Pump Top Y**	OK	2/9/2022 16:38:49	0.08	39
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Pump Bottom X**	OK	2/9/2022 16:39:01	0.05	43
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Pump Bottom Y**	OK	2/9/2022 16:39:11	0.06	28
Mercer Island, City of : Lift Station 21 : LS21-Pump 212 **Pump Axial**	OK	2/9/2022 17:06:27	0.02	35

Date Taken: 2/9/2022 16:37:41

Mercer Island, City of : Lift Station 21 : LS21-Pump 212

Motor Top Y Detail

ISO FFT (inch/s), Run Speed = 1,159.80RPM

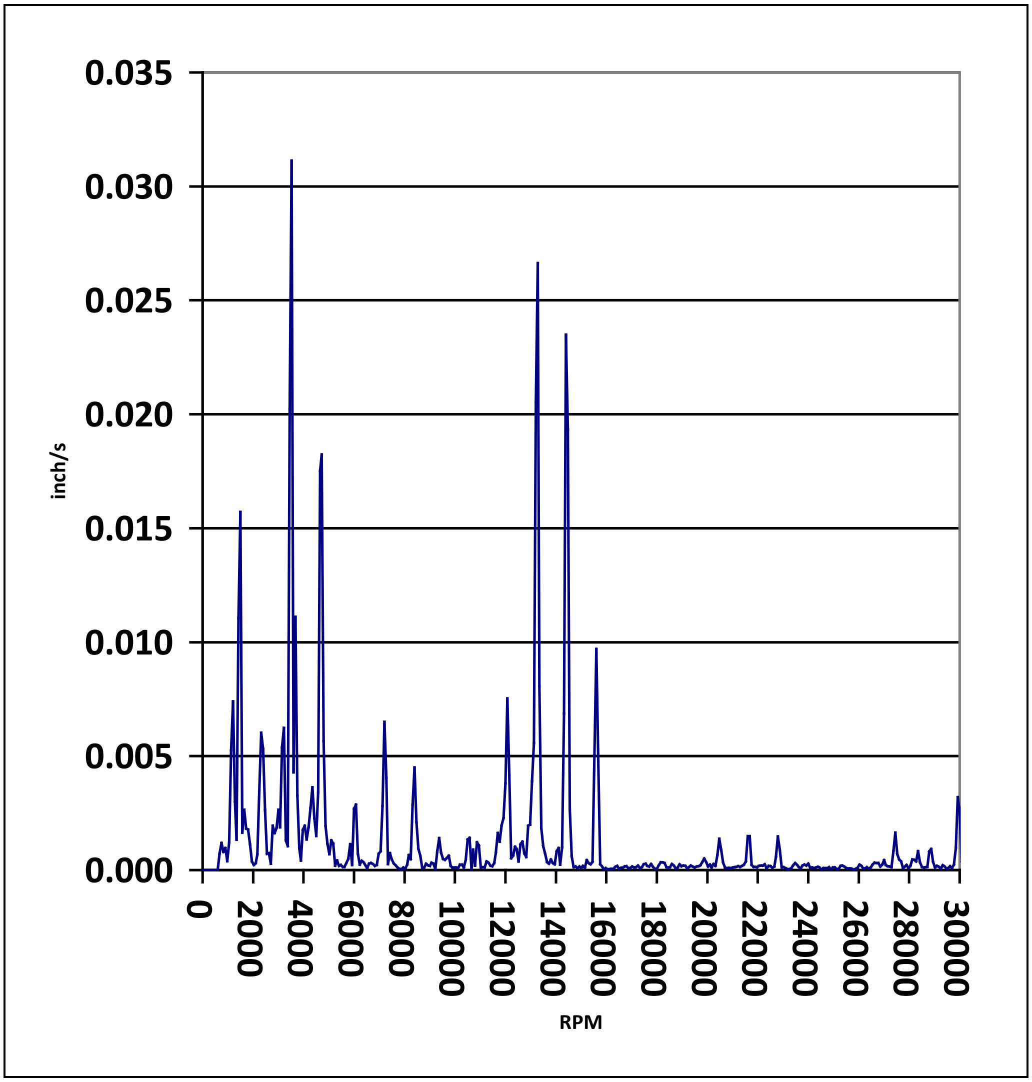


Date Taken: 2/9/2022 16:37:28

Mercer Island, City of : Lift Station 21 : LS21-Pump 212

Motor Top X Detail

ISO FFT (inch/s), Run Speed = 1,159.80RPM



Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Mercer Island, City of
LS21
2/24/22, 12:36 PM
12

Ungrouped Items

(1)

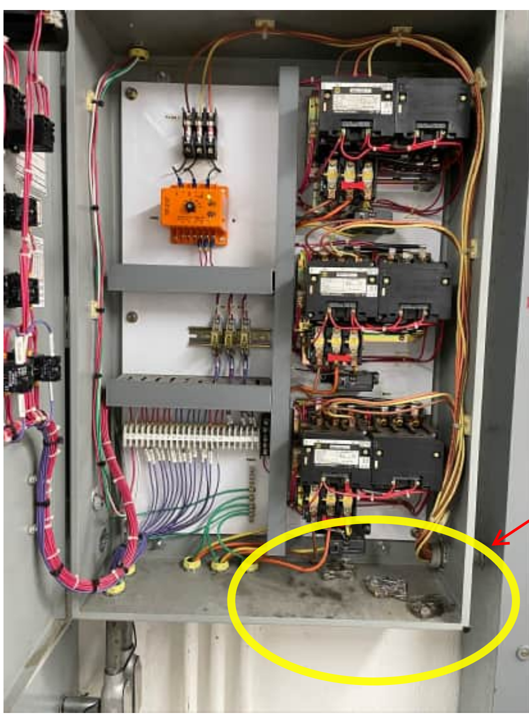
Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Control Panel

(2)

Control Panel
Panel front

(3)



Control Panel
Panel interior

Dust below contacts

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425 864-7175
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Mercer Island, City of
LS21
2/24/22, 12:36 PM
12

Pump 1

(4)

Pump 1

(5)

Pump 1
Motor nameplate

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sking@pumptechnw.com
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Pumptech, Inc

Mercer Island, City of
LS21
2/24/22, 12:36 PM
12

(6)

Pump 1
Pump nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Pump 2

(7)

Pump 2

(8)

Pump 2
Motor nameplate

Shane King
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425 864-7175
Pumptech, Inc

Mercer Island, City of
LS21
2/24/22, 12:36 PM
12

(9)

Pump 2
Pump nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Pump 3

(10)

Pump 3

(11)

Pump 3
Motor nameplate

Shane King
sking@pumptechnw.com
425 864-7175
Pumptech, Inc

Mercer Island, City of
LS21
2/24/22, 12:36 PM
12

(12)

Pump 3
Pump nameplate

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 20	10/24/2023
Equipment ID:	
Pump #1	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-01	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67451	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 20	10/24/2023
Equipment ID:	Test Criteria
Pump #1	

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	494	V1-grd	248	**0.23**
V_{2-3}	494.4	V2-grd	427.5	
V_{1-2}	493	V3-grd	247	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.6	Ω
L_{1-2}	1.6	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 20	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #1	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	489.0
V_{2-3}	490.5
V_{1-2}	486.0
V1-grd	246.0
V2-grd	422.0
V3-grd	244.5
$V_{average}$	488.50
Imbalance*	**0.51**

AMPS

A_1	12.5
A_2	11.7
A_3	11.7
Imbalance*	**4.46**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8

Data Point	1
TDH	14.8
Flow	1550.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

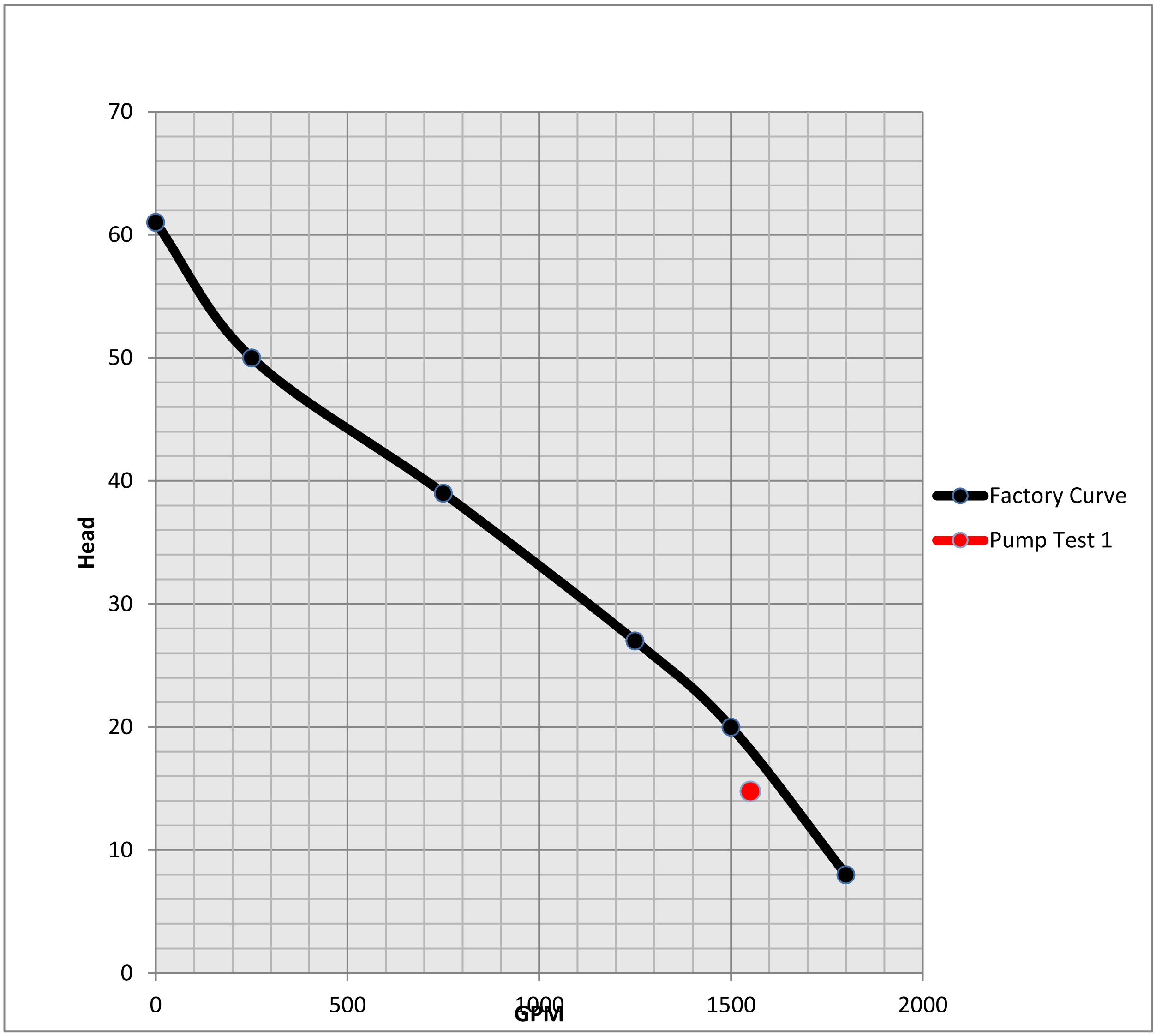
Lift Station 20

DATE:

10/24/2023

Equipment ID:

Pump #1



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 20
DATE:	10/24/2023
Equipment ID:	Pump #2

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-02	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67438	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 20

DATE: 10/24/2023

Equipment ID: Pump #2

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

V_{1-3}	494	V1-grd	248	Imbalance
V_{2-3}	494.4	V2-grd	427.5	**0.23**
V_{1-2}	493	V3-grd	247	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.6	Ω
L_{2-3}	1.6	Ω
L_{1-2}	1.6	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 20
DATE:	10/24/2023
Equipment ID:	Pump #2
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	488.0
V_{2-3}	490.0
V_{1-2}	484.5
V1-grd	246.0
V2-grd	420.5
V3-grd	244.0
$V_{average}$	487.50
Imbalance*	**0.62**

AMPS

A_1	12.1
A_2	11.8
A_3	11.5
Imbalance*	**2.54**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8
Data Point	1
TDH	14.8
Flow	1250.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

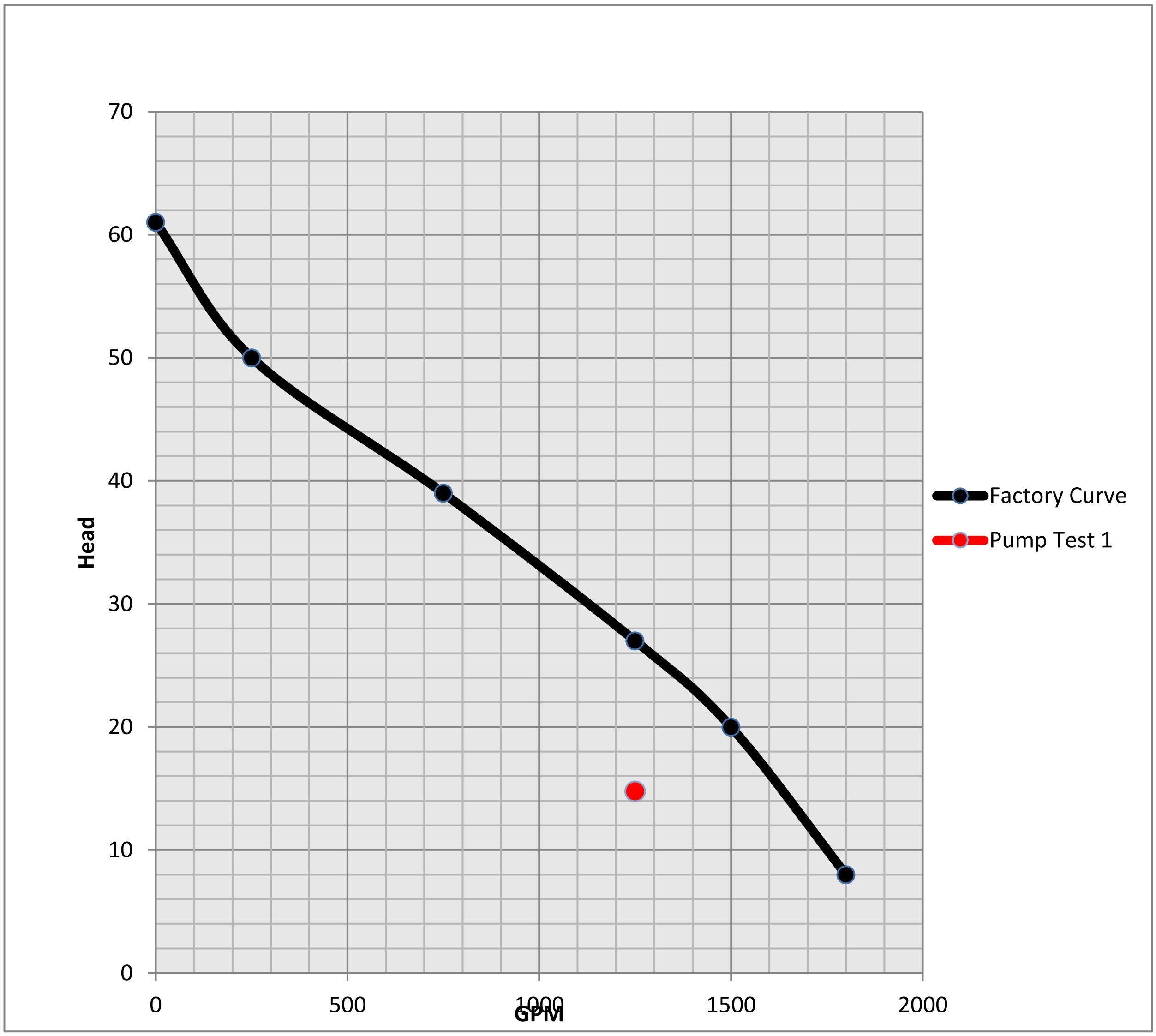
Lift Station 20

DATE:

10/24/2023

Equipment ID:

Pump #2



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

PumpTech an impel company

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 20	10/24/2023
Equipment ID:	
Pump #3	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-04	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67437	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 20

DATE: 10/24/2023

Equipment ID: Pump #3

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	494	V1-grd	248	**0.23**
V_{2-3}	494.4	V2-grd	427.5	
V_{1-2}	493	V3-grd	247	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.6	Ω
L_{2-3}	1.7	Ω
L_{1-2}	1.6	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 20	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #3	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	487.5
V_{2-3}	486.5
V_{1-2}	482.8
V1-grd	245.0
V2-grd	420.0
V3-grd	243.5
$V_{average}$	485.60
Imbalance*	**0.58**

AMPS

A_1	13.3
A_2	12.7
A_3	12.4
Imbalance*	**3.91**

HYDRAULICS

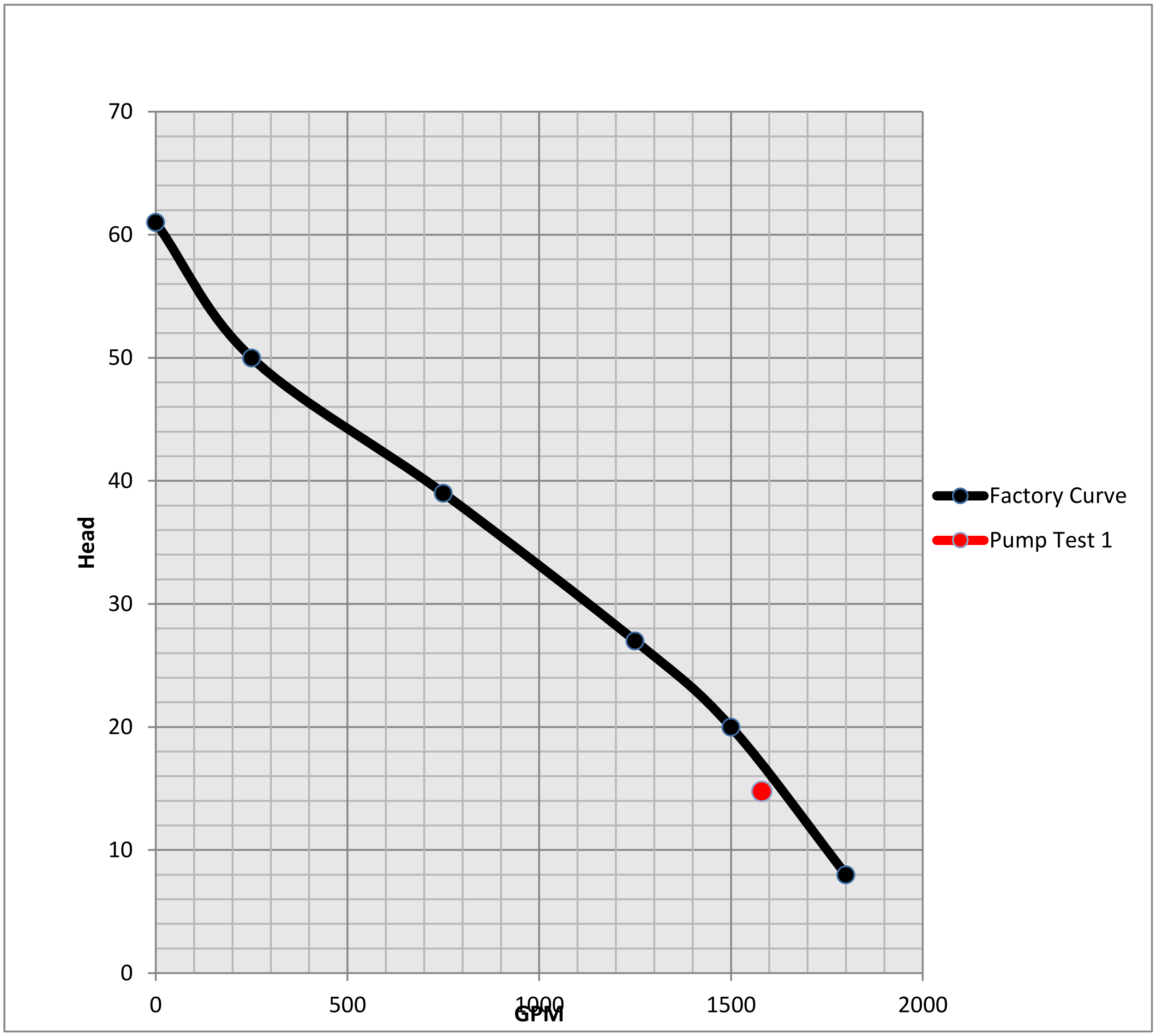
	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8
Data Point	1
TDH	14.8
Flow	1580.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:	Job Number
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 20	10/24/2023
Equipment ID:	
Pump #3	



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 20

DATE: 10/24/2023

	Pump # 1
Top Motor X	0.079
Top Motor Y	0.071
Axial	0.025
Bottom Motor X	0.030
Bottom Motor Y	0.016
Top Pump X	0.028
Top Pump Y	0.035
Axial	0.017
Bottom Pump X	0.043
Bottom Pump Y	0.044

(green)	Acceptable
(yellow)	Warning
(red)	Above Limit

Hydraulic Institute Vibration Limits	
Motor Below 200 kW	0.20 in/s
Pump Below 25 kW	0.30 in/s

PumpTech an impel company

FIELD TEST REPORT

Summary

Job Name:

City of Mercer Island

Job Number:

162240

Station ID:

Lift Station 20

DATE:

10/24/2023

During our Visit the motors on all 3 pumps were checked electrically and the pumps were tested with a drawdown test for flow. During the pump tests we also tested the pumps and motors for vibration. The vibration levels on all Pumps were below the Hydraulic institute's limits . The pump curve used is an estimation based off of the original book curves and is to be used for reference only. All pumps are falling short for the original book curve but that is expected with the age of the pumps.

