

# Spring Lake Pump Station Capacity Enhancement Assessment

## TECHNICAL MEMORANDUM

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## 1 PROJECT BACKGROUND

Water Works Engineers, LLC (Water Works or WWE) is under contract with City of Woodland (City), to assess the Spring Lake Pump Station capacity. Water Works previously completed the sewer collection system Hydraulic Model Update (2018) and Woodland Research and Technology Park (WRTP) Sanitary Sewer Peer Review (2018). More recently, Water Works reviewed updates to the WRTP Wastewater Collection System Technical Memorandum (Cunningham, 2020) and Spring Lake Pump Station flow monitoring data (City of Woodland 2019-2020). The following summarizes Water Works analysis of this information in the context of its impact to the Spring Lake Pump Station:

- Hydraulic Model Update (2018).
  - Updated the City's overall sanitary sewer hydraulic model. Completed a capacity assessment, identified deficiencies, and developed Capacity Improvements Projects and Cost Estimates in a Technical Memorandum.
  - The existing 2017 developed Spring Lake Master Plan is projected to produce 2.1-mgd rain-derived inflow and infiltration, and 2.9-mgd peak wet weather flow, indicating a need for additional 3rd pump to provide pumping redundancy in the near term.
- WRTP Sanitary Sewer Peer Review (2018)
  - Updated the City's overall sanitary sewer hydraulic model to include gravity mains/trunk and projected flows as identified in the Woodland Research and Technology Park (WRTP) Wastewater Collection System TM.
  - Projected build-out flows of Spring Lake Master Plan area and SP-1 (8.8-mgd) exceeds current capacity and would eliminate redundancy if a 3rd pump is installed.
- Recent Analysis:
  - WRTP WW Collection System TM (Cunningham, 2020)
    - Phase 1 projected wastewater flows have dropped slightly by 0.06 mgd
  - Spring Lake Pump Station flow monitoring data (2020)
    - The City requested Water Works analyze recent flow monitoring data with the intention to identify decreases in flow related to an October 2019 CIPP-lining pipe rehabilitation project, which was assumed to have significantly decreased groundwater infiltration. The data did show an immediate reduction in groundwater infiltration of approximately 0.1 mgd, however wet weather flows generally increased that winter from previous years. This is likely due to increased development in the Spring Lake Master Plan area from 2017 to 2019.
  - In the context of the WRTP Peer Review, a total reduction of approximately 0.16 mgd does not eliminate the near term need for a 3rd pump addition at  $3.0 \pm$  mgd and the projected loss of pumping redundancy in the long term at  $6.0 \pm$  mgd.

The capacity enhancement assessment of the Spring Lake Pump Station is presented herein in the context of the background studies, results and analysis listed above.

### 1.1 General Project Objective

The general project objective is to assess the Spring Lake Pump Station and associated forcemains for a 3<sup>rd</sup> pump addition (backup for redundancy), identify possible modifications of existing pumps to enhance flow capacity, and identify any necessary mechanical or electrical improvements.

## 1.2 Previous Studies and Flow Data Sources

Previous studies and data that inform this assessment are:

- Woodland Hydraulic Model Update (2018).
- WRTP Sanitary Sewer Peer Review (2018).
- Spring Lake PS Flow Monitoring Analysis (2019-2020).

## 1.3 Existing Facility Summary and Site Description

An existing description of the Spring Lake Pump Station is listed below:

- Location and Description: Spring Lake Pump Station at Farmer Central Rd and Mickle Ave.
- Facility Age: 15 years in operation (all original equipment)
- Pumping Capacity: Dual 90-HP Flygt submersible pumps in rectangular wet well with blocked out space for phased 3<sup>rd</sup> pump addition.
- Force mains: Dual 4895-LF DIP 12" diameter pressurized sanitary sewer force mains discharging into junction structure at Gibson and CR-102 with a 30" gravity sewer outlet.

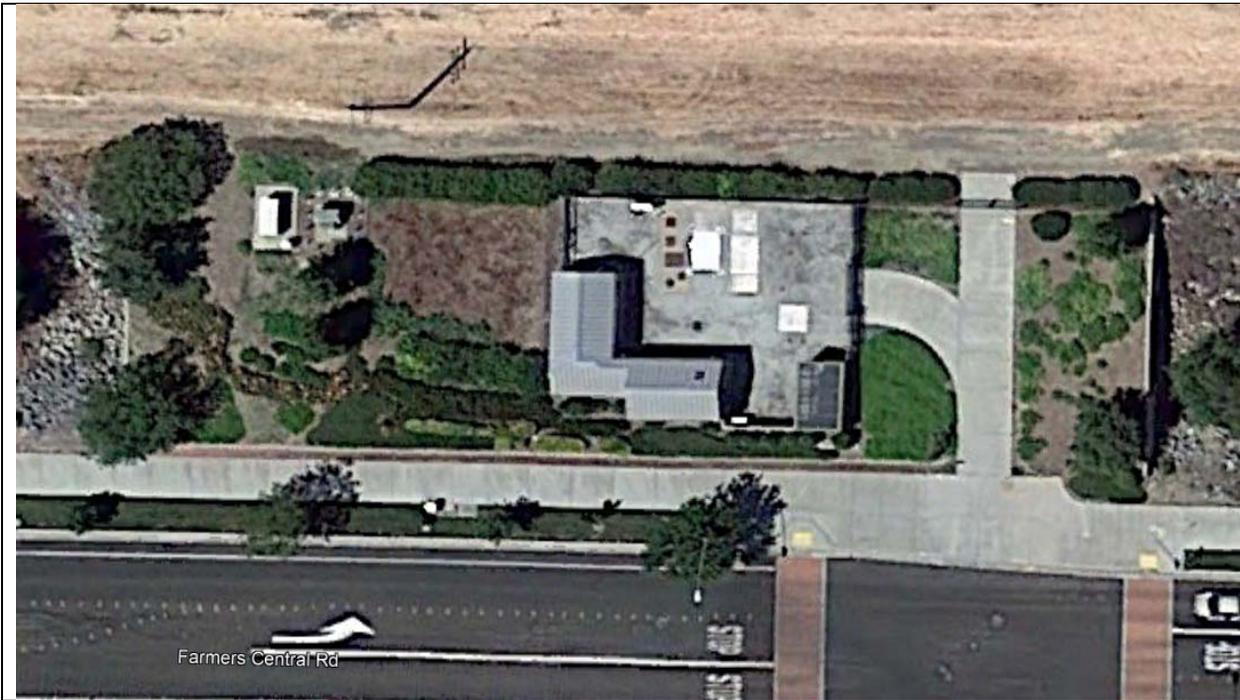
## 2 SPRING LAKE PUMP STATION EXISTING CONDITIONS

### 2.1 Site Visit

Water Works Engineers and Frisch Engineering (Electrical Subconsultant) conducted a site visit on July 14<sup>th</sup>, 2020 and observed the existing condition of mechanical and electrical/instrumentation/control facilities that were open and accessible and required for the project assessment. The team did not conduct a formal condition assessment and did not observe the buried force mains, hidden piping, building/structural conditions, HVAC system, odor control systems, site drainage inlets/piping, fencing, gates, and site aesthetics.

### 2.2 Existing Site Conditions

Site photos of the yard, buildings, wet wells, and vaults are listed below along with short descriptions.



Spring Lake Pump Station orthoimagery.



Spring Lake Pump Station from Farmer Central facing northwest.



Notes: Yard facing north.



Yard facing northeast. Cast iron lids in fair condition. Alum/SST hatches, grates, and appurtenances appear to be in good condition.



Wet/dry well hatches, edge of generator room, and fuel tank building facing southeast. Alum/SST hatches, ladders, and ancillary equipment appear to be in good condition.



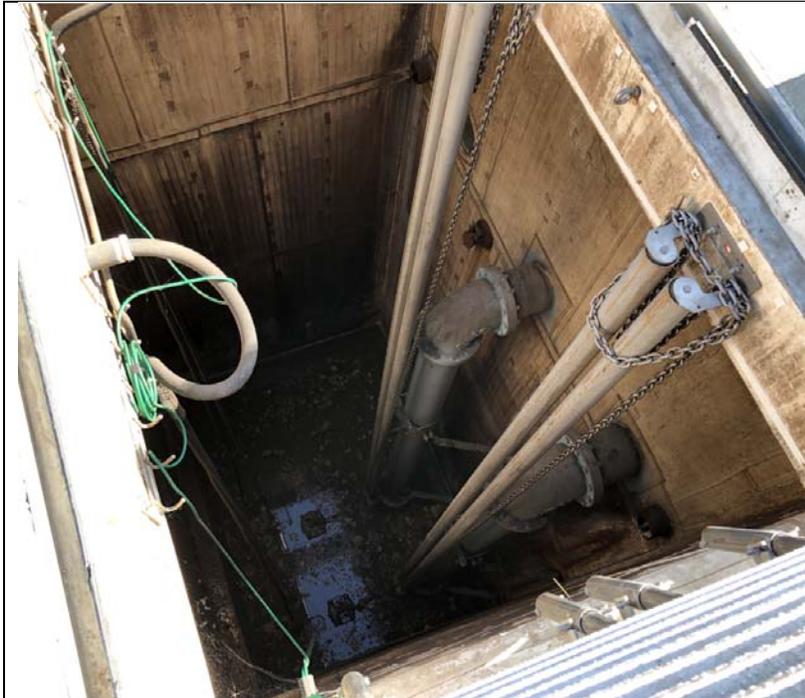
Entrance and generator room facing south.