Recommendations:

- Schedule to have motor serviced (clean, dip and bake)and bearings replaced, or replace with new premium efficient model.
- Open and inspect the pump, checking for clogs and to measure wear ring clearances.
- Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances.
- Pump and motor should have a detailed inspection to determine if replacement is more viable than a repair.

Pumptech Representative

Ronnie Basinger

Print

Signature Date

▪ Municipal ▪ Industrial ▪ Packaged Systems ▪

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Contractor # 270976

PumpTech
an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 21	10/24/2023

Equipment ID: Pump #1

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-07	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67631	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 21

DATE: 10/24/2023

Equipment ID: Pump #1

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

V_{1-3}	495	V1-grd	494	Imbalance
V_{2-3}	491	V2-grd	0	**0.54**
V_{1-2}	495	V3-grd	493	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.7	Ω
L_{1-2}	1.7	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 21
DATE:	10/24/2023
Equipment ID:	Pump #1
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	485.0
V_{2-3}	482.0
V_{1-2}	480.0
V1-grd	486.0
V2-grd	0.0
V3-grd	485.0
$V_{average}$	482.33
Imbalance*	**0.55**

AMPS

A_1	17.3
A_2	17.4
A_3	16.8
Imbalance*	**2.14**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8

Data Point	1
TDH	14.8
Flow	1550.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

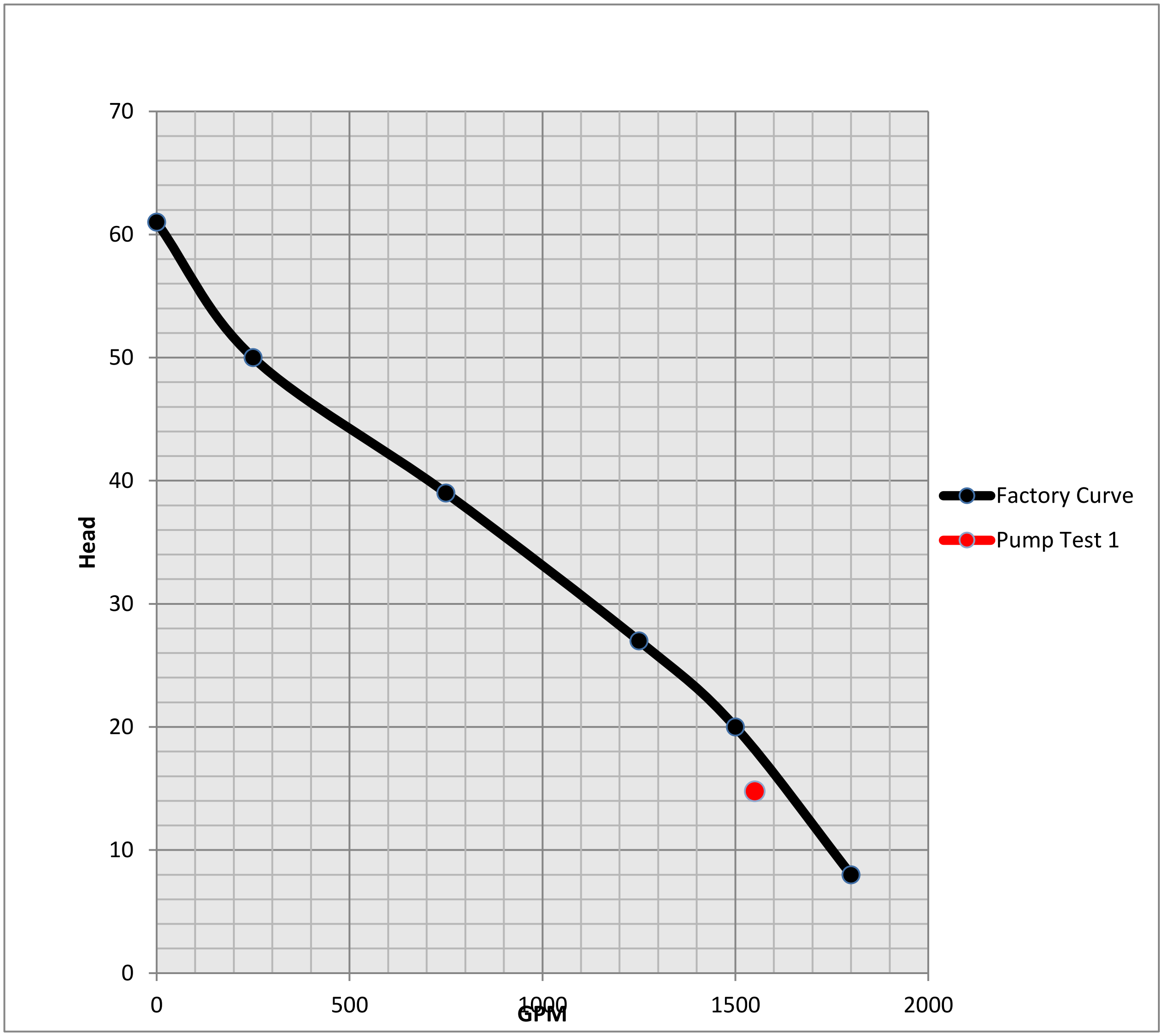
Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 21

DATE: 10/24/2023

Equipment ID: Pump #1



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 21
DATE:	10/24/2023
Equipment ID:	Pump #2

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94402-8/2-05	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15494G-55	29/14.5	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	**Imp Dia**	**Date Code**	**Discharge Size**
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	**Stages**		**Shaft Size**
67450	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 21

DATE: 10/24/2023

Equipment ID: Pump #2

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	495	V1-grd	494	**0.54**
V_{2-3}	491	V2-grd	0	
V_{1-2}	495	V3-grd	493	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.8	Ω
L_{2-3}	1.8	Ω
L_{1-2}	1.8	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 21	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #2	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	487.0
V_{2-3}	484.5
V_{1-2}	484.5
V1-grd	488.8
V2-grd	0.0
V3-grd	486.6
$V_{average}$	485.33
Imbalance*	**0.34**

AMPS

A_1	13.5
A_2	13.7
A_3	12.6
Imbalance*	**5.03**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8
Data Point	1
TDH	14.8
Flow	1240.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

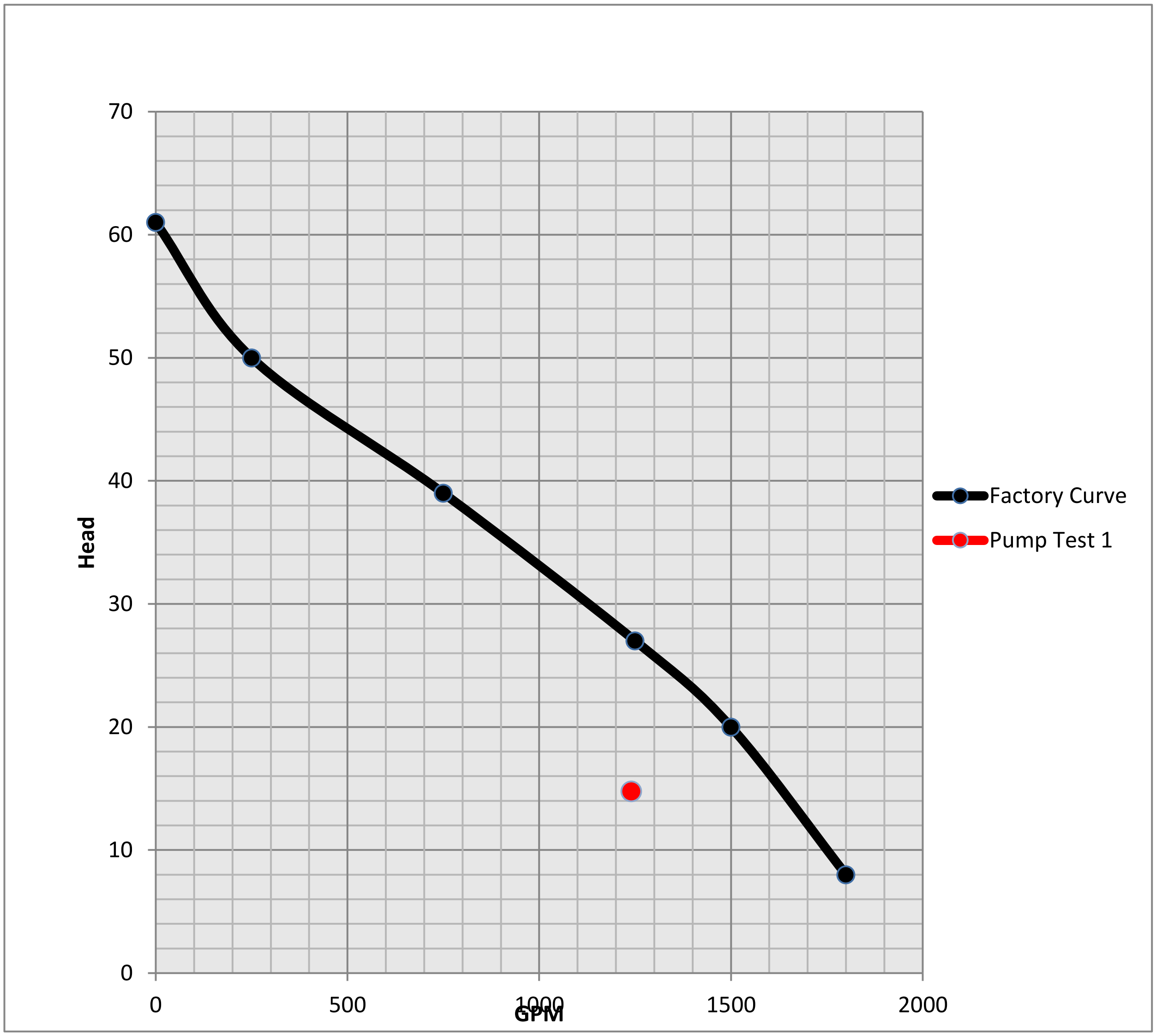
Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 21

DATE: 10/24/2023

Equipment ID: Pump #2



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 21
DATE:	10/24/2023
Equipment ID:	Pump #3

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	10	B	256 HPV	
Serial or ID Number	Volts	Code	Enclosure	
11-94402-8/2-08	230/460	G	DP	
Catalog Number	FLA	Des	Orientation	
A15494G-55	29/14.5	B	Vertical	
Model Number	RPM	Weight	ODE Bearing	Lubrication
WJ 256TTDR7998AN W	1160	n/a	208	Grease
Rating/Max Ambient	SF		DE Bearing	Lubrication
40 C	1.15		309	Grease
Starting Method	PF	Efficiency		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	8
Model	Imp Dia	Date Code	Discharge Size
6NHTA6 VCRH10-6	10.875	n/a	6
Serial or ID Number	Stages		Shaft Size
67436	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 21

DATE: 10/24/2023

Equipment ID: Pump #3

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	2.08
FT of H_2O		FT of H_2O	12.5

Unloaded Voltage

				Imbalance
V_{1-3}	495	V1-grd	494	**0.54**
V_{2-3}	491	V2-grd	0	
V_{1-2}	495	V3-grd	493	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	1.7	Ω
L_{2-3}	1.7	Ω
L_{1-2}	1.7	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 21
DATE:	10/24/2023
Equipment ID:	Pump #3
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	488.0
V_{2-3}	484.0
V_{1-2}	484.0
V1-grd	490.0
V2-grd	0.0
V3-grd	486.0
$V_{average}$	485.33
Imbalance*	**0.55**

AMPS

A_1	14.2
A_2	14.0
A_3	13.8
Imbalance*	**1.43**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.5
Estimated Friction	
Gage Height	2.1
Ft	14.8

Data Point	1
TDH	14.8
Flow	1460.0

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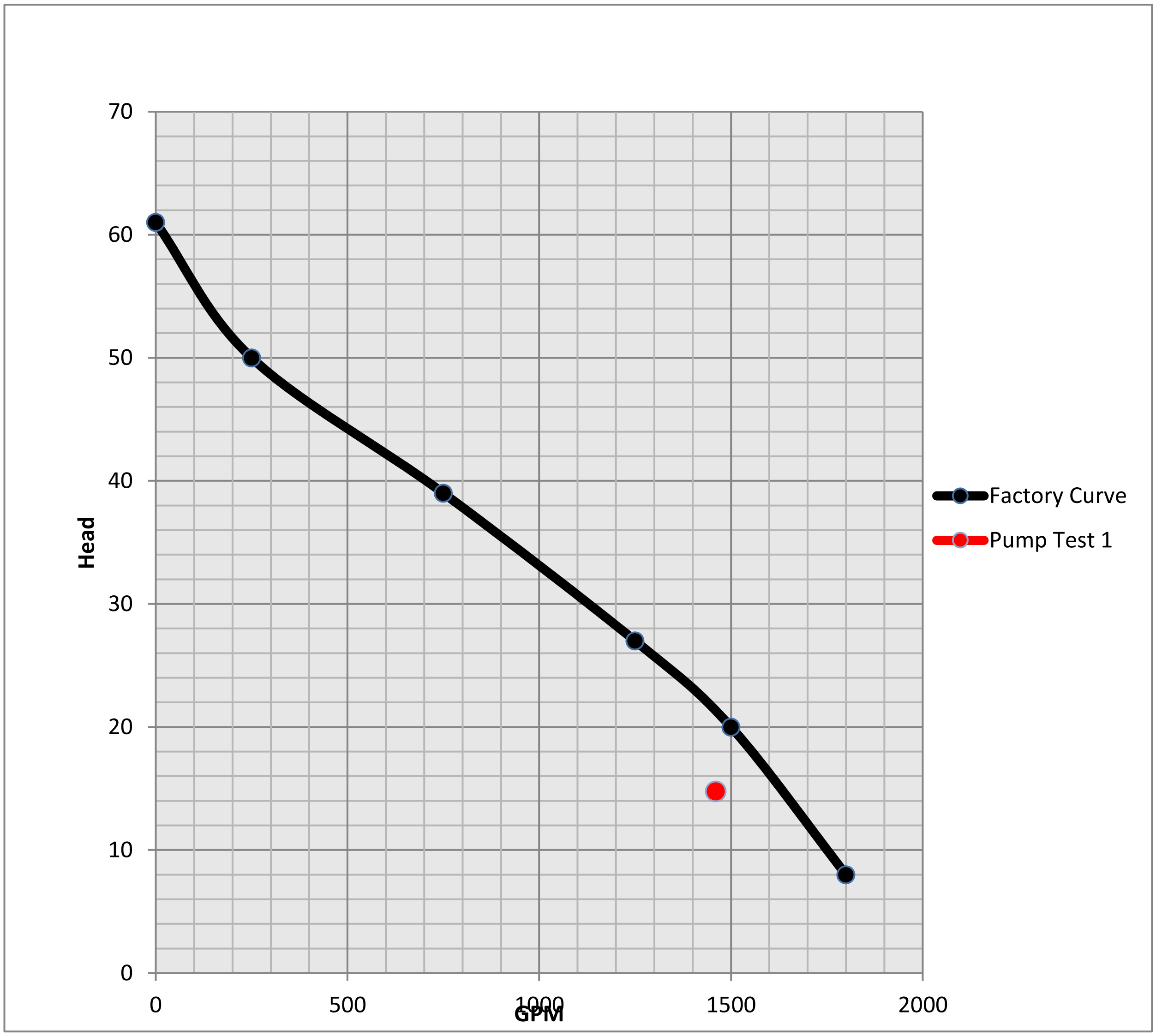
FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:	Job Number
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 21	10/24/2023
Equipment ID:	
Pump #3	



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	61	50	39	27	20	8
Flow	0	250	750	1250	1500	1800

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 22
DATE:	10/24/2023
Equipment ID:	Pump #1

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-06	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNT-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67165	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 22

DATE: 10/24/2023

Equipment ID: Pump #1

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	3.5
Gage Height		Gage Height	1.79
FT of H_2O		FT of H_2O	9.9

Unloaded Voltage

				Imbalance
V_{1-3}	245.7	V1-grd	122.5	
V_{2-3}	244.3	V2-grd	214	**0.54**
V_{1-2}	247	V3-grd	122	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	0.8	Ω
L_{2-3}	0.8	Ω
L_{1-2}	0.8	Ω

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FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 22
DATE:	10/24/2023
Equipment ID:	Pump #1
Test Speed:	60hz
PumpTest #	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	244.0
V_{2-3}	242.0
V_{1-2}	243.0
V1-grd	122.0
V2-grd	212.0
V3-grd	120.5
$V_{average}$	243.00
Imbalance*	**0.41**

AMPS

A_1	17.0
A_2	16.2
A_3	17.5
Imbalance*	**4.14**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.0
Estimated Friction	
Gage Height	1.8
Ft	13.3

Data Point	1
TDH	13.3
Flow	560.0

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FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

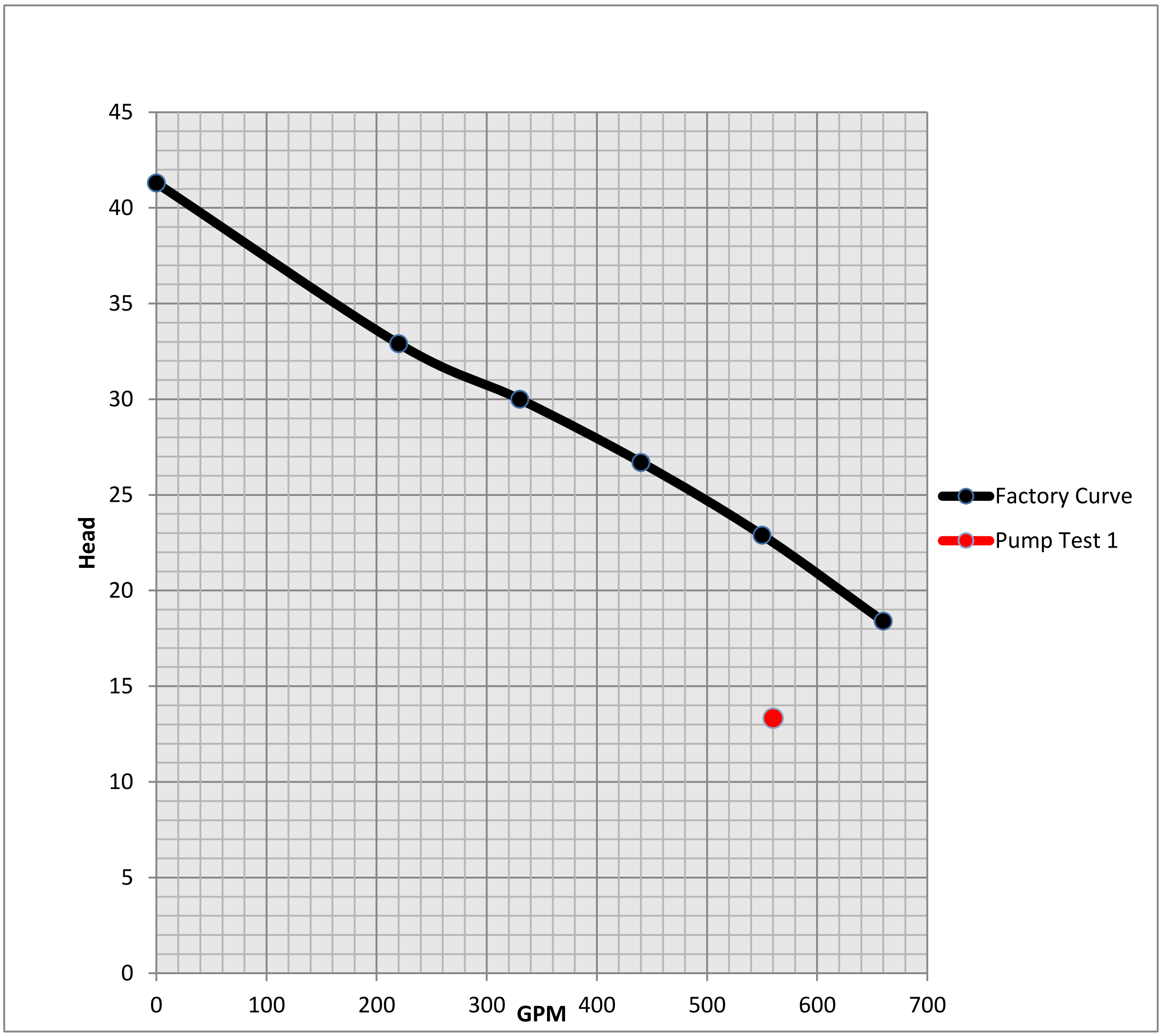
Lift Station 22

DATE:

10/24/2023

Equipment ID:

Pump #1



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 22	10/24/2023

Equipment ID: Pump #2

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-05	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNT-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67166	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 22	10/24/2023
Equipment ID:	Test Criteria
Pump #2	

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	3.5
Gage Height		Gage Height	1.79
FT of H_2O		FT of H_2O	9.9

Unloaded Voltage

				Imbalance
V_{1-3}	245.7	V1-grd	122.5	
V_{2-3}	244.3	V2-grd	214	**0.54**
V_{1-2}	247	V3-grd	122	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	0.9	Ω
L_{2-3}	0.9	Ω
L_{1-2}	0.8	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 22	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #2	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	243.5
V_{2-3}	242.0
V_{1-2}	243.0
V1-grd	122.0
V2-grd	212.0
V3-grd	120.5
$V_{average}$	242.83
Imbalance*	**0.34**

AMPS

A_1	19.0
A_2	19.5
A_3	18.6
Imbalance*	**2.45**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.0
Estimated Friction	
Gage Height	1.8
Ft	13.3

Data Point	1
TDH	13.3
Flow	560.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

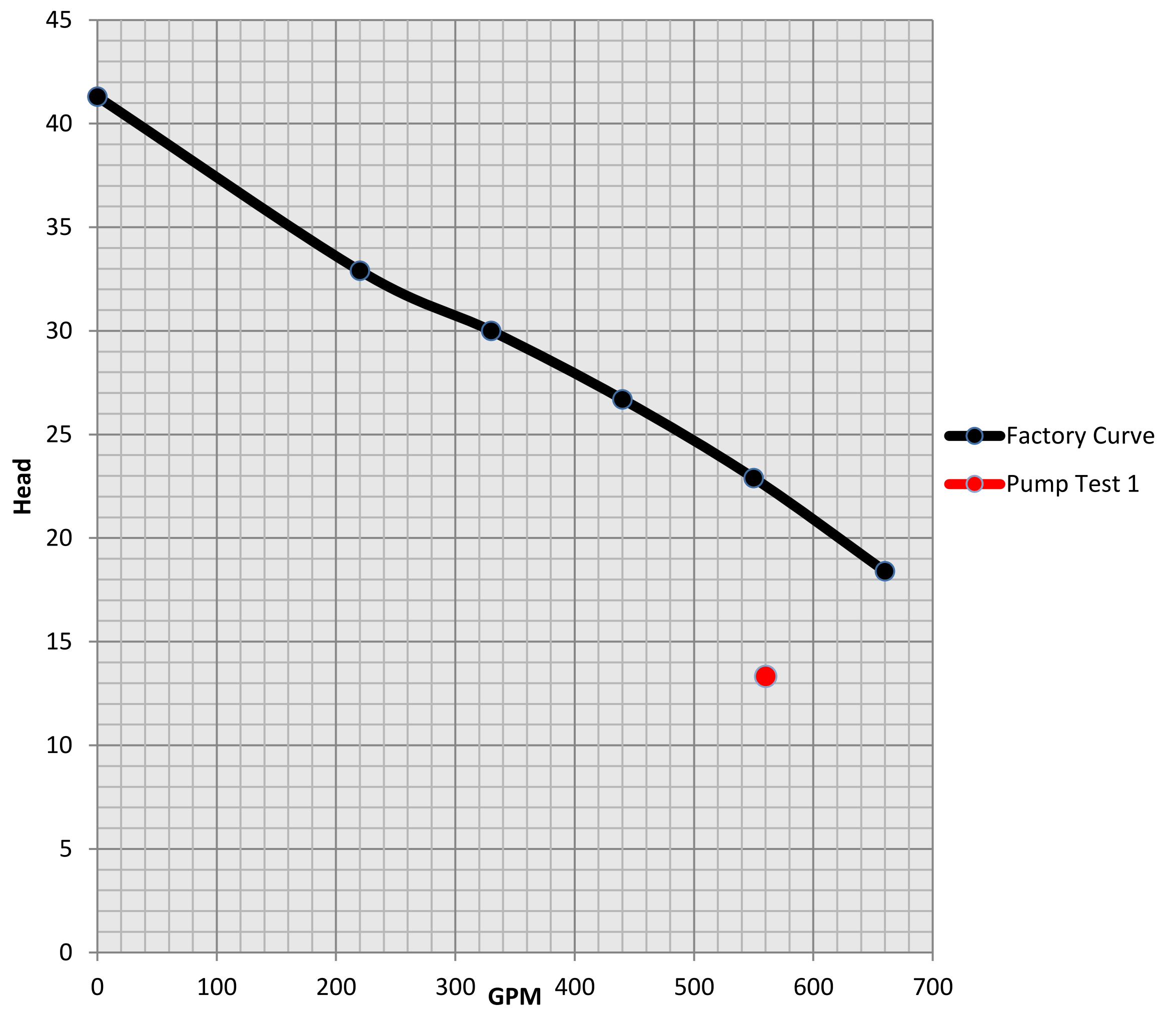
Lift Station 22

DATE:

10/24/2023

Equipment ID:

Pump #2



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	City of Mercer Island
Job Number:	162240
Station ID:	Lift Station 22
DATE:	10/24/2023
Equipment ID:	Pump #3

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-03	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNT-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67167	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 22

DATE: 10/24/2023

Equipment ID: Pump #3

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	3.5
Gage Height		Gage Height	1.79
FT of H_2O		FT of H_2O	9.9

Unloaded Voltage

				Imbalance
V_{1-3}	245.7	V1-grd	122.5	
V_{2-3}	244.3	V2-grd	214	**0.54**
V_{1-2}	247	V3-grd	122	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	0.8	Ω
L_{2-3}	0.8	Ω
L_{1-2}	0.8	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 22	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #3	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	244.5
V_{2-3}	243.0
V_{1-2}	243.5
V1-grd	122.0
V2-grd	212.5
V3-grd	121.0
$V_{average}$	243.67
Imbalance*	**0.34**

AMPS

A_1	17.6
A_2	17.2
A_3	17.8
Imbalance*	**1.90**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	5.0
Estimated Friction	
Gage Height	1.8
Ft	13.3

Data Point	1
TDH	13.3
Flow	502.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

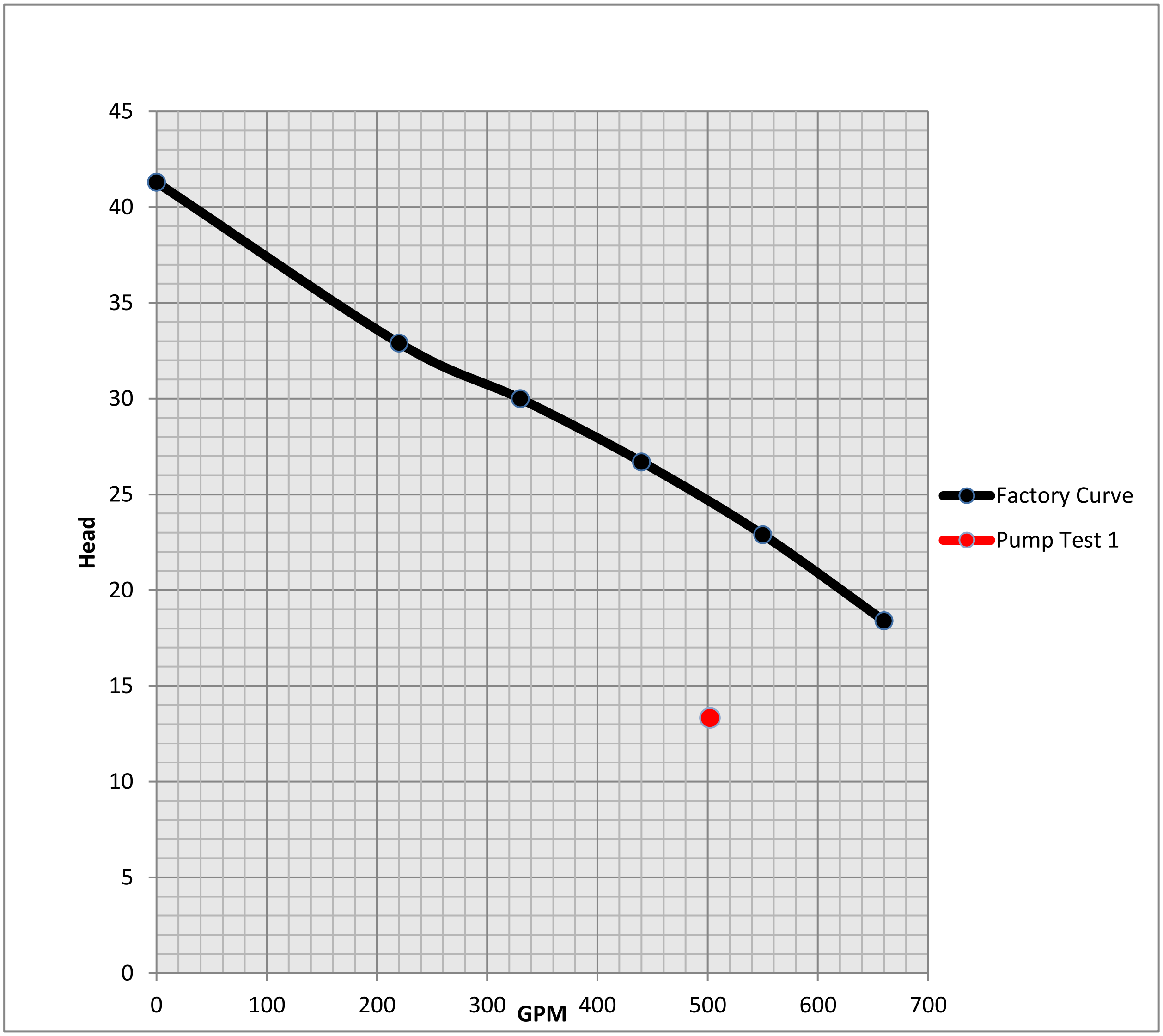
Lift Station 22

DATE:

10/24/2023

Equipment ID:

Pump #3



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

PumpTech an impel company

Job Name:

City of Mercer Island

Station ID:

Lift Station 22

Job Number:

162240

DATE:

10/24/2023

	Pump # 1	Pump # 2	Pump # 3
Top Motor X	0.367	0.032	0.116
Top Motor Y	0.184	0.028	0.114
Axial	0.023	0.010	0.013
Bottom Motor X	0.187	0.020	0.077
Bottom Motor Y	0.126	0.019	0.076
Top Pump X	0.186	0.020	0.029
Top Pump Y	0.114	0.006	0.060
Axial	0.036	0.002	0.009
Bottom Pump X	0.111	0.011	0.043
Bottom Pump Y	0.072	0.003	0.036

Green	Acceptable
Yellow	Warning
Red	Above Limit

Hydraulic Institute Vibration Limits	
Motor Below 200 kW	0.20 in/s
Pump Below 25 kW	0.30 in/s

PumpTech an impel company

FIELD TEST REPORT

Summary

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 22	10/24/2023

During our Visit the motors on all 3 pumps were checked electrically and the pumps were tested with a clamp on flow meter on the common discharge line. During the pump tests we also tested the pumps and motors for vibration. The vibration levels were all below the Hydraulic institute's limits but Pump #1 has couple points on the motor that it is close enough to trigger a warning level and one over the limit, this should be monitored with the elevated vibration levels. The pumps performance was a little lower than the original book curve shows, but due to the age of the pumps it is expected.

Recommendations:

- Schedule to have motor serviced (clean, dip and bake)and bearings replaced, or replace with new premium efficient model.
- Open and inspect the pump, checking for clogs and to measure wear ring clearances.
- Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances.
- Pump and motor should have a detailed inspection to determine if replacement is more viable than a repair.

Pumptech Representative

Ronnie Basinger

Print

11/12/2023

Signature Date

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 23	10/24/2023

Equipment ID: Pump #1

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-01	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNTLH-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67157	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 23	10/24/2023
Equipment ID:	Test Criteria
Pump #1	

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	1.875
FT of H_2O		FT of H_2O	12.3

Unloaded Voltage

				Imbalance
V_{1-3}	492	V1-grd	490	**0.34**
V_{2-3}	490	V2-grd	0	
V_{1-2}	489	V3-grd	489	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	2.6	Ω
L_{2-3}	2.5	Ω
L_{1-2}	2.5	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 23	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #1	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	489.0
V_{2-3}	487.0
V_{1-2}	485.0
V1-grd	490.0
V2-grd	0.0
V3-grd	485.0
$V_{average}$	487.00
Imbalance*	**0.41**

AMPS

A_1	8.7
A_2	8.4
A_3	8.7
Imbalance*	**2.33**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	6.5
Estimated Friction	
Gage Height	1.9
Ft	16.9

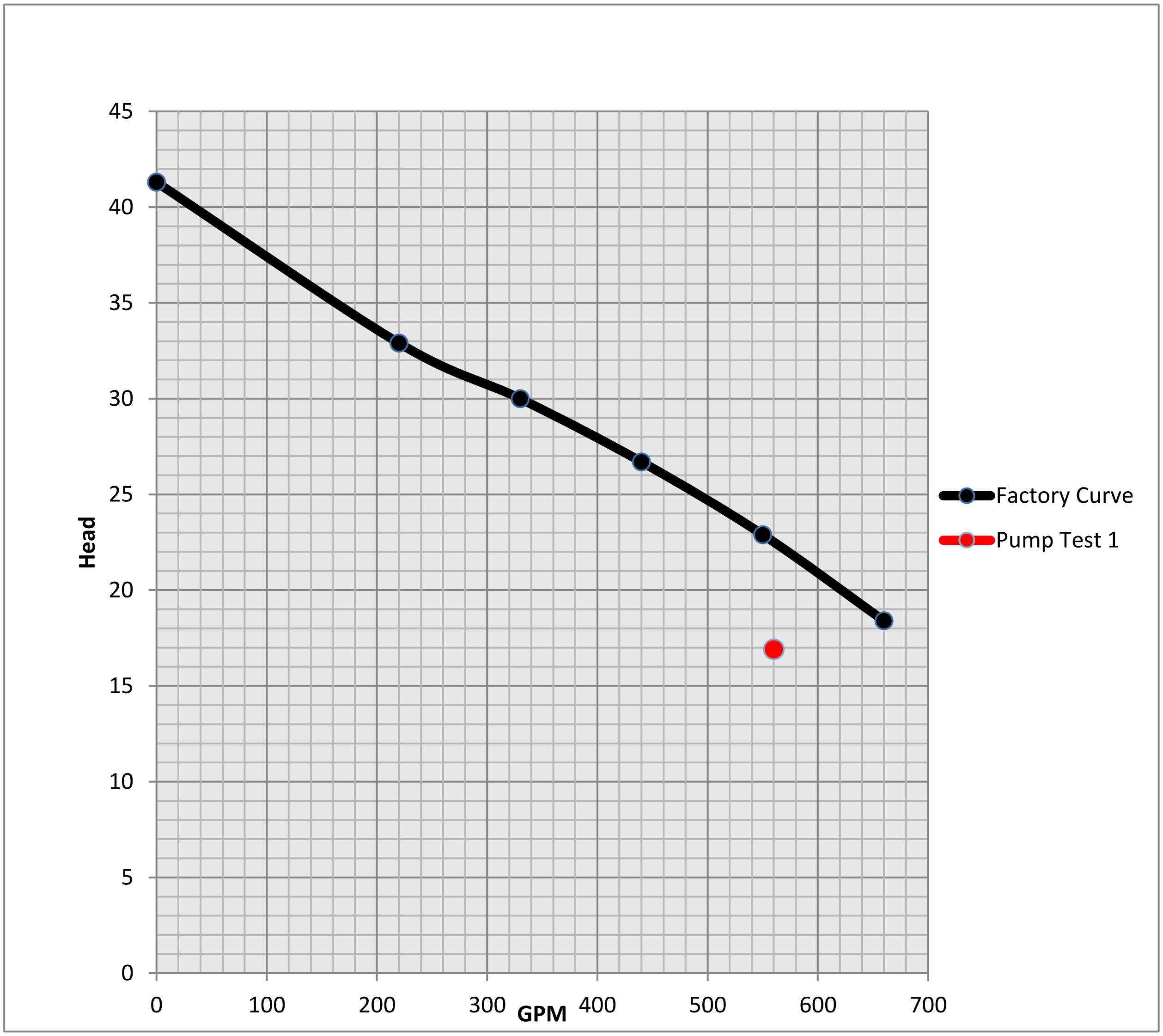
Data Point	1
TDH	16.9
Flow	560.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:	Job Number
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 23	10/24/2023
Equipment ID:	
Pump #1	



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 23	10/24/2023
Equipment ID:	
Pump #2	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-04	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNTLH-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67159	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 23

DATE: 10/24/2023

Equipment ID: Pump #2

Test Criteria

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	1.875
FT of H_2O		FT of H_2O	12.3

Unloaded Voltage

V_{1-3}	492	V1-grd	490	Imbalance
V_{2-3}	490	V2-grd	0	**0.34**
V_{1-2}	489	V3-grd	489	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	2.7	Ω
L_{2-3}	2.7	Ω
L_{1-2}	2.7	Ω

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 23	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #2	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	488.0
V_{2-3}	487.0
V_{1-2}	486.5
V1-grd	490.0
V2-grd	0.0
V3-grd	489.0
$V_{average}$	487.17
Imbalance*	**0.17**

AMPS

A_1	9.1
A_2	8.7
A_3	8.6
Imbalance*	**3.41**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	6.5
Estimated Friction	
Gage Height	1.9
Ft	16.9

Data Point	1
TDH	16.9
Flow	565.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

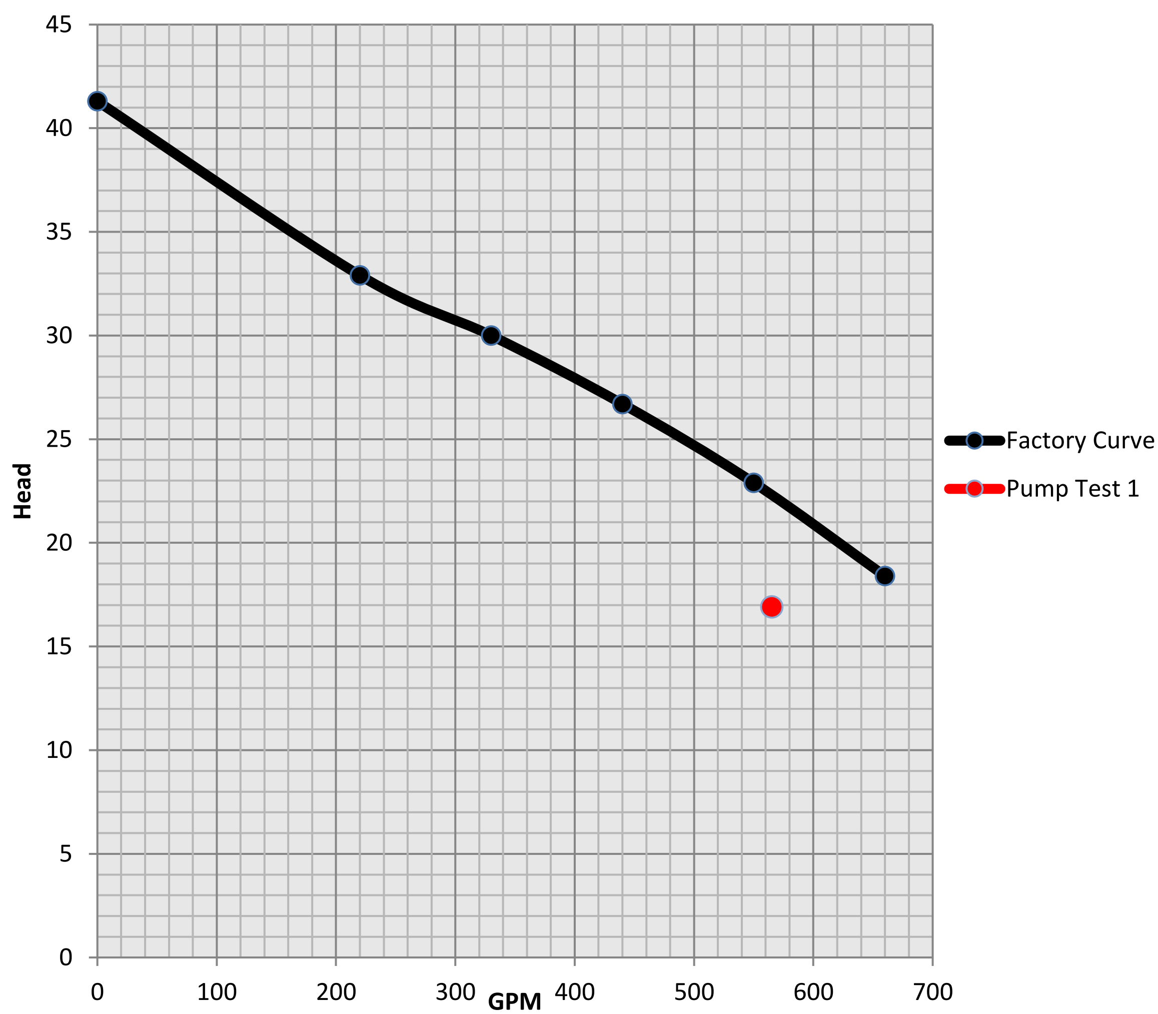
Lift Station 23

DATE:

10/24/2023

Equipment ID:

Pump #2



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

PumpTech an impel company

FIELD TEST REPORT

Equipment Information Sheet

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	**DATE:**
Lift Station 23	10/24/2023
Equipment ID:	
Pump #3	

Motor Data

Manufacturer	HP	Insulation Class	Frame Size	
Marathon Electric	7.5	B	254 HPV	
Serial or ID Number	**Volts**	**Code**	**Enclosure**	
11-94281-8/2-02	230/460	G	DP	
Catalog Number	**FLA**	**Des**	**Orientation**	
A15493G-55	22/11	B	Vertical	
Model Number	**RPM**	**Weight**	**ODE Bearing**	**Lubrication**
WJ 254TTDR8379AN W	1155	n/a	208	Grease
Rating/Max Ambient	**SF**		**DE Bearing**	**Lubrication**
40 C	1.15		309	Grease
Starting Method	**PF**	**Efficiency**		
Across the Line	76.5%	84.0%		

Pump Data

Manufacturer	Design Head	Design Flow	Suction Size
Cornell	n/a	n/a	6
Model	**Imp Dia**	**Date Code**	**Discharge Size**
4NNTLH-6VC	9	n/a	4
Serial or ID Number	**Stages**		**Shaft Size**
67158	n/a		n/a

FIELD TEST REPORT

Conditions

Job Name:	Job Number:
City of Mercer Island	162240
Station ID:	DATE:
Lift Station 23	10/24/2023
Equipment ID:	Test Criteria
Pump #3	

Static Pressure(s)

Suction/Water Level		Discharge	
PSI/In Hg		PSI	4.5
Gage Height		Gage Height	1.875
FT of H_2O		FT of H_2O	12.3

Unloaded Voltage

				Imbalance
V_{1-3}	492	V1-grd	490	
V_{2-3}	490	V2-grd	0	**0.34**
V_{1-2}	489	V3-grd	489	