Fan room and MCC room facing southwest.



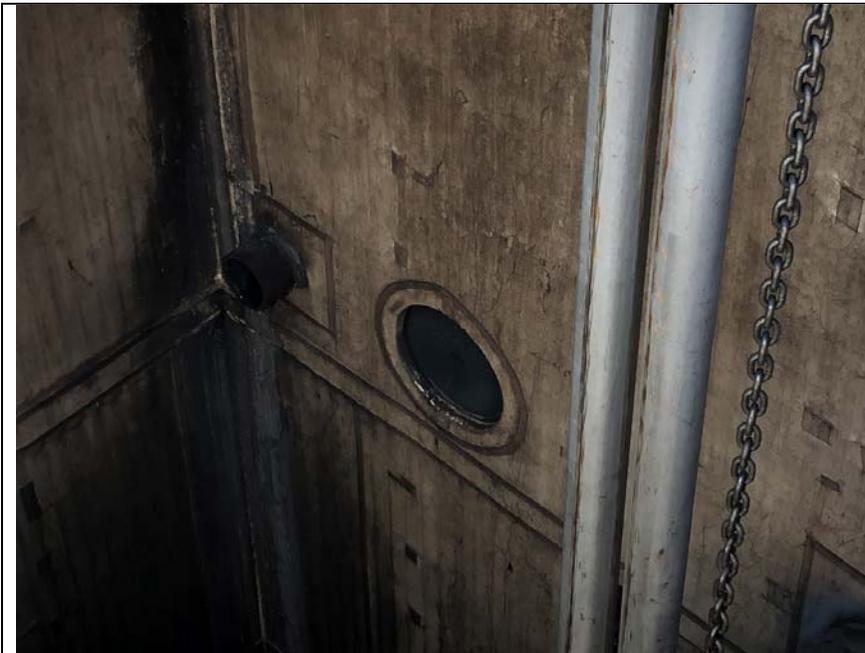
Wet well. Liner appears to be in good condition. Slide gate open and assumed to be operable. Sensor assumed to be operable. Floats assumed operable but appear to be covered in FOG. Moderate FOG presence. Moderate infiltration observed from stubout to north (future phase) which should be dry.



Wet well. Railing appears to be in good condition. All existing conduits into wet well are in use and there is no current backup for the future 3<sup>rd</sup> pump



Wet well water surface. Moderate FOG buildup. Mechanical piping and supports appear to be in good condition.



3<sup>rd</sup> pump blockout (future phase) confirmed.



Existing 3" dual submersible pump guide rails.



Flow meter vault. Current mag meters assumed to be in good working condition based on quality of flow meter data.



Dry well. ARVs and vented header to odor control system assumed to be operable. Supports and grating appear to be in good condition.



Dry well. Pump header discharge check valve and plug valve. Assumed to be operable and in good condition.



Standby generator. Assumed to be operable and in good condition.

### 2.3 Existing Electrical Conditions

Electrical-related equipment photos are listed below along with short descriptions of observed existing conditions encountered by the team.



Utility Service: The existing station has a 600A, 480V, 3 phase, 4 wire service from PG&E. The existing site drawings indicate there is a single 4" conduit from the utility service point to the primary of the transformer and a single 3" conduit from the transformer secondary to the meter/main switchboard.