Insulation Test

L_{1-GRD}	>660	MΩ
L_{2-GRD}	>660	MΩ
L_{3-GRD}	>660	MΩ

Winding Resistance

L_{1-3}	2.4	Ω
L_{2-3}	2.4	Ω
L_{1-2}	2.4	Ω

PumpTech an impel company

FIELD TEST REPORT

Pressure Testing Data Sheet

Job Name:	Job Number:
City of Mercer Island	162240

Station ID:	DATE:
Lift Station 23	10/24/2023

Equipment ID:	Test Speed:	PumpTest #
Pump #3	60hz	

VOLTS

TEST	1
Time/Condition	
V_{1-3}	488.0
V_{2-3}	487.0
V_{1-2}	486.5
V1-grd	490.0
V2-grd	0.0
V3-grd	485.5
$V_{average}$	487.17
Imbalance*	**0.17**

AMPS

A_1	8.6
A_2	8.2
A_3	8.5
Imbalance*	**2.77**

HYDRAULICS

	1
Suction Pressure	
Estimated Friction	
Gage Height	
Ft	0.0
Discharge Pressure	6.5
Estimated Friction	
Gage Height	1.9
Ft	16.9

Data Point	1
TDH	16.9
Flow	490.0

PumpTech an impel company

FIELD TEST REPORT

Data Point Plotting Worksheet

Job Name:

City of Mercer Island

Job Number

162240

Station ID:

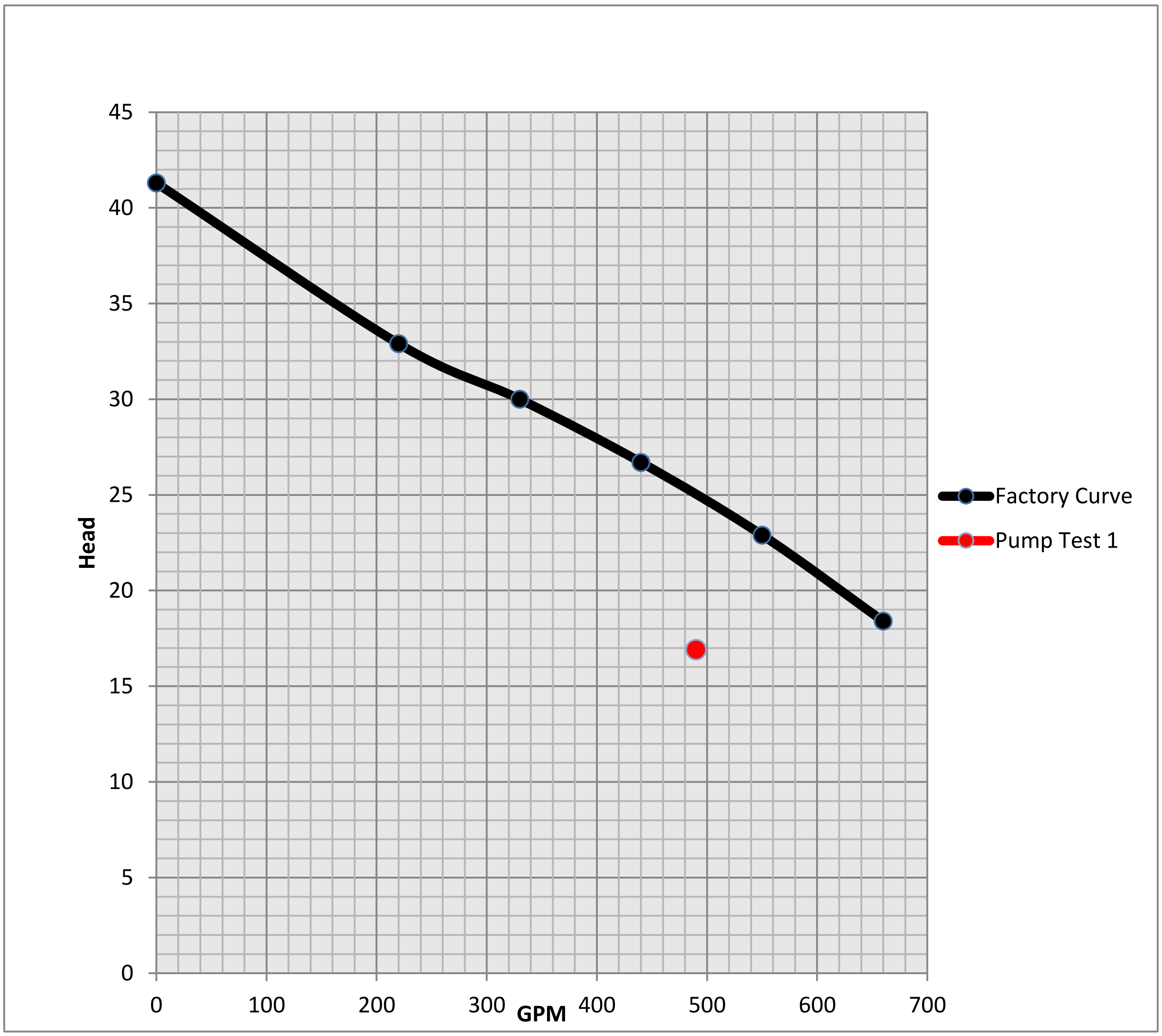
Lift Station 23

DATE:

10/24/2023

Equipment ID:

Pump #3



Factory Curve Data

	Shutoff	1	2	3	4	5
Head	41.3	32.9	30	26.7	22.9	18.4
Flow	0	220	330	440	550	660

Job Name:

City of Mercer Island

Station ID:

Lift Station 23

Job Number:

162240

DATE:

10/24/2023

	Pump # 1	Pump # 2	Pump # 3
Top Motor X	0.073	0.181	0.149
Top Motor Y	0.070	0.174	0.132
Axial	0.019	0.013	0.030
Bottom Motor X	0.046	0.136	0.106
Bottom Motor Y	0.040	0.110	0.119
Top Pump X	0.040	0.114	0.062
Top Pump Y	0.032	0.051	0.073
Axial	0.014	0.013	0.016
Bottom Pump X	0.033	0.075	0.051
Bottom Pump Y	0.021	0.061	0.050

(green)	Acceptable
(yellow)	Warning
(red)	Above Limit

Hydraulic Institute Vibration Limits	
Motor Below 200 kW	0.20 in/s
Pump Below 25 kW	0.30 in/s

PumpTech an impel company

FIELD TEST REPORT

Summary

Job Name: City of Mercer Island

Job Number: 162240

Station ID: Lift Station 23

DATE: 10/24/2023

During our Visit the motors on all 3 pumps were checked electrically and the pumps were tested with a clamp on flow meter on the common discharge line. During the pump tests we also tested the pumps and motors for vibration. The vibration levels were all below the Hydraulic institute's limits but Pump#2 has one point on the motor that it is close enough to trigger a warning level and should be monitored. The pumps performance was a little lower than the original book curve shows, but due to the age of the pumps it is expected.

Recommendations:

- Schedule to have motor serviced (clean, dip and bake)and bearings replaced, or replace with new premium efficient model.
- Open and inspect the pump, checking for clogs and to measure wear ring clearances.
- Due to the age of the equipment, the pump bearing housing should be disassembled, bearing lands and bores measured for proper clearances.
- Pump and motor should have a detailed inspection to determine if replacement is more viable than a repair.

Pumptech Representative

Ronnie Basinger

Print

11/13/2023

Signature Date

Appendix D

Field Forms and Interview Information

			Pump Station No.				City Notes
?#		19	20	21	22	23	
1	**Has pump station ever overflowed?**	No, not in Dennis Baker's tenure at MI.	No, not in Dennis Baker's tenure at MI.	No, not in Dennis Baker's tenure at MI. Floatables always present on water surface, indicating they have not been sucked off the top during an overflow event.	No, not in Dennis Baker's tenure at MI.	No, not in Dennis Baker's tenure at MI.	
2	**How often are wetwells pumped of grit?**	3 years ago - saw bottom	Grit is present in pumps. Accessible with City's vac truck. Once a year sediments are cleaned. Most grit from the wall of the station.	In the past, every 10 years a vactor truck is loaded onto a barge and wetwells are pumped of accumuated sediments. Want to get on 2 year cleaning cycle. Haven't seen bottom of this	3 years ago - saw bottom	3 years ago - saw bottom	
3	**How often is grease removed from pump station walls?**	See PS No. 20 comment	Can't clean because of condition of concrete wall. Wall will disintegrate with heavy cleaning. Some grease accumulates in dry weather. Wet weather keeps wetwell rinsed clean.	See PS No. 20 comment	See PS No. 20 comment	See PS No. 20 comment	
4	**Have there been odor complaints**	Yes	No	Yes. Home two properties to southwest complains regularly. Does service line for this home serve as a Lakeline highpoint vent here? Has private manhole on property that consolidates 2 or 3 services. Location of manhole is unknown.	Yes	No	
5	**Have there been noise complaints**	No	No	No	No	No	
6	**Has infiltration been observed entering wetwell?**	No, not that Dennis recalls	None was observed on February 9, 2022.	None was observed on February 9, 2022.	No, not that Dennis recalls	No, not that Dennis recalls	
7	**Has infiltration been observed entering drywell?**	No	None was observed on February 9, 2022.	None was observed on February 9, 2022.	No	No	
8	**How often do pumps require rag removal?**	Depends on the season. Haven't done anything with rags this year	Wetwell will have floating rag mat. Rags must be removed from pumps approximately 6 times per year. A rag clearing takes 90 minutes with a two man crew. Requires prybar to remove stuck rags.	See PS No. 20 comment	Depends on the season. Have received 4-5 rags this year	Depends on the season. Have received 4-5 rags this year	
9	**Which pumps rag?**	It depends on where it falls and how it comes in. Could impact any one of the pumps	First and second pumps closest to the influent pipe rag the most.	See PS No. 20 comment	It depends on where it falls and how it comes in. Could impact any one of the pumps	It depends on where it falls and how it comes in. Could impact any one of the pumps	

?#		Pump Station No. 19	20	21	22	23	City Notes
10	**Do suction valves operate and seat leak free?**	No. Valves don't work correctly - leak (sometimes)	Valves are original and are prone to breaking. They make a distinctive sound that, in Dennis experience, indicates that breakage is imminent. Mercer Island staff want valves replaced urgently. Replacement parts are not available. The inlet valve is not secured, must be supported with come-along when operated. Valves are gate valves, not designed for wastewater service.	See PS No. 20 comment. Remove comment about suction valve.	No. Valves don't work correctly - leak (sometimes)	No. Valves don't work correctly - leak (sometimes)	
11	**Do discharge valves operate and seat leak free?**	No. Valves don't work correctly - leak (sometimes)	See response to suction valves, but in poorer condition.	See PS No. 20 comment	No. Valves don't work correctly - leak (sometimes)	No. Valves don't work correctly - leak (sometimes)	
12	**What are the ages of the check valves in the pump station?**	1 kennedy check valve (pump #2) replaced 5 years ago	Check valves are original. City is currently replacing all check valves.	See PS No. 20 comment. Pumps 2 and 3 have new Kennedy check valves.	Check valves are original. 1965 or 1966	Check valves are original. 1965 or 1966	
13	**What are the conditions of the check valves in the pump station?**	Poor condition, still functioning (expect City will need to jerryrig one pump this year) - except pump 2 that was replaced	Check valve on Pump 2 was leaking out of the spring arm opening. (3 drips per second). New check valves are on order.	Valves are being replaced.	Poor condition, still functioning (expect City will need to jerryrig one pump this year)	Poor condition, still functioning (expect City will need to jerryrig one pump this year)	
14	**Does pump hoist operate successfully?**	Functional. Rails are newer. Hoist chain falls and ratchet should be replaced	Hoist appeared to be operating successfully.	Hoist appears operational	Functional. Rails are newer. Hoist chain falls and ratchet should be replaced	Functional. Rails are newer. Hoist chain falls and ratchet should be replaced	
15	**Does drywell access hatch open easily and latch securely open?**	Yes - likely replaced in 1990s	Hatch was new in the 1990s and operates successfully	Hatch was new in the 1990s and operates successfully	Yes - likely replaced in 1990s	Yes - likely replaced in 1990s	
16	**Does drywell exhaust fan function adequately?**	Yes, adequate air circulation. Fans operating	Apparently fan is working. Lack of corrosion on metals indicates it is working consistently. Does it run fulltime?	See response to PS 20.	Yes, adequate air circulation. Fans operating	Yes, adequate air circulation. Fans operating	
17	**What is age of drywell exhaust fan?**	Unknown	Fans are replaced regularly. Some last years, others months.	See response to PS 20.	New fan instlaled within last 6 months (in-line fan tech). Typically this station requires a new fan replacement 1x/year - City would like RH2 to assess	Unknown	
18	**Do drywell float switches operate?**	Assume flood alarm for this quesiton. Works	Yes	Yes	Assume flood alarm for this quesiton. Relay issue - City would like RH2 to assess.	Assume flood alarm for this quesiton. Works	
18a	**Float switch for sump pump?**	Works. Tested every 3 weeks	Works. Tested every 3 weeks	Works. Tested every 3 weeks	Works. Tested every 3 weeks	Works. Tested every 3 weeks	Same response for all 17 sites
19	**What is the age of the pump control centers?**	Not entirely sure. Dennis thinks there was upgrade in 1990s. Currently manufacturer saying parts obsolete and no longer available	Can't get parts.	See response to PS 20.	Not entirely sure. Dennis thinks there was upgrade in 1990s. Currently manufacturer saying parts obsolete and no longer available	Not entirely sure. Dennis thinks there was upgrade in 1990s. Currently manufacturer saying parts obsolete and no longer available	Hard to get breakers

			Pump Station No.				City Notes
?#		19	20	21	22	23	
20	**Do pump control centers hum and chatter at pump start up?**	No	Not observed. City does not observe hum or chatter.	See response to PS 20.	No	No	
21	**What is the age of the remote telemetry unit?**	See response to PS 20.	Installed by Hector of Omega in 2009 or 2010. MJK manufacture.	See response to PS 20.	See response to PS 20.	See response to PS 20.	
22	**What is the level sensing device that controls the pumps?**	Primary control is MJK	Level transducer and backup provided by Xylem (Flygt) Level Probe.	Level transducer with low, high, and high-high floats.	Primary control is MJK	Primary control is MJK	
23	**What is the age and condition of the level sensing device?**	Installed 2009 or 2010 by Hector of Omega. Condition still good, as long as City keeps them clean which they're doing	City planning to use Flygt FogRODs for all pump stations for back up. Will be installed as part of SCADA project. Level transducers will continue to be used as the lead control instrument.	See response to PS 20.	Installed 2009 or 2010 by Hector of Omega. Condition still good, as long as City keeps them clean which they're doing	Installed 2009 or 2010 by Hector of Omega. Condition still good, as long as City keeps them clean which they're doing	
24	**What is the age of the corrosion inhibiting chemical equipment?**	Bioxide runs through 19 on its way to 20	New this year. Storage and peristaltic pump for Bioxide.	NA	NA	NA	Boxide at PS 16 and 20
25	**What is the age and condition of the sump pump in the drywell?**	See response to PS 20.	Generally less than 5 years old.	See response to PS 20.	See response to PS 20.	See response to PS 20.	City planning to start new cylce in next biennium (2023-2024)
26	**Do flush valves operate successfully?**	No. Air actuator failed, City made inoperable over 15 years ago	NA	NA	No. Air actuator failed, City made inoperable over 15 years ago	NA	City prefer to go to AWU drive
27	**What is the age of the flush valve?**	Original equipment from 1965.	NA	NA	Original equipment from 1965.	NA	PS 1, 15, 16, 19, 22, 25 flush capabilities = flush valve. PS 12 strictly flush station
28	**Does wetwell have vent to allow air discharge and supply?**	No. Sand filters failed. Air hisses into wetwell during pumping. Wetwell lid might/might not be able to be removed when this occurs (depends).	No.	No. Wetwell lid cannot be removed when this occurs.	No. Sand filters failed. Air hisses into wetwell during pumping. Wetwell lid might/might not be able to be removed when this occurs (depends).	No. Station releases pressure into HGMH so no air hissing.	
29	**Power supply**	True 3-phase power.	True 3-phase power.	Pump Station 21 has 3-phase converter in panel near generator. 480 volt, three phase. Only two phases come in from PSE.	True 3-phase power.	True 3-phase power.	
30	**Other notes**			Influent line to wetwell submerges soon after pump off level			

Appendix E

Ranking Matrix

CITY OF MERCER ISLAND - Sewer Pump Station Condition Assessment

Ranking Matrix

	A	B	C	D	E	F	G	H	I
1	**A. General Categories**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
2		Status of Health, Fire, and Life Safety Systems	5	20	20	20	20	20	25
3		Exterior Concrete Condition	5	20	25	20	25	25	25
4		Condition of City's Dock(s) (if Applicable)	3	3	N/A	9	N/A	N/A	15
6		Type of Vehicle Assess to Station	1	1	3	3	3	4	5
7		Weighted Points for each Station		44	48	52	48	49	70
8		Max Available Points for Station		70	55	70	55	55	---
9		Percentage of Available Points		63%	87%	74%	87%	89%	---
10		Ranking		1	3	2	3	5	---
11									
12	**B. Station Overflow Vulnerability**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
13		Response Time (Hours) Before Overflow Event	2	2	2	2	2	2	10
14		Number of Overflows in Past 5 years	5	25	25	25	25	25	25
15		Weighted Points for each Station		27	27	27	27	27	35
16		Max Available Points for Station		35	35	35	35	35	---
17		Percentage of Available Points		77%	77%	77%	77%	77%	---
18		Ranking		1	1	1	1	1	---
19									
20	**C. Wet Well Operation**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
21		WW Cycling Index (Current)	5	20	5	25	25	25	25
22		WW Influent Pipe Surcharge Index	3	6	6	3	3	3	15
23		Apparent Severity of WW Grease Removal	1	4	3	5	5	5	5
24		Apparent Severity of WW Rock/Grit/Obstruction Removal	3	9	3	9	9	9	15
25		Weighted Points for each Station		39	17	42	42	42	60
26		Max Available Points for Station		60	60	60	60	60	---
27		Percentage of Available Points		65%	28%	70%	70%	70%	---
28		Ranking		2	1	3	3	3	---
29									
30	**D. Wet Well Condition**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
31		WW - Condition of Access Metals	3	9	9	9	9	9	15
32		WW - Condition of Concrete	5	10	5	15	15	15	25
33		Degree of Infiltration	1	5	5	5	5	5	5
34		Weighted Points for each Station		24	19	29	29	29	45
35		Max Available Points for Station		45	45	45	45	45	---
36		Percentage of Available Points		53%	42%	64%	64%	64%	---
37		Ranking		2	1	3	3	3	---
38									
39	**E. Dry Well Condition**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
40		DW - Condition of Access Metals	3	15	15	15	15	15	15
41		DW - Condition of Concrete	5	25	25	25	25	25	25
42		Degree and Status of Interior Lighting	1	5	5	5	5	5	5
43		Degree of Infiltration	2	5	5	5	5	5	10
44		Condition of Water Pumping System	2	10	10	10	10	10	10
45		Weighted Points for each Station		60	60	60	60	60	65
46		Max Available Points for Station		65	65	65	65	65	---
47		Percentage of Available Points		92%	92%	92%	92%	92%	---
48		Ranking		1	1	1	1	1	---
49									
50	**F. Pumps**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
51		Pump Flow Capacity Ratio (Current)	5	15	20	5	5	10	25
52		Maximum Pump Cycling Index (Current)	5	25	15	25	25	25	25
53		Condition of Sump Pump	1	5	5	5	5	5	5
54		Condition of Valves and Piping	4	8	4	4	8	8	20
55		Number of Times Pumps Deragged in Last Year	3	15	3	3	6	6	15
56		Weighted Points for each Station		68	47	42	49	54	90
57		Max Available Points for Station		90	90	90	90	90	---
58		Percentage of Available Points		76%	52%	47%	54%	60%	---
59		Ranking		5	2	1	3	4	---
60									
61	**G. Motors**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
62		Motor Age (years) - Pump No. 1	3	3	3	3	3	3	15
63		Motor Age (years) - Pump No. 2	3	3	3	3	3	3	15
64		Motor Age (years) - Pump No. 3	3	3	3	3	3	3	15
65		Motor Maximum Voltage Imbalance - Pump No. 1	1	3	3	3	4	4	5
66		Motor Maximum Voltage Imbalance - Pump No. 2	1	3	3	4	4	5	5
67		Motor Maximum Voltage Imbalance - Pump No. 3	1	3	3	3	3	5	5
68		Motor Maximum Current Imbalance - Pump No. 1	1	4	3	4	3	4	5
69		Motor Maximum Current Imbalance - Pump No. 2	1	3	4	3	4	3	5
70		Motor Maximum Current Imbalance - Pump No. 3	1	3	3	4	4	4	5
71		Motor Maximum Lateral Vibration Index - Pump No. 1	1	1	4	1	1	5	5
72		Motor Maximum Lateral Vibration Index - Pump No. 2	1	4	1	1	5	3	5
73		Motor Maximum Lateral Vibration Index - Pump No. 3	1	1	1	N/A	4	4	5
74		Motor Megger Index (for Each Pump) - Pump No. 1	1	5	5	5	5	5	5
75		Motor Megger Index (for Each Pump) - Pump No. 2	1	5	5	5	5	5	5
76		Motor Megger Index (for Each Pump) - Pump No. 3	1	5	5	5	5	5	5
77		Weighted Points for each Station		49	49	47	56	61	105
78		Max Available Points for Station		105	105	100	105	105	---
79		Percentage of Available Points		47%	47%	47%	53%	58%	---
80		Ranking		1	1	3	4	5	---
81									
82	**H. Force Main (Exterior to the Pump Station**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
83		Age (years)	4	12	12	12	12	12	20
85		Material	3	9	9	9	9	9	15
87		Current Force Main Velocity (fps)	3	3	3	3	3	3	15
88		Weighted Points for each Station		24	24	24	24	24	50
89		Max Available Points for Station		50	50	50	50	50	---
90		Percentage of Available Points		48%	48%	48%	48%	48%	---
91		Ranking		1	1	1	1	1	---
92									
93	**I. Emergency Power and Bypass**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
94		EG Power	4	12	12	12	12	12	20
96		Weighted Points for each Station		12	12	12	12	12	20
97		Max Available Points for Station		20	20	20	20	20	---
98		Percentage of Available Points		60%	60%	60%	60%	60%	---
99		Ranking		1	1	1	1	1	---
100									
101	**J. Controls and Electrical Power**	Criteria	Weights	PS 19	PS 20	PS 21	PS 22	PS 23	Max
102		Type of Pump Control System	1	3	3	4	4	4	5
103		Pump Control System Age (Years)	1	3	3	3	3	3	5
104		Motor Control Panel Age (Years)	1	2	2	2	2	2	5
105		Condition of Motor Control Panel	1	3	3	3	3	3	5
106		Condition of Electrical Conduit in Pump Station	1	3	3	3	3	3	5
107		Condition of Pump Station Electrical and Control Panel	1	3	3	3	3	3	5
108		Condition of External Electrical Wiring (Power Lines to Pump Station)	2	8	8	8	8	8	10
109		Weighted Points for each Station		25	25	26	26	26	40
110		Max Available Points for Station		40	40	40	40	40	---
111		Percentage of Available Points		63%	63%	65%	65%	65%	---
112		Ranking		1	1	3	3	3	---
113									
114									
115	**Overall Ranking**			PS 19	PS 20	PS 21	PS 22	PS 23	Max
116		General		44	48	52	48	49	70
117		Station Overflow Vulnerability		27	27	27	27	27	35
118		Wet Well Operation		39	17	42	42	42	60
119		Wet Well Condition		24	19	29	29	29	45
120		Dry Well Condition		60	60	60	60	60	65
121		Pumps		68	47	42	49	54	90
122		Motors		49	49	47	56	61	105
123		Force Main and Exterior of Pump Station		24	24	24	24	24	50
124		Emergency Power and Bypass		12	12	12	12	12	20
125		Controls and Electrical Power		25	25	26	26	26	40
126		Total Weighted Points		372	328	361	373	384	580
127		Max Available Points for Station		580	565	575	565	565	---
128		Percent of Available Points for Station		64.1%	58.1%	62.8%	66.0%	68.0%	---
129		Overall Ranking		3	1	2	4	5	---

Appendix F

Ranking Matrix – Detailed

Ranking Matrix - Detailed

	A	B / C	D	E	F	G	H	I
1				Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores	**CRITERION**	Pump Station No.:	19	20	21	22	23
3		**A. GENERAL CATEGORIES**						
4		**Status of Health, Fire, and Life Safety Systems**	weight: 5	20	20	20	20	20
5		Value manually inserted here		4	4	4	4	4
6	5	Adequate		0	0	0	0	0
7	4	One known missing item		4	4	4	4	4
8	3	Two known missing items		0	0	0	0	0
9	2	Three known missing items		0	0	0	0	0
10	1	None		0	0	0	0	0
11		**Exterior Concrete Condition**	weight: 5	20	25	20	25	25
12		Value manually inserted here		4	5	4	5	5
13	5	No visible signs		0	5	0	5	5
14	4	Slight to moderate signs		4	0	4	0	0
15	3	Moderate signs		0	0	0	0	0
16	2	Moderate to widespread signs		0	0	0	0	0
17	1	Widespread signs		0	0	0	0	0
18		**Condition of City's Dock(s) (if Applicable)**	weight: 3	3	N/A	9	N/A	N/A
19		Value manually inserted here		1	0	3	0	0
20	5	No visible signs		0	0	0	0	0
21	4	Slight to moderate signs		0	0	0	0	0
22	3	Moderate signs		0	0	3	0	0
23	2	Moderate to widespread signs		0	0	0	0	0
24	1	Widespread signs		1	0	0	0	0
32		**Type of Vehicle Assess to Station**	weight: 1	1	3	3	3	4
33		Value manually inserted here		1	3	3	3	4
34	5	Easily accessible access road, parking lot with dedicated parking available		0	0	0	0	0
35	4	Easily accessible access road, parking lot but no dedicated parking available		0	0	0	0	4
36	3	Minor road or driveway with adequate turnaround		0	3	3	3	0
37	2	Narrow road or driveway with inadequate turnaround		0	0	0	0	0
38	1	Nearest road more than 100 feet from station		1	0	0	0	0
39								
40		**B. STATION OVERFLOW VULNERABILITY**						
41		**Response Time (Hours) Before Overflow Event**	weight: 2	2	2	2	2	2
42		[B1] Peak Daily Inflow (gpm)		841	583	707	396	377
43		[B1] Adjusted Peak Daily Inflow (gpm)		841	841	841	396	377
44		Pump Station Overflow Level (ft)		15.75	15.75	15.75	15.75	15.75
45		High Alarm Level (ft)		7.5	7.5	7.5	7.5	7.5
46		[C1] WW Plan area in zone between lead pump "on" and "off" (sq. ft.)		80	80	80	55	55
47		[B2] Storage Volume (gallons) from High Alarm to Overflow		4937	4937	4937	3409	3409
48		Response Time (minutes) = [B2] / [B1]		5.87	5.87	5.87	8.61	9.05
49		[B3] Response Time (hours)		0.10	0.10	0.10	0.14	0.15
50	5	> 3.0		0	0	0	0	0
51	4	> 1.5 and ≤ 3.0		0	0	0	0	0
52	3	> 1.0 and ≤ 1.5		0	0	0	0	0
53	2	> 0.5 and ≤ 1.0		0	0	0	0	0
54	1	≤ 0.5		1	1	1	1	1
55		**Number of Overflows in Past 5 years**	weight: 5	25	25	25	25	25
56		Value manually inserted here		5	5	5	5	5
57	5	No known overflows		5	5	5	5	5
58	4	One known overflow		0	0	0	0	0
59	3	Two known overflows		0	0	0	0	0
60	2	Three known overflows		0	0	0	0	0
61	1	Four or more known overflows		0	0	0	0	0
62								
63		**C. WET WELL OPERATION**						
64		**WW Cycling Index (Current)**	weight: 5	20	5	25	25	25
65		[C1] WW Plan area in zone between lead pump "on" and "off" (sq. ft.)		80	80	80	55	55
66		Lead Pump "on" Level (ft)		6.0	6.0	6.5	6.0	6.0
67		Lead Pump "off" Level (ft)		2.0	2.5	2.0	3.5	3.5
68		[C2] Max available active vertical distance (feet) for lead pump = [C0]		4.0	3.5	4.5	2.5	2.5
69		[C3] Max active WW volume (ft3) per cycle available for lead pump = [C1] * [C2]		320	280	360	138	138
70		Maximum Inflow (gpm)		1578	1351	1776	689	667
71		[C4] Second Highest Inflow (gpm)		1436	1337	1737	681	646
72		[F8a] Pump No. 1 Capacity per Pump Testing (gpm)		1545	1550	1550	560	560
73		[F8b] Pump No. 2 Capacity per Pump Testing (gpm)		1400	1250	1240	560	565
74		[F8c] Pump No. 3 Capacity per Pump Testing (gpm)		1255	1580	1460	502	490
75		[C5] Average Pump Capacity per Pump Testing (gpm)		1400	1460	1417	541	538
76		[C5a] Inflow (gpm) to cause max number of cycles= [C5] / 2		700	730	708	270	269
77		[C6] Inflow (cubic feet / hour) to cause max number of cycles = [C5a] * 60 / 7.48		5615	5856	5682	2168	2159
78		[C7] Maximum number of cycles per hour = [C6]/[C3]		17.5	20.9	15.8	15.7	15.6
79		[C11] Largest HP motor		10.0	10.0	10.0	7.5	7.5
80		Maximum allowable cycles per hour per pump based on [C11]		8	8	8	8	8
81		[C12] Maximum allowable cycles per hour for pump station		16	16	16	16	16
82		[C13] WW Cycling Index = [C7] / [C12]		1.10	1.31	0.99	0.98	0.98
83	5	≤ 1.0		0	0	5	5	5
84	4	> 1.0 and ≤ 1.1		4	0	0	0	0
85	3	> 1.1 and ≤ 1.2		0	0	0	0	0
86	2	> 1.2 and ≤ 1.3		0	0	0	0	0
87	1	> 1.3		0	1	0	0	0

Ranking Matrix - Detailed

	A	B / C	D	E	F	G	H	I
1				Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores	**CRITERION**	Pump Station No.:	19	20	21	22	23
88		**WW Influent Pipe Surcharge Index**	weight: 3	6	6	3	3	3
89		**Lead Pump "on" Level (ft)**		6.0	6.0	6.5	6.0	6.0
90		**Lead Pump "off" Level (ft)**		2.0	2.5	2.0	3.5	3.5
91		**Top of Fillet Elevation - Pump Operational Level Adjsutment Factor to Elevation (ft)**		2.45	2.45	2.45	3.65	3.7
92		**Lead Pump "on" Elevation (ft)**		8.5	8.5	9.0	9.7	9.7
93		**Lead Pump "off" Elevation (ft)**		4.5	5.0	4.5	7.2	7.2
94		**[C16] Lowest Influent Pipe Invert (ft)**		7.8	7.8	6.25	7.5	7.6
95		**[C17] WW Influent Pipe Surcharge Index = Lead Pump "on" Level (ft) - [C16]**		0.6	0.6	2.7	2.2	2.1
96	5	-≤ 0.5		0	0	0	0	0
97	4	-> 0.5 and ≤ 0.0		0	0	0	0	0
98	3	> 0.0 and ≤ 0.5		0	0	0	0	0
99	2	> 0.5 and ≤ 1.0		2	2	0	0	0
100	1	> 1.0		0	0	1	1	1
101		**Apparent Severity of WW Grease Removal**	weight: 1	4	3	5	5	5
102		**Value manually inserted here**		4	3	5	5	5
103	5	None to slight		0	0	5	5	5
104	4	Slight		4	0	0	0	0
105	3	Slight to moderate		0	3	0	0	0
106	2	Moderate		0	0	0	0	0
107	1	Moderate to chronic		0	0	0	0	0
108		**Apparent Severity of WW Rock/Grit/Obstruction Removal**	weight: 3	9	3	9	9	9
109		**Value manually inserted here**		3	1	3	3	3
110	5	None to slight		0	0	0	0	0
111	4	Slight		0	0	0	0	0
112	3	Slight to moderate		3	0	3	3	3
113	2	Moderate		0	0	0	0	0
114	1	Moderate to chronic		0	1	0	0	0
115								
116		**D. WET WELL CONDITION**						
117		**WW - Condition of Access Metals**	weight: 3	9	9	9	9	9
118		**Access MH Lid Metal**		5	5	5	5	5
119		**Access Ladder Metal Components**		1	1	1	1	1
120		**Average Condition Value of Access Metals**		3	3	3	3	3
121	5	Slight signs of corrosion of access metal components, minor discoloration of metals.		0	0	0	0	0
122	4	Slight to moderate signs of corrosion		0	0	0	0	0
123	3	Moderate signs of corrosion		3	3	3	3	3
124	2	Moderate to widespread signs of corrosion		0	0	0	0	0
125	1	Widespread signs of corrosion, metal pitting/damage, metal strength in question, etc.		0	0	0	0	0
126		**WW - Condition of Concrete**	weight: 5	10	5	15	15	15
127		**Ceiling Concrete**		3	2	4	4	4
128		**Wall Concrete**		2	1	3	3	3
129		**Average Condition Value of Upper Level Concrete**		2	1	3	3	3
130	5	Slight signs of concrete cracking, surface damage, surface sloughing, spalling, etc.		0	0	0	0	0
131	4	Slight to moderate signs of concrete cracking, surface damage, surface sloughing, spalling, etc.		0	0	0	0	0
132	3	Moderate signs of concrete cracking, surface damage, surface sloughing, spalling, etc.		0	0	3	3	3
133	2	Moderate to widespread signs of concrete cracking, surface damage, surface sloughing, spalling, etc.		2	0	0	0	0
134	1	Widespread signs of concrete cracking, surface damage, surface sloughing, spalling, etc.		0	1	0	0	0
135		**Degree of Infiltration**	weight: 1	5	5	5	5	5
136		**Value manually inserted here**		5	5	5	5	5
137	5	No infiltration visible through wall(s)		5	5	5	5	5
138	4	Little to minor infiltration		0	0	0	0	0
139	3	Minor seepage through wall(s)		0	0	0	0	0
140	2	Minor to excessive infiltration		0	0	0	0	0
141	1	Excessive flow through wall(s)		0	0	0	0	0
142								
143		**E. DRY WELL CONDITION**						
144		**DW - Condition of Access Metals**	weight: 3	15	15	15	15	15
145		**Access Hatch Metal**		5	5	5	5	5
146		**Access Ladder Metal Components**		5	5	5	5	5
147		**Platform Grating Metal Components**		5	5	5	5	5
148		**Average Condition Value of Upper Level Access Metals**		5	5	5	5	5
149	5	Slight signs of corrosion of access metal components, minor discoloration of metals.		5	5	5	5	5
150	4	Slight to moderate signs.		0	0	0	0	0
151	3	Moderate signs of corrosion		0	0	0	0	0
152	2	Moderate to widespread signs.		0	0	0	0	0
153	1	Widespread signs of corrosion, metal pitting/damage, metal strength in question, etc.		0	0	0	0	0
154		**DW - Condition of Concrete**	weight: 5	25	25	25	25	25
155		**Ceiling Concrete**		5	5	5	5	5
156		**Wall Concrete**		5	5	5	5	5
157		**Floor Concrete**		5	5	5	5	5
158		**Average Condition Value of Upper Level Concrete**		5	5	5	5	5
159	5	Slight signs of cracking		5	5	5	5	5
160	4	Slight to moderate signs.		0	0	0	0	0
161	3	Moderate signs of cracking, surface sloughing, spalling, etc.		0	0	0	0	0
162	2	Moderate to widespread signs.		0	0	0	0	0
163	1	Widespread signs of concrete cracking, surface damage, etc.		0	0	0	0	0
164		**Degree and Status of Interior Lighting**	weight: 1	5	5	5	5	5
165		**Value manually inserted here**		5	5	5	5	5
166	5	Sufficient lighting		5	5	5	5	5
167	4	Moderate to sufficient lighting		0	0	0	0	0
168	3	Moderate lighting		0	0	0	0	0
169	2	Insufficient to moderate lighting		0	0	0	0	0
170	1	Insufficient lighting		0	0	0	0	0
171		**Degree of Infiltration**	weight: 1	5	5	5	5	5
172		**Value manually inserted here**		5	5	5	5	5
173	5	Dry; no infiltration visible through wall(s)		5	5	5	5	5
174	4	Dry to minor infiltration.		0	0	0	0	0
175	3	Minor seepage through wall(s)		0	0	0	0	0
176	2	Minor to excessive infiltration		0	0	0	0	0
177	1	Excessive flow through wall(s)		0	0	0	0	0

	A	B / C	D	E	F	G	H	I
1				Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores	**CRITERION**	Pump Station No.:	19	20	21	22	23
178		**Condition of Water Pumping System**	weight: 2	10	10	10	10	10
179		**Value manually inserted here**		5	5	5	5	5
180	5	None to slight signs of wear		5	5	5	5	5
181	4	Slight to moderate signs		0	0	0	0	0
182	3	Moderate signs		0	0	0	0	0
183	2	Moderate to widespread signs.		0	0	0	0	0
184	1	Widespread signs		0	0	0	0	0
185								
186		**F. PUMPS**						
187		**Pump Flow Capacity Ratio (Current)**	weight: 5	15	20	5	5	10
188		**Maximum Inflow (gpm)**		1578	1351	1776	689	667
189		**[C4] Second Highest Inflow (gpm)**		1436	1337	1737	681	646
190		**[C5] Average Pump Capacity per Pump Testing (gpm)**		1400	1460	1417	541	538
191		**[F1a] Discharge Flow Capacity Ratio = [C4] / [C5]**		1.03	0.92	1.23	1.26	1.20
192	5	≤ 0.9		0	0	0	0	0
193	4	> 0.9 and ≤ 1.0		0	4	0	0	0
194	3	> 1.0 and ≤ 1.1		3	0	0	0	0
195	2	> 1.1 and ≤ 1.2		0	0	0	0	2
196	1	> 1.2		0	0	1	1	0
197		**Maximum Pump Cycling Index (Current)**	weight: 5	25	15	25	25	25
198		**[C14] Maximum pump cycles per hour from runtime data**		15	18	9	10	14
199		**Second highest pump cycles per hour from runtime data**		13	9	9	9	10
200		**[C12] Maximum allowable cycles per hour for pump station**		16	16	16	16	16
201		**[C15] Pump Cycling Index = [C14] / [C12]**		0.9	1.1	0.6	0.6	0.9
202	5	≤ 1.0		5	0	5	5	5
203	4	> 1.0 and ≤ 1.1		0	0	0	0	0
204	3	> 1.1 and ≤ 1.2		0	3	0	0	0
205	2	> 1.2 and ≤ 1.3		0	0	0	0	0
206	1	> 1.3		0	0	0	0	0
207		**Condition of Sump Pump**	weight: 1	5	5	5	5	5
208		**Sump Pump and Piping**		5	5	5	5	5
209	5	None to slight signs of wear		5	5	5	5	5
210	4	Slight to moderate signs of wear		0	0	0	0	0
211	3	Moderate signs of wear		0	0	0	0	0
212	2	Moderate to widespread signs of wear		0	0	0	0	0
213	1	Widespread signs of wear		0	0	0	0	0
214		**Condition of Valves and Piping**	weight: 4	8	4	4	8	8
215		**Value manually inserted here**		2	1	1	2	2
216	5	None to slight signs of corrosion		0	0	0	0	0
217	4	Slight to moderate signs of corrosion or problems with valve operation		0	0	0	0	0
218	3	Moderate signs of corrosion, moderate problems with valve operation		0	0	0	0	0
219	2	Moderate to widespread signs of corrosion or problems with valve operation		2	0	0	2	2
220	1	Widespread signs of corrosion, significant problems with valve operation		0	1	1	0	0
221		**Number of Times Pumps Deragged in Last Year**	weight: 3	15	3	3	6	6
222		**Value manually inserted here**		5	1	1	2	2
223	5	No known repairs		5	0	0	0	0
224	4	One known time		0	0	0	0	0
225	3	Two or three known times		0	0	0	0	0
226	2	Four or five known times		0	0	0	2	2
227	1	More than five		0	1	1	0	0
228								
229		**G. MOTORS**						
230		**Motor Age (years) - Pump No. 1**	weight: 3	3	3	3	3	3
231		**Motor Age**		28	28	28	28	28
232	5	≤ 5		0	0	0	0	0
233	4	> 5 and ≤ 10		0	0	0	0	0
234	3	> 10 and ≤ 15		0	0	0	0	0
235	2	> 15 and ≤ 20		0	0	0	0	0
236	1	> 20		1	1	1	1	1
237		**Motor Age (years) - Pump No. 2**	weight: 3	3	3	3	3	3
238		**Motor Age**		28	28	28	28	28
239	5	≤ 5		0	0	0	0	0
240	4	> 5 and ≤ 10		0	0	0	0	0
241	3	> 10 and ≤ 15		0	0	0	0	0
242	2	> 15 and ≤ 20		0	0	0	0	0
243	1	> 20		1	1	1	1	1
244		**Motor Age (years) - Pump No. 3**	weight: 3	3	3	3	3	3
245		**Motor Age**		28	28	28	28	28
246	5	≤ 5		0	0	0	0	0
247	4	> 5 and ≤ 10		0	0	0	0	0
248	3	> 10 and ≤ 15		0	0	0	0	0
249	2	> 15 and ≤ 20		0	0	0	0	0
250	1	> 20		1	1	1	1	1
251		**Motor Maximum Voltage Imbalance - Pump No. 1**	weight: 1	3	3	3	4	4
252		**[G1a] Max Voltage Leg/Leg Deviation (volts)**		3.13	2.50	2.67	1.00	2.00
253		**Voltage, $V_{1\text{-}3}$**		481.00	489.0	485.0	244.0	489.0
254		**Voltage, $V_{2\text{-}3}$**		486.40	490.5	482.0	242.0	487.0
255		**Voltage, $V_{1\text{-}2}$**		485.00	486.0	480.0	243.0	485.0
256		**[F10a] Voltage, average of 3 legs**		484.13	488.50	482.33	243.00	487.00
257		**[G2a] Maximum Voltage Imbalance (%) = [G1a] / [F10a]*100**		0.65	0.51	0.55	0.41	0.41
258	5	≤ 0.25%		0	0	0	0	0
259	4	> 0.25% and ≤ 0.50%		0	0	0	4	4
260	3	> 0.50% and ≤ 0.75%		3	3	3	0	0
261	2	> 0.75% and ≤ 1.0%		0	0	0	0	0
262	1	> 1.0%		0	0	0	0	0