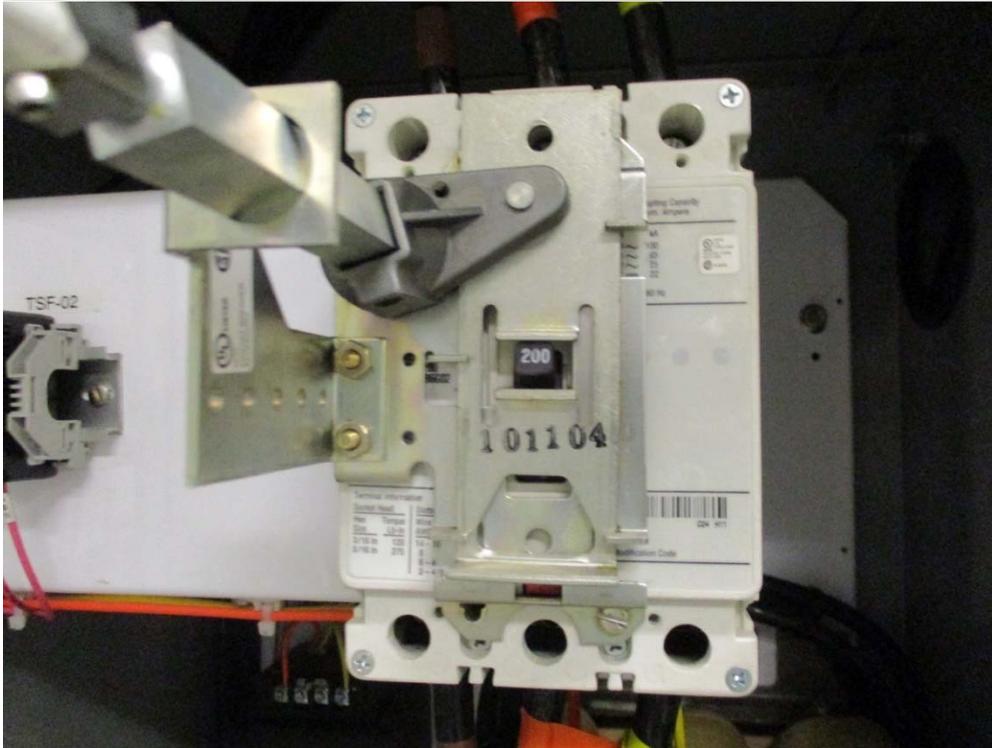
Meter/Main Switchboard: The PG&E service is metered by meter number 1005717922. The main breaker is a 600A with 160A ground fault interrupt. Wiring from the utility input to the breaker is parallel 350MCM cable. Arc Flash hazard is high at this pump station as indicated by the current labels on the meter/main switchboard and motor control center.



Automatic Transfer Switch: The automatic transfer switch is an ASCO 7000 series 600A unit with solid neutral.



Motor Control Center: The motor control center houses several distribution breakers, a lighting panelboard with transformer and the PLC control panel with operator interface/SCADA. In addition, there are three motor control sections allocated for the station's pumps. Only two have been used. Originally there were solid-state soft starters which have since been replaced by variable frequency drives (VFDs). The VFDs are now located in separate enclosures on the adjacent wall to the motor control center. The motor control center sections for the pumps are now just a location for the feeder breakers to the VFDs. One of these breakers is pictured below.



The variable frequency drives are Allen Bradley Powerflex 700S units. Currently two of the three enclosures contain 100hp/125A Frame size 5 VFDs. The third enclosure is empty awaiting a future upgrade. These VFDs are fed from a 200A local feeder breaker.