	A	B	C	D	E	F	G	H	I
1					Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores		**CRITERION**	Pump Station No.:	19	20	21	22	23
263			**Motor Maximum Voltage Imbalance - Pump No. 2**	weight: 1	3	3	4	4	5
264			**[G1b] Max Voltage Leg/Leg Deviation (volts)**		2.67	3.00	1.67	0.83	0.83
265			**Voltage, V_{1-3}**		482.00	488.0	487.0	243.5	488.0
266			**Voltage, V_{2-3}**		485.00	490.0	484.5	242.0	487.0
267			**Voltage, V_{1-2}**		487.00	484.5	484.5	243.0	486.5
268			**[F10b] Voltage, average of 3 legs**		484.67	487.50	485.33	242.83	487.17
269			**[G2b] Maximum Voltage Imbalance (%) = [G1b] / [F10b]*100**		0.55	0.62	0.34	0.34	0.17
270	5	≤ 0.25%			0	0	0	0	5
271	4	> 0.25%	and ≤ 0.50%		0	0	4	4	0
272	3	> 0.50%	and ≤ 0.75%		3	3	0	0	0
273	2	> 0.75%	and ≤ 1.0%		0	0	0	0	0
274	1	> 1.0%			0	0	0	0	0
275			**Motor Maximum Voltage Imbalance - Pump No. 3**	weight: 1	3	3	3	3	5
276			**[G1c] Max Voltage Leg/Leg Deviation (volts)**		2.87	2.80	2.67	0.83	0.83
277			**Voltage, V_{1-3}**		481.70	487.5	488.0	244.5	488.0
278			**Voltage, V_{2-3}**		485.50	486.5	484.0	243.0	487.0
279			**Voltage, V_{1-2}**		486.50	482.8	484.0	243.5	486.5
280			**[F10c] Voltage, average of 3 legs**		484.57	485.60	485.33	243.67	487.17
281			**[G2c] Maximum Voltage Imbalance (%) = [G1c] / [F10c]*100**		0.59	0.58	0.55	0.34	0.17
282	5	≤ 0.25%			0	0	0	0	5
283	4	> 0.25%	and ≤ 0.25%		0	0	0	0	0
284	3	> 0.25%	and ≤ 0.75%		3	3	3	3	0
285	2	> 0.75%	and ≤ 1.0%		0	0	0	0	0
286	1	> 1.0%			0	0	0	0	0
287			**Motor Maximum Current Imbalance - Pump No. 1**	weight: 1	4	3	4	3	4
288			**[G5a] Max Current Leg/Leg Deviation (amps)**		0.30	0.53	0.37	0.70	0.20
289			**Current, A_1**		14.9	12.5	17.3	17.0	8.7
290			**Current, A_2**		14.5	11.7	17.4	16.2	8.4
291			**Current, A_3**		15.0	11.7	16.8	17.5	8.7
292			**[F11a] Current, average of 3 legs**		14.80	11.97	17.17	16.90	8.60
293			**[G6a] Maximum Current Imbalance (%) = [G5a] / [F11a]*100**		2.03	4.46	2.14	4.14	2.33
294	5	≤ 1%			0	0	0	0	0
295	4	> 1%	and ≤ 3%		4	0	4	0	4
296	3	> 3%	and ≤ 6%		0	3	0	3	0
297	2	> 6%	and ≤ 10%		0	0	0	0	0
298	1	> 10%			0	0	0	0	0
299			**Motor Maximum Current Imbalance - Pump No. 2**	weight: 1	3	4	3	4	3
300			**[G5b] Max Current Leg/Leg Deviation (amps)**		0.47	0.30	0.67	0.47	0.30
301			**Current, A_1**		15.2	12.1	13.5	19.0	9.1
302			**Current, A_2**		15.2	11.8	13.7	19.5	8.7
303			**Current, A_3**		15.9	11.5	12.6	18.6	8.6
304			**[F11b] Current, average of 3 legs**		15.43	11.80	13.27	19.03	8.80
305			**[G6b] Maximum Current Imbalance (%) = [G5b] / [F11b]*100**		3.02	2.54	5.03	2.45	3.41
306	5	≤ 1%			0	0	0	0	0
307	4	> 1%	and ≤ 3%		0	4	0	4	0
308	3	> 3%	and ≤ 6%		3	0	3	0	3
309	2	> 6%	and ≤ 10%		0	0	0	0	0
310	1	> 10%			0	0	0	0	0
311			**Motor Maximum Current Imbalance - Pump No. 3**	weight: 1	3	3	4	4	4
312			**[G5c] Max Current Leg/Leg Deviation (amps)**		0.43	0.50	0.20	0.33	0.23
313			**Current, A_1**		13.3	13.3	14.2	17.6	8.6
314			**Current, A_2**		12.8	12.7	14.0	17.2	8.2
315			**Current, A_3**		13.6	12.4	13.8	17.8	8.5
316			**[F11c] Current, average of 3 legs**		13.23	12.80	14.00	17.53	8.43
317			**[G6c] Maximum Current Imbalance (%) = [G5c] / [F11c]*100**		3.27	3.91	1.43	1.90	2.77
318	5	≤ 1%			0	0	0	0	0
319	4	> 1%	and ≤ 3%		0	0	4	4	4
320	3	> 3%	and ≤ 6%		3	3	0	0	0
321	2	> 6%	and ≤ 10%		0	0	0	0	0
322	1	> 10%			0	0	0	0	0
323			**Motor Maximum Lateral Vibration Index - Pump No. 1**	weight: 1	1	4	1	1	5
324			**Pump Orientation?**		Vert	Vert	Vert	Vert	Vert
325			**[C8] Pump No. 1 Motor Horsepower (HP)**		10.0	10.0	10.0	7.5	7.5
326			**Pump No. 1 Vibration Reading Value 1a (horizontal or vertical pump)**		0.602	0.079	0.13	0.367	0.073
327			**Pump No. 1 Vibration Reading Value 1b (horizontal or vertical pump)**		0.386	0.030	0.08	0.187	0.046
328			**Pump No. 1 Vibration Reading Value 2a (horizontal or vertical pump)**		0.233	0.071	0.41	0.184	0.070
329			**Pump No. 1 Vibration Reading Value 2b (horizontal or vertical pump)**		0.195	0.016	0.28	0.126	0.040
330			**Pump No. 1 Vibration Reading Value 3a from database (horizontal pump only)**		N/A	N/A	N/A	N/A	N/A
331			**Pump No. 1 Vibration Reading Value 3b from database (horizontal pump)**		N/A	N/A	N/A	N/A	N/A
332			**Pump No. 1 Vibration Reading Value 4a from database (horizontal pump)**		N/A	N/A	N/A	N/A	N/A
333			**Pump No. 1 Vibration Reading Value 4b from database (horizontal pump)**		N/A	N/A	N/A	N/A	N/A
334			**[G9a] Maximum Vibration Lateral Velocity Reading (inch/sec)**		0.60	0.08	0.41	0.37	0.07
335			**[G10a] Maximum Allowable Lateral Vibration (inch/sec)**		0.30	0.30	0.30	0.30	0.30
336			**[G11a] Lateral Vibration Index = [G9a] / [G10a]**		2.01	0.26	1.37	1.22	0.24
337	5	≤ 0.25			0	0	0	0	5
338	4	> 0.25	and ≤ 0.50		0	4	0	0	0
339	3	> 0.50	and ≤ 0.75		0	0	0	0	0
340	2	> 0.75	and ≤ 1.0		0	0	0	0	0
341	1	> 1.0			1	0	1	1	0

	A	B / C	D	E	F	G	H	I
1				Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores	**CRITERION**	Pump Station No.:	19	20	21	22	23
342		**Motor Maximum Lateral Vibration Index - Pump No. 2**	weight: 1	4	1	1	5	3
343		Pump Orientation?		Vert	Vert	Vert	Vert	Vert
344		[C9] Pump No. 2 Motor Horsepower (HP)		10.0	10.0	10.0	7.5	7.5
345		Pump No. 2 Vibration Reading Value 1a (horizontal or vertical pump)		0.099	0.36	0.08	0.032	0.181
346		Pump No. 2 Vibration Reading Value 1b (horizontal or vertical pump)		0.069	0.34	0.05	0.020	0.136
347		Pump No. 2 Vibration Reading Value 2a (horizontal or vertical pump)		0.106	1.28	0.31	0.028	0.174
348		Pump No. 2 Vibration Reading Value 2b (horizontal or vertical pump)		0.036	0.77	0.15	0.019	0.110
349		Pump No. 2 Vibration Reading Value 3a from database (horizontal pump only)		N/A	N/A	N/A	N/A	N/A
350		Pump No. 2 Vibration Reading Value 3b from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
351		Pump No. 2 Vibration Reading Value 4a from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
352		Pump No. 2 Vibration Reading Value 4b from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
353		[G9b] Maximum Vibration Lateral Velocity Reading (inch/sec)		0.11	1.28	0.31	0.03	0.18
354		[G10b] Maximum Allowable Lateral Vibration (inch/sec)		0.30	0.30	0.30	0.30	0.30
355		[G11b] Lateral Vibration Index = [G9b] / [G10b]		0.35	4.27	1.03	0.11	0.60
356	5	≤ 0.25		0	0	0	5	0
357	4	> 0.25 and ≤ 0.50		4	0	0	0	0
358	3	> 0.50 and ≤ 0.75		0	0	0	0	3
359	2	> 0.75 and ≤ 1.0		0	0	0	0	0
360	1	> 1.0		0	1	1	0	0
361		**Motor Maximum Lateral Vibration Index - Pump No. 3**	weight: 1	1	1	N/A	4	4
362		Pump Orientation?		Vert	Vert	Vert	Vert	Vert
363		[C9] Pump No. 3 Motor Horsepower (Hp)		10.0	10.0	10.0	7.5	7.5
364		Pump No. 3 Vibration Reading Value 1a (horizontal or vertical pump)		0.415	0.18	N/A	0.116	0.149
365		Pump No. 3 Vibration Reading Value 1b (horizontal or vertical pump)		0.268	0.12	N/A	0.077	0.106
366		Pump No. 3 Vibration Reading Value 2a (horizontal or vertical pump)		0.232	0.38	N/A	0.114	0.132
367		Pump No. 3 Vibration Reading Value 2b (horizontal or vertical pump)		0.169	0.30	N/A	0.076	0.119
368		Pump No. 3 Vibration Reading Value 3a from database (horizontal pump only)		N/A	N/A	N/A	N/A	N/A
369		Pump No. 3 Vibration Reading Value 3b from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
370		Pump No. 3 Vibration Reading Value 4a from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
371		Pump No. 3 Vibration Reading Value 4b from database (horizontal pump)		N/A	N/A	N/A	N/A	N/A
372		[G9c] Maximum Vibration Lateral Velocity Reading (inch/sec)		0.42	0.38	N/A	0.12	0.15
373		[G10c] Maximum Allowable Lateral Vibration (inch/sec)		0.30	0.30	0.30	0.30	0.30
374		[G11c] Lateral Vibration Index = [G9c] / [G10c]		1.38	1.27	N/A	0.39	0.50
375	5	≤ 0.25		0	0	0	0	0
376	4	> 0.25 and ≤ 0.50		0	0	0	4	4
377	3	> 0.50 and ≤ 0.75		0	0	0	0	0
378	2	> 0.75 and ≤ 1.0		0	0	0	0	0
379	1	> 1.0		1	1	1	0	0
380		**Motor Megger Index (for Each Pump) - Pump No. 1**	weight: 1	5	5	5	5	5
381		Motor Orientation		Vert	Vert	Vert	Vert	Vert
382		Brake Horsepower		10.0	10.0	10.0	7.5	7.5
383		[G12a] Megger Reading (Mohms)		660	660	2200	660	660
384		[G13a] Minimum Allowable Megger Reading for Particular Horsepower (Mohms)		450	450	450	475	475
385		[G14a] Megger Index = [G12a] / [G13a]		1	1.47	4.89	1	1
386	5	> 1.0		5	5	5	5	5
387	4	> 0.75 and ≤ 1.00		0	0	0	0	0
388	3	> 0.50 and ≤ 0.75		0	0	0	0	0
389	2	> 0.25 and ≤ 0.50		0	0	0	0	0
390	1	≤ 0.25		0	0	0	0	0
391		**Motor Megger Index (for Each Pump) - Pump No. 2**	weight: 1	5	5	5	5	5
392		Motor Orientation		Vert	Vert	Vert	Vert	Vert
393		Brake Horsepower		10.0	10.0	10.0	7.5	7.5
394		[G12b] Megger Reading (Mohms)		660	2200	2200	660	660
395		[G13b] Minimum Allowable Megger Reading for Particular Horsepower (Mohms)		450	450	450	475	475
396		[G14b] Megger Index = [G12b] / [G13b]		1	4.89	4.89	1	1
397	5	> 1.0		5	5	5	5	5
398	4	> 0.75 and ≤ 1.00		0	0	0	0	0
399	3	> 0.50 and ≤ 0.75		0	0	0	0	0
400	2	> 0.25 and ≤ 0.50		0	0	0	0	0
401	1	≤ 0.25		0	0	0	0	0
402		**Motor Megger Index (for Each Pump) - Pump No. 3**	weight: 1	5	5	5	5	5
403		Motor Orientation		Vert	Vert	Vert	Vert	Vert
404		Brake Horsepower		10.0	10.0	10.0	7.5	7.5
405		[G12c] Megger Reading (Mohms)		660	2200	660	660	660
406		[G13c] Minimum Allowable Megger Reading for Particular Horsepower (Mohms)		450	450	450	475	475
407		[G14c] Megger Index = [G12c] / [G13c]		1	4.89	1.47	1	1
408	5	> 1.0		5	5	5	5	5
409	4	> 0.75 and ≤ 1.00		0	0	0	0	0
410	3	> 0.50 and ≤ 0.75		0	0	0	0	0
411	2	> 0.25 and ≤ 0.50		0	0	0	0	0
412	1	≤ 0.25		0	0	0	0	0
413								
414		**H. FORCE MAIN (EXTERIOR TO THE PUMP STATION)**						
415		**Age (years)**	weight: 4	12	12	12	12	12
416		Force Main Age		59	59	59	59	59
417	5	≤ 20		0	0	0	0	0
418	4	> 20 and ≤ 40		0	0	0	0	0
419	3	> 40 and ≤ 60		3	3	3	3	3
420	2	> 60 and ≤ 80		0	0	0	0	0
421	1	> 80		0	0	0	0	0
429		**Material**	weight: 3	9	9	9	9	9
430		Force Main Material (Value manually inserted here)		3	3	3	3	3
431	5	HDPE		0	0	0	0	0
432	4	Ductile Iron		0	0	0	0	0
433	3	Cast Iron after 1945		3	3	3	3	3
434	2	PVC		0	0	0	0	0
435	1	AC or Galvanized Steel		0	0	0	0	0

	A	B	C	D	E	F	G	H	I
1					Weighted Criteria Scores vs Individual Criteria				
2	Unweighted Scores	CRITERION		Pump Station No.:	19	20	21	22	23
447		Current Force Main Velocity (fps)		weight: 3	3	3	3	3	3
448			[I4] Force Main Diameter (inches)		18	18	18	14	12
449			[I5] Cross-Sectional Area (square inches)		254	254	254	154	113
450			[C5] Average Pump Capacity per Pump Testing (gpm)		1400	1460	1417	541	538
451			[I8] Force Main Velocity outside station (fps) = [C5] / [I5]		1.8	1.8	1.8	1.1	1.5
452	5	≥ 2.5	and ≤ 8.0		0	0	0	0	0
453	3	≥ 2.0	and < 2.5		0	0	0	0	0
454	3	> 8.0	and ≤ 10.0		0	0	0	0	0
455	1	< 2.0	or > 10.0		1	1	1	1	1
456									
457		**I. EMERGENCY POWER AND BYPASS**							
458		EG Power		weight: 4	12	12	12	12	12
459			EG Plug Exist? (Option ID, 5=Yes, 1=No)		1	1	1	1	1
460			Engine Generator Exist? (Option ID, 5=Yes, 1=No)		5	5	5	5	5
462			Value manually inserted here		3	3	3	3	3
463	5	Permanent EG set and EG plug, with low to moderate possibility of power outages			0	0	0	0	0
464	4	Permanent EG set and EG plug, with high possibility of power outages			0	0	0	0	0
465	3	Permanent EG set or EG plug, with low to high possibility of power outages			3	3	3	3	3
466	2	No permanent plug or generator, with low to moderate possibility of power outages			0	0	0	0	0
467	1	No permanent plug or generator, with high possibility of power outages			0	0	0	0	0
475									
476		**J. CONTROLS AND ELECTRICAL POWER**							
477		Type of Pump Control System		weight: 1	3	3	4	4	4
478			Value manually inserted here		3	3	4	4	4
479	5	Transducer w/ PLC and FOGRod (or similar) backup			0	0	0	0	0
480	4	Transducer w/ PLC and float backup			0	0	4	4	4
481	3	Transducer w/ PLC and no float			3	3	0	0	0
482	2	Floats but no PLC			0	0	0	0	0
483	1	Other			0	0	0	0	0
484		Pump Control System Age (Years)		weight: 1	3	3	3	3	3
485			Value manually inserted here		14	14	14	14	14
486	5	≤ 5			0	0	0	0	0
487	4	> 5	and ≤ 9		0	0	0	0	0
488	3	> 9	and ≤ 14		3	3	3	3	3
489	2	> 14	and ≤ 20		0	0	0	0	0
490	1	> 20			0	0	0	0	0
491		Motor Control Panel Age (Years)		weight: 1	2	2	2	2	2
492			Value manually inserted here		29	29	29	29	29
493	5	≤ 10			0	0	0	0	0
494	4	> 10	and ≤ 15		0	0	0	0	0
495	3	> 15	and ≤ 25		0	0	0	0	0
496	2	> 25	and ≤ 35		2	2	2	2	2
497	1	> 35			0	0	0	0	0
498		Condition of Motor Control Panel		weight: 1	3	3	3	3	3
499			Value manually inserted here		3	3	3	3	3
500	5	None to slight signs of wear, corrosion, and/or chattering or humming			0	0	0	0	0
501	4	Slight to moderate signs of wear, corrosion, and/or chattering or humming			0	0	0	0	0
502	3	Moderate signs of wear, corrosion, and/or chattering or humming			3	3	3	3	3
503	2	Moderate to widespread signs of wear, corrosion, and/or chattering or humming			0	0	0	0	0
504	1	Widespread signs of wear, corrosion, and/or chattering or humming			0	0	0	0	0
505		Condition of Electrical Conduit in Pump Station		weight: 1	3	3	3	3	3
506			Value manually inserted here		3	3	3	3	3
507	5	None to slight signs of wear			0	0	0	0	0
508	4	Slight to moderate signs of wear			0	0	0	0	0
509	3	Moderate signs of wear			3	3	3	3	3
510	2	Moderate to widespread signs of wear			0	0	0	0	0
511	1	Widespread signs of wear			0	0	0	0	0
512		Condition of Pump Station Electrical and Control Panel		weight: 1	3	3	3	3	3
513			Value manually inserted here		3	3	3	3	3
514	5	None to slight signs of wear			0	0	0	0	0
515	4	Slight to moderate signs of wear			0	0	0	0	0
516	3	Moderate signs of wear			3	3	3	3	3
517	2	Moderate to widespread signs of wear			0	0	0	0	0
518	1	Widespread signs of wear			0	0	0	0	0
519		Condition of External Electrical Wiring (Power Lines to Pump Station)		weight: 2	8	8	8	8	8
520			Value manually inserted here		4	4	4	4	4
521	5	None to slight signs of wear			0	0	0	0	0
522	4	Slight to moderate signs of wear			4	4	4	4	4
523	3	Moderate signs of wear			0	0	0	0	0
524	2	Moderate to widespread signs of wear			0	0	0	0	0
525	1	Low hanging power lines or widespread signs of wear			0	0	0	0	0

Appendix G

Cost Estimates

Project Name: City of Mercer Island Sewer Pump Station Condition Assessment
Project No.: 21-29
Sewer Pump Station 19
Engineer's Opinion of Probable Cost - Conceptual Design

		Matl Units	Quantity	Total Cost	Priority 1 Total Cost	Priority 2 Total Cost	Priority 3 Total Cost
1	**Mobilization and Demobilization (12%)**	**LS**	**1**	**$202,945**	**$165,779**	**$5,592**	**$31,574**
2	**Site Work and Restoration**	**LS**	**1**	**$77,050**	**$57,800**	**$0**	**$19,250**
3	**Sewer Bypass (Temporary Pumping)**	**LS**	**1**	**$368,000**	**$368,000**	**$0**	**$0**
4	**Temporary Erosion & Sediment Control**	**LS**	**1**	**$11,500**	**$11,500**	**$0**	**$0**
5	**Structural**	**LS**	**1**	**$91,856**	**$23,000**	**$2,300**	**$66,556**
6	**Wet Well Concrete Repair and Coating**	**LS**	**1**	**$230,000**	**$230,000**	**$0**	**$0**
7	**Mechanical**	**LS**	**1**	**$508,300**	**$458,550**	**$21,000**	**$28,750**
8	**Electrical and Control**	**LS**	**1**	**$398,250**	**$381,250**	**$0**	**$17,000**
9	**Asbuilts and O&M Manuals**	**LS**	**1**	**$6,250**	**$6,250**	**$0**	**$0**
	Subtotal PS Construction Costs			$1,894,151	$1,702,129	$28,892	$163,130
	Contingency (30%)			$568,245	$510,639	$8,668	$48,939
	Risk Contingency (40%)			$984,959	$885,107	$15,024	$84,827
	Sales Tax (10.1%)			$348,183	$312,885	$5,311	$29,987
	Total PS Construction Costs			**$3,795,538**	**$3,410,761**	**$57,894**	**$326,883**
	Engineering Design and Plan Review (15%)			$569,331	$569,331	---	---
	Survey, Geotechnical, Permitting, and Public Outreach (10%)			$379,554	$379,554	---	---
	Construction Engineering and Administration (10%)			$379,554	$379,554	---	---
	City Project Administration (15%)			$569,331	$569,331	---	---
	Indirect Subtotal Cost			$1,897,769	$1,897,769	---	---
	Total Project Cost			**$5,693,306**	**$5,308,529**	**$57,894**	**$326,883**
	Rounded Total Project Cost			**$5,695,000**	**$5,310,000**	**$58,000**	**$327,000**

Project Name: City of Mercer Island Sewer Pump Station Condition Assessment
Project No.: 21-29
Sewer Pump Station 20
Engineer's Opinion of Probable Cost - Conceptual Design

		Matl Units	Quantity	Total Cost	Priority 1 Total Cost	Priority 2 Total Cost	Priority 3 Total Cost
1	**Mobilization and Demobilization (12%)**	**LS**	**1**	**$202,273**	**$176,351**	**$6,072**	**$19,850**
2	**Site Work and Restoration**	**LS**	**1**	**$59,800**	**$59,800**	**$0**	**$0**
3	**Sewer Bypass (Temporary Pumping)**	**LS**	**1**	**$379,500**	**$379,500**	**$0**	**$0**
4	**Temporary Erosion & Sediment Control**	**LS**	**1**	**$11,500**	**$11,500**	**$0**	**$0**
5	**Structural**	**LS**	**1**	**$70,006**	**$17,250**	**$2,300**	**$50,456**
6	**Wet Well Concrete Repair and Coating**	**LS**	**1**	**$264,500**	**$264,500**	**$0**	**$0**
7	**Mechanical**	**LS**	**1**	**$502,550**	**$462,300**	**$23,000**	**$17,250**
8	**Electrical and Control**	**LS**	**1**	**$391,500**	**$376,500**	**$0**	**$15,000**
9	**Asbuilts and O&M Manuals**	**LS**	**1**	**$6,250**	**$6,250**	**$0**	**$0**
	Subtotal PS Construction Costs			$1,887,879	$1,753,951	$31,372	$102,556
	Contingency (30%)			$566,364	$526,185	$9,412	$30,767
	Risk Contingency (30%)			$736,273	$684,041	$12,235	$39,997
	Sales Tax (10.1%)			$322,242	$299,382	$5,355	$17,505
	Total PS Construction Costs			**$3,512,758**	**$3,263,560**	**$58,374**	**$190,824**
	Engineering Design and Plan Review (15%)			$526,914	$526,914	---	---
	Survey, Geotechnical, Permitting, and Public Outreach (10%)			$351,276	$351,276	---	---
	Construction Engineering and Administration (10%)			$351,276	$351,276	---	---
	City Project Administration (15%)			$526,914	$526,914	---	---
	Indirect Subtotal Cost			$1,756,379	$1,756,379	---	---
	Total Project Cost			**$5,269,136**	**$5,019,938**	**$58,374**	**$190,824**
	Rounded Total Project Cost			**$5,270,000**	**$5,020,000**	**$59,000**	**$191,000**

Project Name: City of Mercer Island Sewer Pump Station Condition Assessment
Project No.: 21-29
Sewer Pump Station 21
Engineer's Opinion of Probable Cost - Conceptual Design

		Matl Units	Quantity	Total Cost	Priority 1 Total Cost	Priority 2 Total Cost	Priority 3 Total Cost
1	**Mobilization and Demobilization (12%)**	**LS**	**1**	**$197,595**	**$171,369**	**$6,072**	**$20,155**
2	**Site Work and Restoration**	**LS**	**1**	**$59,800**	**$59,800**	**$0**	**$0**
3	**Sewer Bypass (Temporary Pumping)**	**LS**	**1**	**$368,000**	**$368,000**	**$0**	**$0**
4	**Temporary Erosion & Sediment Control**	**LS**	**1**	**$11,500**	**$11,500**	**$0**	**$0**
5	**Structural**	**LS**	**1**	**$88,528**	**$17,250**	**$2,300**	**$68,978**
6	**Wet Well Concrete Repair and Coating**	**LS**	**1**	**$218,500**	**$218,500**	**$0**	**$0**
7	**Mechanical**	**LS**	**1**	**$502,550**	**$479,550**	**$23,000**	**$0**
8	**Electrical and Control**	**LS**	**1**	**$391,500**	**$376,500**	**$0**	**$15,000**
9	**Asbuilts and O&M Manuals**	**LS**	**1**	**$6,250**	**$6,250**	**$0**	**$0**
	Subtotal PS Construction Costs			$1,844,223	$1,708,719	$31,372	$104,132
	Contingency (30%)			$553,267	$512,616	$9,412	$31,240
	Risk Contingency (30%)			$719,247	$666,400	$12,235	$40,612
	Sales Tax (10.1%)			$314,790	$291,661	$5,355	$17,774
	Total PS Construction Costs			**$3,431,527**	**$3,179,396**	**$58,374**	**$193,758**
	Engineering Design and Plan Review (15%)			$514,729	$514,729	---	---
	Survey, Geotechnical, Permitting, and Public Outreach (10%)			$343,153	$343,153	---	---
	Construction Engineering and Administration (10%)			$343,153	$343,153	---	---
	City Project Administration (15%)			$514,729	$514,729	---	---
	Indirect Subtotal Cost			$1,715,764	$1,715,764	---	---
	Total Project Cost			**$5,147,291**	**$4,895,159**	**$58,374**	**$193,758**
	Rounded Total Project Cost			**$5,150,000**	**$4,897,000**	**$59,000**	**$194,000**

Project Name: City of Mercer Island Sewer Pump Station Condition Assessment
Project No.: 21-29
Sewer Pump Station 22
Engineer's Opinion of Probable Cost - Conceptual Design

		Matl Units	Quantity	Total Cost	Priority 1 Total Cost	Priority 2 Total Cost	Priority 3 Total Cost
1	**Mobilization and Demobilization (12%)**	**LS**	**1**	**$177,061**	**$147,680**	**$5,112**	**$24,269**
2	**Site Work and Restoration**	**LS**	**1**	**$59,800**	**$59,800**	**$0**	**$0**
3	**Sewer Bypass (Temporary Pumping)**	**LS**	**1**	**$327,750**	**$327,750**	**$0**	**$0**
4	**Temporary Erosion & Sediment Control**	**LS**	**1**	**$11,500**	**$11,500**	**$0**	**$0**
5	**Structural**	**LS**	**1**	**$63,423**	**$23,000**	**$2,300**	**$38,123**
6	**Wet Well Concrete Repair and Coating**	**LS**	**1**	**$218,500**	**$218,500**	**$0**	**$0**
7	**Mechanical**	**LS**	**1**	**$403,535**	**$338,535**	**$19,000**	**$46,000**
8	**Electrical and Control**	**LS**	**1**	**$384,750**	**$367,750**	**$0**	**$17,000**
9	**Asbuilts and O&M Manuals**	**LS**	**1**	**$6,250**	**$6,250**	**$0**	**$0**
	Subtotal PS Construction Costs			$1,652,568	$1,500,765	$26,412	$125,392
	Contingency (30%)			$495,771	$450,229	$7,924	$37,618
	Risk Contingency (30%)			$644,502	$585,298	$10,301	$48,903
	Sales Tax (10.1%)			$282,077	$256,165	$4,508	$21,403
	Total PS Construction Costs			**$3,074,917**	**$2,792,457**	**$49,145**	**$233,315**
	Engineering Design and Plan Review (15%)			$461,238	$461,238	---	---
	Survey, Geotechnical, Permitting, and Public Outreach (10%)			$307,492	$307,492	---	---
	Construction Engineering and Administration (10%)			$307,492	$307,492	---	---
	City Project Administration (15%)			$461,238	$461,238	---	---
	Indirect Subtotal Cost			$1,537,459	$1,537,459	---	---
	Total Project Cost			**$4,612,376**	**$4,329,916**	**$49,145**	**$233,315**
	Rounded Total Project Cost			**$4,615,000**	**$4,331,000**	**$50,000**	**$234,000**

Project Name: City of Mercer Island Sewer Pump Station Condition Assessment
Project No.: 21-29
Sewer Pump Station 23
Engineer's Opinion of Probable Cost - Conceptual Design

		Matl Units	Quantity	Total Cost	Priority 1 Total Cost	Priority 2 Total Cost	Priority 3 Total Cost
1	**Mobilization and Demobilization (12%)**	**LS**	**1**	**$173,371**	**$151,370**	**$5,112**	**$16,889**
2	**Site Work and Restoration**	**LS**	**1**	**$59,800**	**$59,800**	**$0**	**$0**
3	**Sewer Bypass (Temporary Pumping)**	**LS**	**1**	**$339,250**	**$339,250**	**$0**	**$0**
4	**Temporary Erosion & Sediment Control**	**LS**	**1**	**$11,500**	**$11,500**	**$0**	**$0**
5	**Structural**	**LS**	**1**	**$63,423**	**$23,000**	**$2,300**	**$38,123**
6	**Wet Well Concrete Repair and Coating**	**LS**	**1**	**$218,500**	**$218,500**	**$0**	**$0**
7	**Mechanical**	**LS**	**1**	**$374,785**	**$338,535**	**$19,000**	**$17,250**
8	**Electrical and Control**	**LS**	**1**	**$371,250**	**$356,250**	**$0**	**$15,000**
9	**Asbuilts and O&M Manuals**	**LS**	**1**	**$6,250**	**$6,250**	**$0**	**$0**
	Subtotal PS Construction Costs			$1,618,128	$1,504,455	$26,412	$87,262
	Contingency (30%)			$485,439	$451,336	$7,924	$26,179
	Risk Contingency (30%)			$631,070	$586,737	$10,301	$34,032
	Sales Tax (10.1%)			$276,198	$256,795	$4,508	$14,895
	Total PS Construction Costs			**$3,010,835**	**$2,799,323**	**$49,145**	**$162,367**
	Engineering Design and Plan Review (15%)			$451,625	$451,625	---	---
	Survey, Geotechnical, Permitting, and Public Outreach (10%)			$301,084	$301,084	---	---
	Construction Engineering and Administration (10%)			$301,084	$301,084	---	---
	City Project Administration (15%)			$451,625	$451,625	---	---
	Indirect Subtotal Cost			$1,505,418	$1,505,418	---	---
	Total Project Cost			**$4,516,253**	**$4,304,741**	**$49,145**	**$162,367**
	Rounded Total Project Cost			**$4,520,000**	**$4,307,000**	**$50,000**	**$163,000**

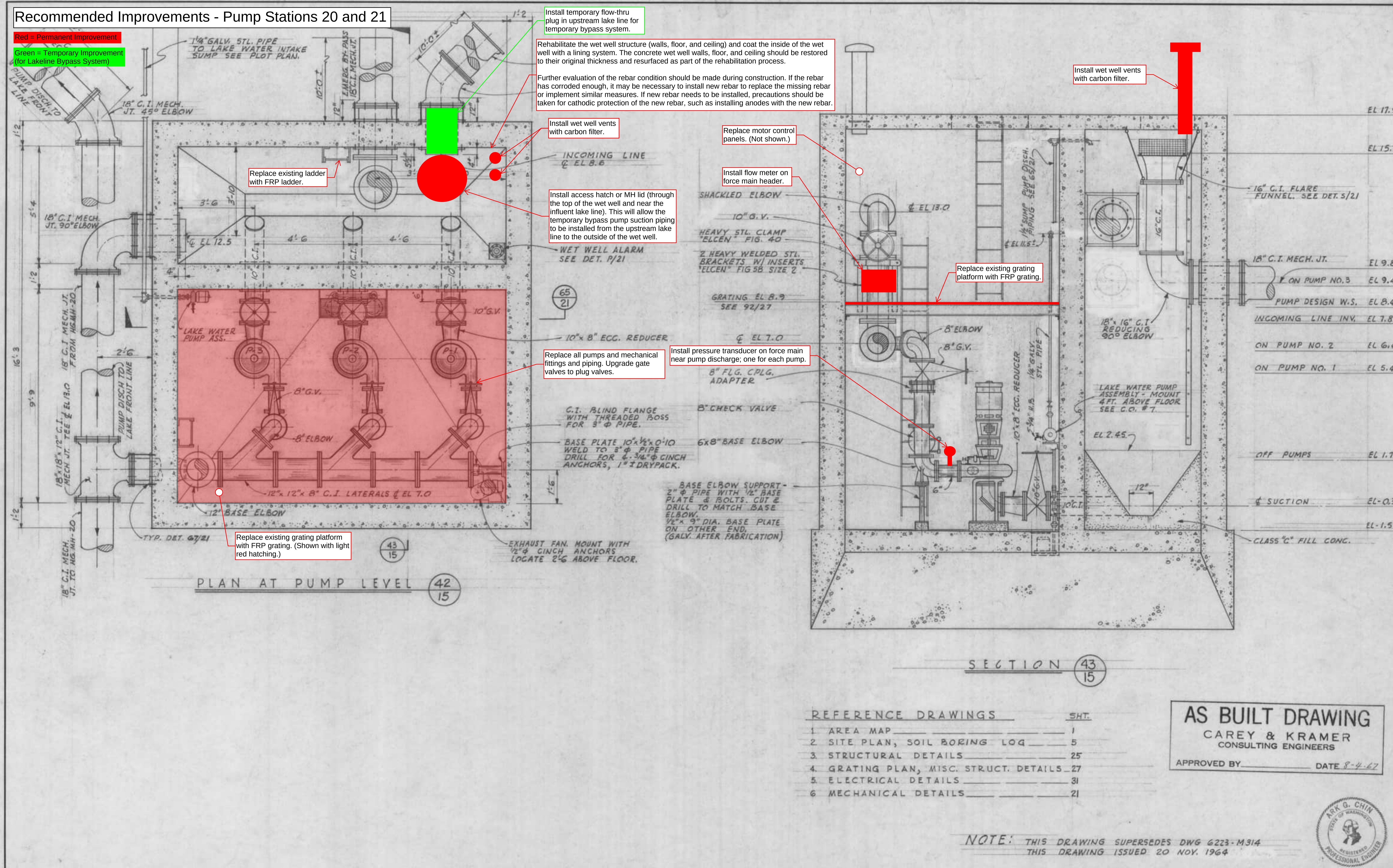
Appendix H

Figures of Recommended Improvements

Recommended Improvements - Pump Stations 20 and 21

Red = Permanent Improvement

Green = Temporary Improvement (for Lakeline Bypass System)



REFERENCE DRAWINGS

	SHT.
1. AREA MAP	1
2. SITE PLAN, SOIL BORING LOG	5
3. STRUCTURAL DETAILS	25
4. GRATING PLAN, MISC. STRUCT. DETAILS	27
5. ELECTRICAL DETAILS	31
6. MECHANICAL DETAILS	21

AS BUILT DRAWING
CAREY & KRAMER
CONSULTING ENGINEERS
APPROVED BY ________ DATE 8-4-67

NOTE: THIS DRAWING SUPERSEDES DWG 6223-M314 THIS DRAWING ISSUED 20 NOV. 1964

REVISIONS: REV. 1, NOV. 1964 - ADD LAKE WATER ASSEMBLY CHANGE HEADER PIPING.

DW'N BY: FM & WG | DES BY: | DATE: APRIL 1964 | CK'D BY: | APV'D BY: | SCALE: ½" = 1'-0

CAREY AND KRAMER
CONSULTING ENGINEERS
SEATTLE, WASHINGTON

MERCER ISLAND SEWER DISTRICT
MERCER ISLAND, WASHINGTON

U.L.I.D. NO. 3 SCHEDULE H
MECHANICAL
PUMP STATION NO. 20

DRAWING NUMBER 6223-M 314.1
SHEET NUMBER 15 OF 32

Recommended Improvements - Pump Stations 19, 20, 21, 22, and 23

Red = Permanent Improvement

Green = Temporary Improvement (for Lakeline Bypass System)

Green = Temporary Improvement (for Upland Gravity Sewer Bypass System)

Install a temporary flow-thru plug in upstream gravity sewer main and bypass pump (in HGMH) for temporary bypass pumping of the upland sewer system. Pump wastewater collected from the HGMH gravity inlet to the pipe in HGMH that is connected to the lake line.

*Only recommended for Pump Stations 20 and 23. Not needed for Pump Stations 19, 21, or 22.

-Install the temporary bypass pumps on site. The bypass pumps will be placed on land if viable with site access and if adjacent homeowners are accepting. Otherwise, the bypass pumps will be placed on barge.

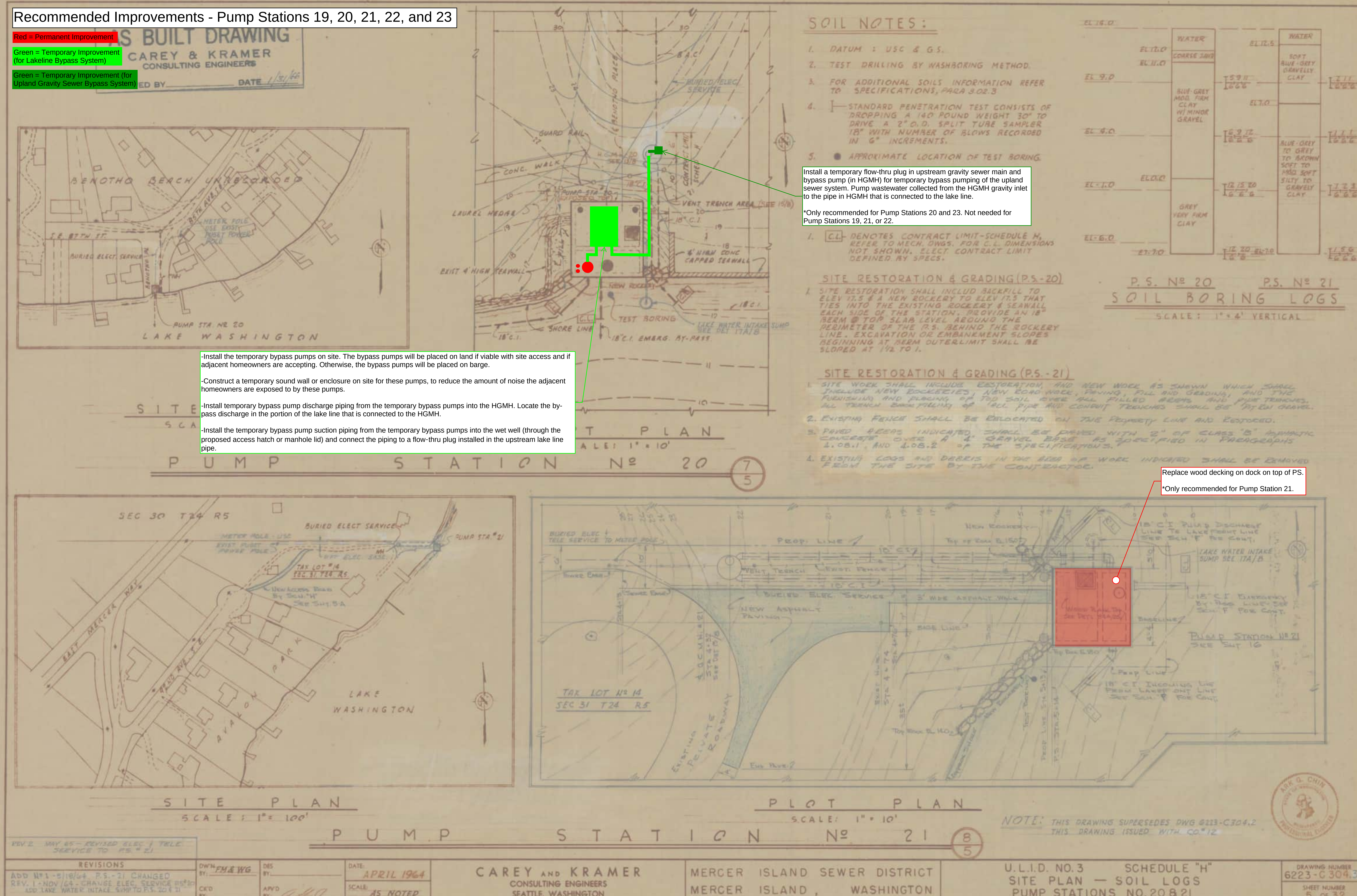
-Construct a temporary sound wall or enclosure on site for these pumps, to reduce the amount of noise the adjacent homeowners are exposed to by these pumps.

-Install temporary bypass pump discharge piping from the temporary bypass pumps into the HGMH. Locate the by-pass discharge in the portion of the lake line that is connected to the HGMH.

-Install the temporary bypass pump suction piping from the temporary bypass pumps into the wet well (through the proposed access hatch or manhole lid) and connect the piping to a flow-thru plug installed in the upstream lake line pipe.

Replace wood decking on dock on top of PS.

*Only recommended for Pump Station 21.

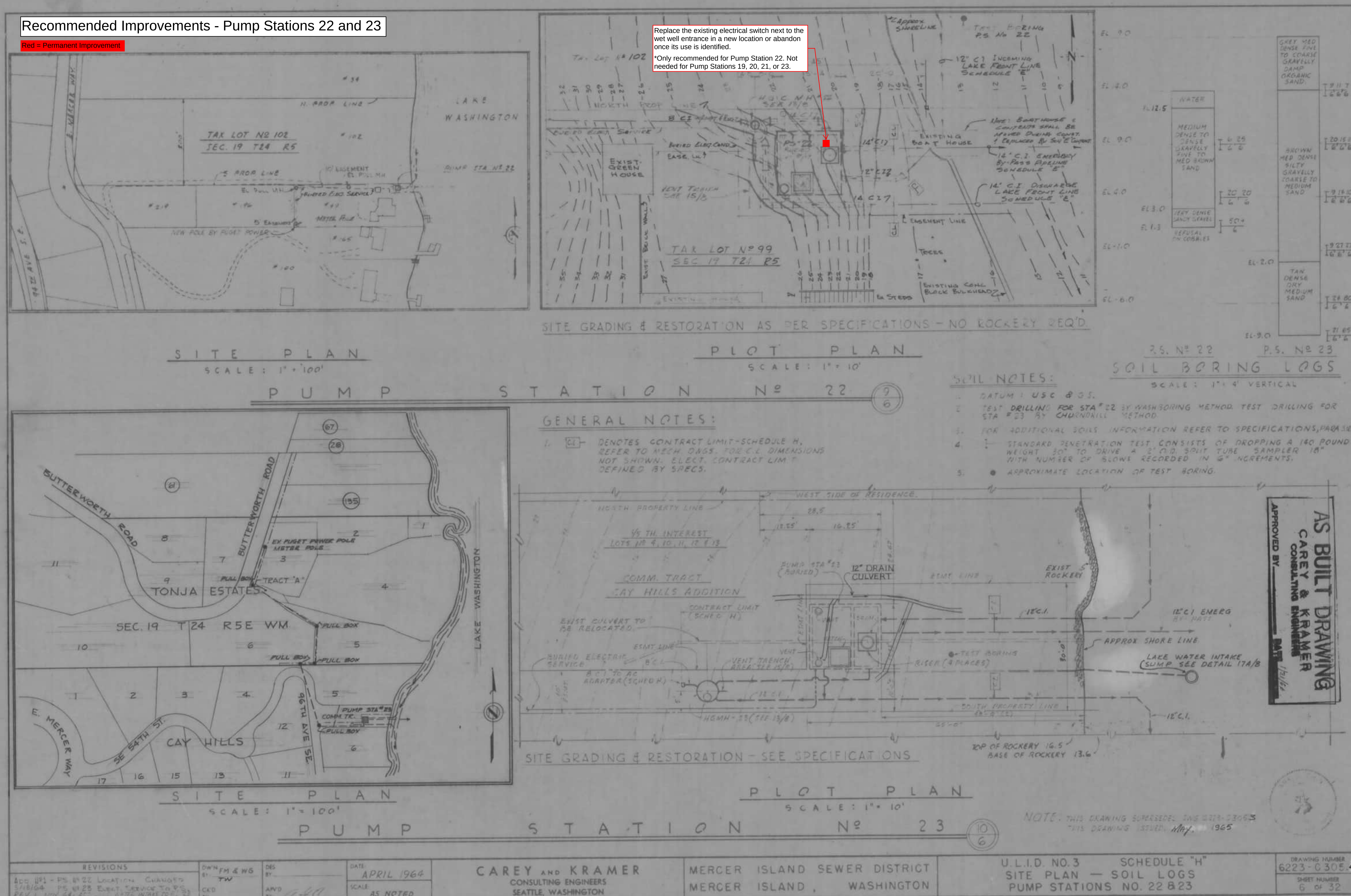


Recommended Improvements - Pump Stations 22 and 23

Red = Permanent Improvement

Replace the existing electrical switch next to the wet well entrance in a new location or abandon once its use is identified.

*Only recommended for Pump Station 22. Not needed for Pump Stations 19, 20, 21, or 23.



Recommended Improvements - Pump Station 19

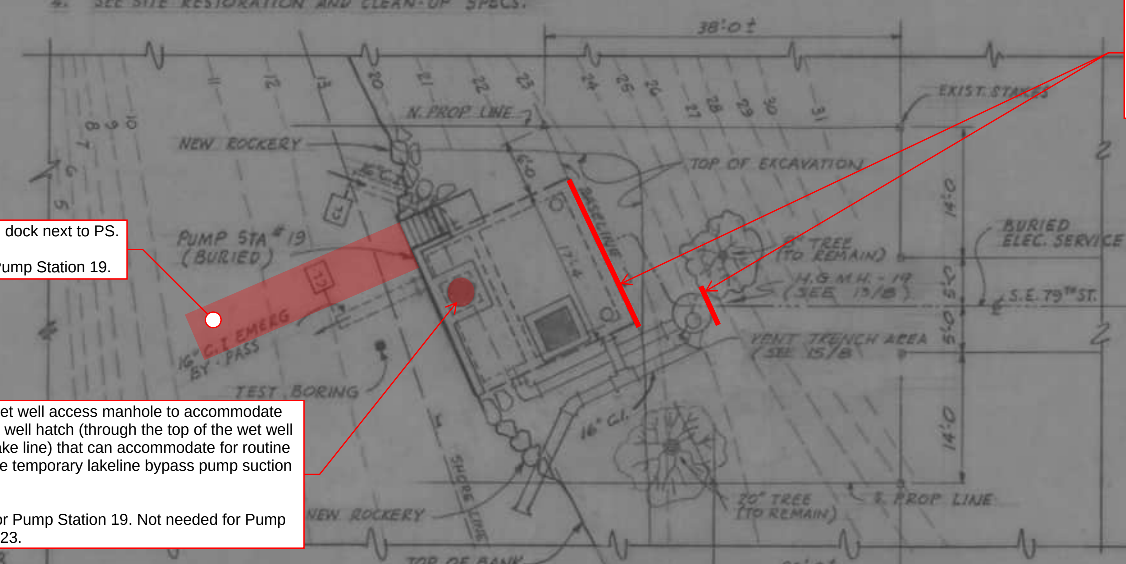
Red = Permanent Improvement

CAREY & KRAMER
CONSULTING ENGINEERS
APPROVED BY ___ DATE ___

SITE RESTORATION AND GRADING (P.S. -19

1. A NEW ROCKERY SHALL BE INSTALLED AS SHOWN BETWEEN THE LIMITS ESTABLISHED BY STREET RIGHT-OF-WAY OR CONST. EXCAVATION LIMITS.
2. SITE RESTORATION SHALL INCLUDE RESTORATION OF THE ORIGINAL SHORELINE WITH ROCKERY AND BACKFILL TO BLEND INTO AND MATCH EXISTING GRADES TO THE NORTH AND EAST OF THE SITE, AND AS DIRECTED BY ENGINEER TO THE SOUTH.
3. FINISH GRADES SHALL BE ESTABLISHED TO PROVIDE DRAINAGE AWAY FROM HATCHES AND MANHOLES IN A MANNER TO BLEND INTO THE ADJOINING EXISTING GROUND SURFACES.
4. SEE SITE RESTORATION AND CLEAN-UP SPECS.

SITE PLAN
SCALE: 1" = 100'



Replace wood decking on dock next to PS.

*Only recommended for Pump Station 19.

Remove the existing wet well access manhole to accommodate for a larger access wet well hatch (through the top of the wet well and near the influent lake line) that can accommodate for routine wet well access and the temporary lakeline bypass pump suction piping.

*Only recommended for Pump Station 19. Not needed for Pump Stations 20, 21, 22, or 23.

Install site drainage to redirect surface water away from the PS. Install a short retaining wall(s) (less than 2 feet tall) to prevent dirt eroding from the uphill slope from covering the PS access points, including HGMH.

*Only recommended for Pump Station 19. Not needed for Pump Stations 20, 21, 22, or 23.

PLOT PLAN
SCALE: 1" = 10'

REVISION Nº 3
(a) REORIENTED STATION
(b) REARRANGED EXTERIOR PIPING
(c) ADDED STAIRWAY AND COVER

REVISION Nº 4
GRADIENT CONTROL MANHOLE LOCATION AND PIPING CHANGED

P.S. Nº 19 SOIL BORING LOGS

SCALE: 1" = 4' VERTICAL

WATER
MEDIUM DENSE SANDY ORGANIC GRAVEL

SOIL NOTES:

1. DATUM: U.S.C. & G.S.
2. TEST DRILLING BY WASHBORING METHOD.
3. FOR ADDITIONAL SOILS INFORMATION REFER TO SPECIFICATIONS, PAR. 2.02.3
4. STANDARD PENETRATION TEST CONSISTS OF DROPPING A 140 POUND WEIGHT 30" TO DRIVE A 2" O.D. SPLIT TUBE SAMPLER 18" WITH NUMBER OF BLOWS RECORDED IN 6" INCREMENTS.
5. ● APPROXIMATE LOCATION OF TEST BORING.

GENERAL NOTES:

1. [C.L.] DENOTES CONTRACT LIMIT - SCHEDULE H, REFER TO MECH. DWGS. FOR C.L. DIMENSIONS NOT SHOWN. ELECT. CONTRACT LIMIT DEFINED BY SPECS.

NOTE: THIS DRAWING SUPERSEDES DWG. Nº 6223-C303.4
THIS DRAWING ISSUED JUNE 15, 1965.

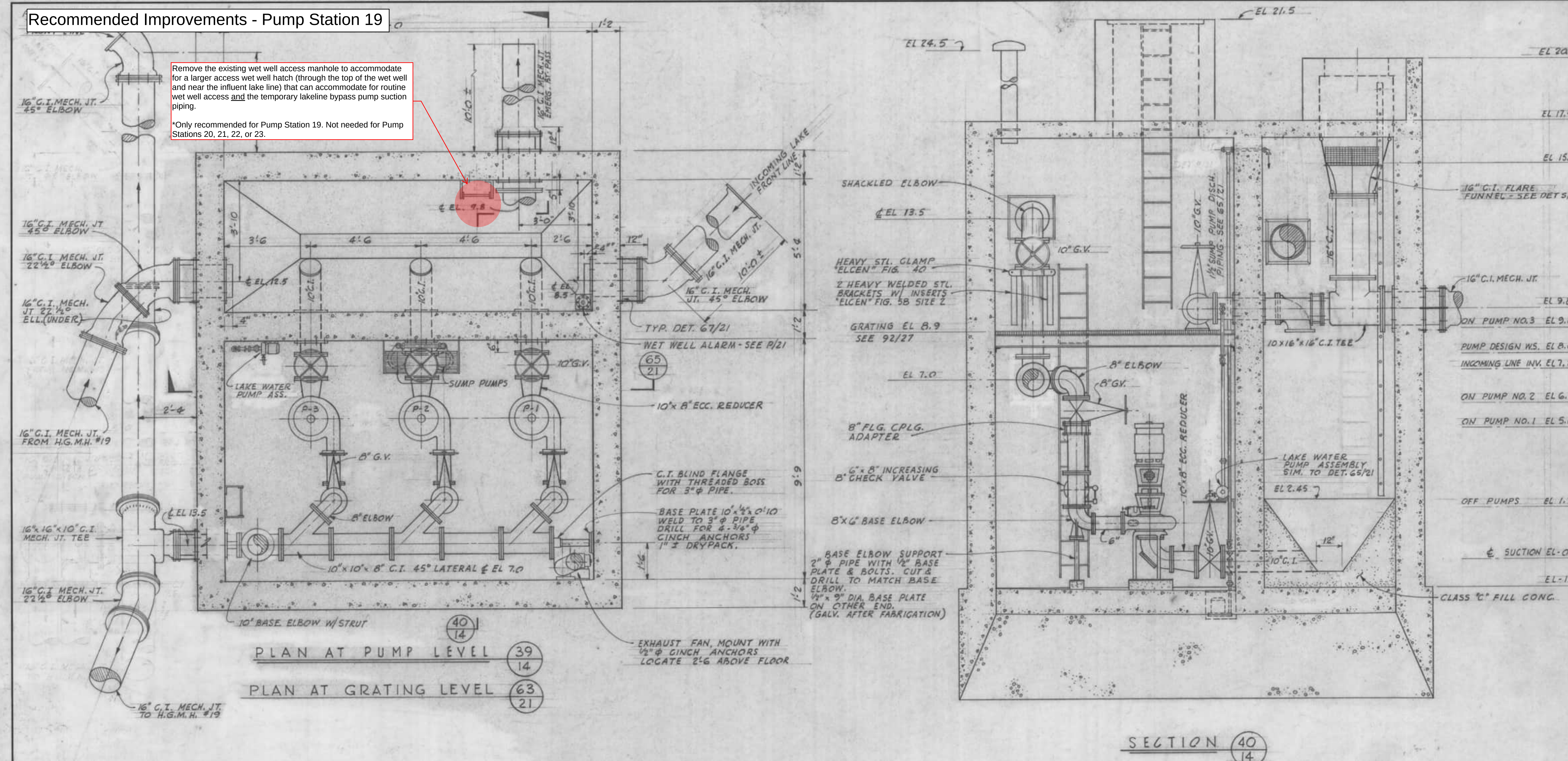
PUMP STATION Nº 19

REVISIONS	DWN BY: FM & WG	DATE: APRIL 1964	CAREY AND KRAMER CONSULTING ENGINEERS SEATTLE, WASHINGTON	MERCER ISLAND SEWER DISTRICT MERCER ISLAND, WASHINGTON	U.L.I.D. NO. 3 SCHEDULE "H" SITE PLAN — SOIL LOGS PUMP STATIONS NO. 18 & 19	DRAWING NUMBER 6223-C303.5
OCT. 1964 - REV. 1 - P.S. #18 REVISED; NOV. 1964 - REV. 2 - P.S. #18 REVISED; NOV. 1964 - REV. 3 - P.S. #19 REVISED; MAY 1965 - REV. 4 - P.S. #19 ABOVE; JUNE 1965 - REV. 5 - VENT TRENCH P.S. #18	CK'D BY:	SCALE: AS NOTED				SHEET NUMBER 4 OF 32

Recommended Improvements - Pump Station 19

Remove the existing wet well access manhole to accommodate for a larger access wet well hatch (through the top of the wet well and near the influent lake line) that can accommodate for routine wet well access and the temporary lakeline bypass pump suction piping.

*Only recommended for Pump Station 19. Not needed for Pump Stations 20, 21, 22, or 23.



REFERENCE DRAWINGS

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5.	ELECTRICAL DETAILS	31
6.	MECHANICAL DETAILS	21

AS. BUILT DRAWING
CAREY & KRAMER
CONSULTING ENGINEERS
APPROVED BY ________ DATE 8-4-67

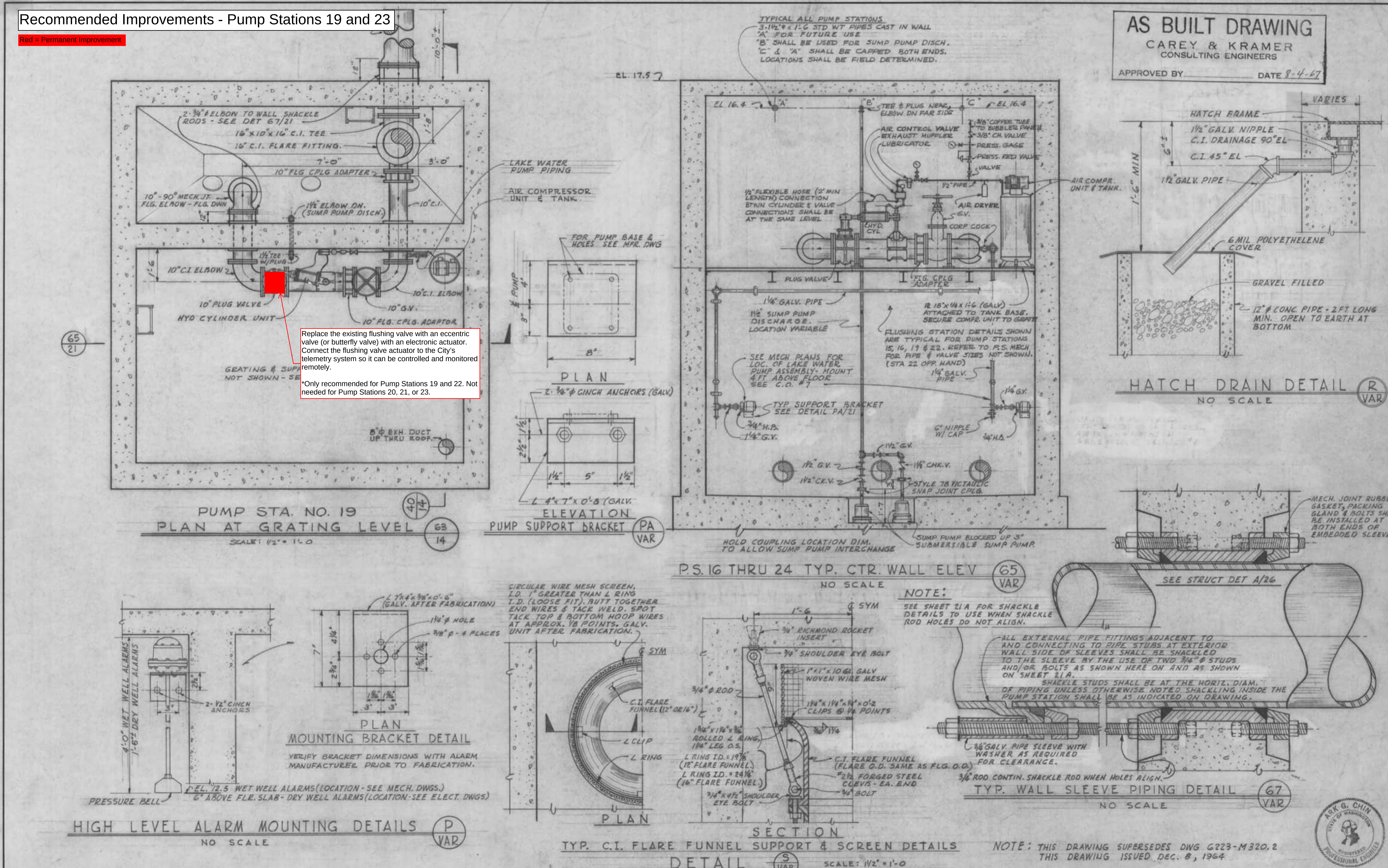
NOTE: THIS DRAWING SUPERSEDES DWG 6223-M313
THIS DRAWING ISSUED 20 NOV 1964

ARK G. CHIN — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

REVISIONS	DW'N BY: FM & WG / CK'D BY:	DES BY: / APP'D BY: ALC	DATE: APRIL 1964 / SCALE: ½" = 1'-0	CAREY AND KRAMER CONSULTING ENGINEERS SEATTLE, WASHINGTON	MERCER ISLAND SEWER DISTRICT MERCER ISLAND, WASHINGTON	U.L.I.D NO. 3 SCHEDULE H MECHANICAL PUMP STATION NO. 19	DRAWING NUMBER 6223-M313.1 SHEET NUMBER 14 OF 32
REV 1. NOV. 1964 - ADD LAKE WATER ASS. CHANGED HEADER PIPING, OUTSIDE PIPING & COVERED TOP.							

Recommended Improvements - Pump Stations 19 and 23

Red = Permanent Improvement



Replace the existing flushing valve with an eccentric valve (or butterfly valve) with an electronic actuator. Connect the flushing valve actuator to the City's telemetry system so it can be controlled and monitored remotely.

*Only recommended for Pump Stations 19 and 22. Not needed for Pump Stations 20, 21, or 23.

REVISIONS	DW'N BY: FM	DES BY: RDM	DATE: APRIL 1964	CAREY AND KRAMER CONSULTING ENGINEERS SEATTLE, WASHINGTON	MERCER ISLAND SEWER DISTRICT MERCER ISLAND, WASHINGTON	U.L.I.D. NO. 3 SCHEDULE H MECHANICAL MISC. SECTIONS & DETAILS	DRAWING NUMBER 6223-M320.3
REV. 1 - 9/9/64 - REVISED DET. R/VAR. REV. 2 - 10/28/64 - LAKE WATER PUMP ASSEMBLY AND MOUNTING BRACKET ADDED REV. 3 12-8-64 DETAIL 67/VAR - SHACKLE MODIFICATION	CK'D BY:	APV'D BY:	SCALE: AS NOTED				SHEET NUMBER 21 OF 32

Appendix I

City’s Deed for Pump Station 21 Site

5751021

Statutory Warranty Deed

J-4
312405-9070
8002 AVALON PL.

WASHINGTON TITLE INSURANCE COMPANY
SEATTLE, WASHINGTON

Mail to

Send Tax Statement to

VOL. 4547 PAGE 36 5751021

Statutory Warranty Deed

FORM L58

THE GRANTOR CLAUDE E. WHITMAN and JOHNNIE WHITMAN, HIS WIFE, and JOHN A. WIDRIG

for and in consideration of $1,500.00

in hand paid, conveys and warrants to MERCER ISLAND SEWER DISTRICT

the following described real estate, situated in the County of KING , State of Washington:

A portion of shorelands adjacent to Government Lot 1, Sec. 31, T24N,R5EWM, described as follows: Beginning at the intersection of the existing shoreline with the north line of Government Lot 1; thence east 28 feet; thence south 28 feet; thence west to existing shoreline; thence northerly along the existing shoreline to the point of beginning.

Reference is hereby made to that certain Easement dated May 18, 1964, and recorded in the office of the Auditor of King County, Washington under Receiving No 5751000, which instrument by this reference is incorporated herein and made a part hereof.

Dated this 18th day of May, 1964

John A. Widrig Claude E. Whitman (SEAL)
As my own separate property. Johnnie Whitman (SEAL)

STATE OF WASHINGTON } ss.
County of

On this day personally appeared before me Claude E. Ed Johnnie Whitman to me known to be the individual described in and who executed the within and foregoing instrument, and acknowledged that they signed the same as their free and voluntary act and deed, for the uses and purposes therein mentioned.

GIVEN under my hand and official seal this 18th day of May, 1964

Edna G. Fairchild
Notary Public in and for the State of Washington, residing at

STATE OF WASHINGTON, } ss.
County of King

On this day personally appeared before me John A. Widrig to me known to be the individual described in and who executed the within and foregoing instrument, and acknowledged that HE signed the same as HIS free and voluntary act and deed, for the uses and purposes therein mentioned.

GIVEN under my hand and official seal this 9 day of May 1964

Clarence P. Schwarz
Notary Public in and for the State of Washington, residing at Seattle

Filed for Record June 19 1964 2:04 PM
Request of Roberta Shefelman et al
ROBERT A. MORRIS, County Auditor

5751021

RECORDED 4547 deeds
VOL OF
PAGE 36 REQUEST OF

1964 JUN 19 PM 2 04

ROBERT A. MORRIS AUDITOR
KING COUNTY WASH.
DEPUTY

FILED for Record at Request of

Name [illegible]

Address Roberts, Shefelman, et al
No. Life Tower
Seattle