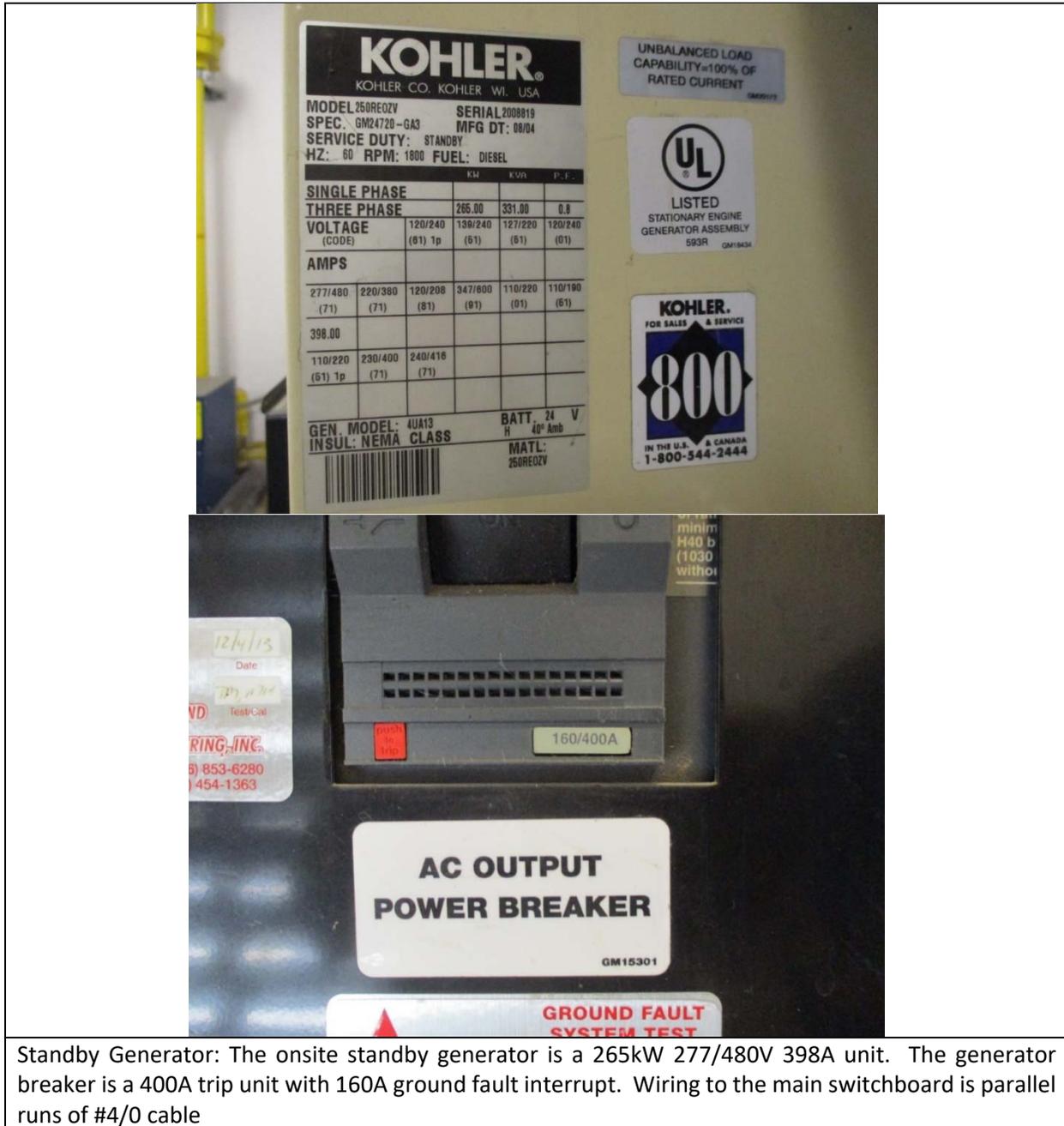
The wetwell currently has a single 2" conduit for each pump bay for the power cabling. There are a total of three pump bays. Two bays contain pumps and the third is currently empty. As can be seen in the photos below the pump power cable currently overfills the available conduit. The pump signal cabling for each of the first two pumps is routed through the third pump bay conduit to the sump termination panel leaving no conduits available for an additional pump.



Sump Termination Panel: There are several conduits beneath the sump termination panel currently leaving little if any space for future expansion or replacement of existing undersized conduits.



Surge Suppression Device: The meter/main switchboard does have a surge suppressor installed, however it appears to not be fully functional based on the indicator lights.



*PLC Control Panel Picture Not Available*

PLC Control Panel: Based on existing drawings the PLC has I/O locations allocated for the addition of the third pump, both analog and digital. The operator interface on the door of the control panel has some information displayed for a potential third pump. It is unknown if the PLC programming is currently present for a 3rd pump.

### 3 HYDRAULIC CAPACITY ASSESSMENT

#### 3.1 2018 Hydraulic Model Update Summary

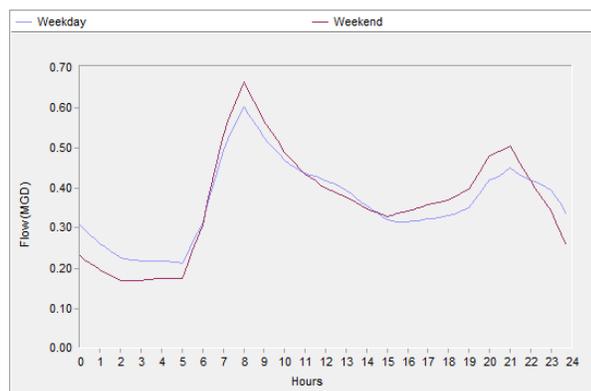
In 2018 the Water Works updated the City’s sanitary sewer hydraulic model (Innovyze InfoSewer) and completed the Spring Lake Sanitary Peer Review. A summary of the work completed is listed below:

- 1) Physical Network Update: Water Works updated the physical network (manholes and pipes) for existing conditions and buildout conditions using the WRTP specific plans.
- 2) Existing Conditions Dry Weather Flow: Water Works utilized flow meter data from the Spring Lake Pump Station to analyze and determine what existing dry weather flow conditions are like in the Spring Lake area and how it compares with the dry weather flow assumptions within the WRTP (based on City standards).
- 3) Wet Weather Flow Development: Water Works analyzed flow meter data and estimated unit rain derived inflow and infiltration (RDII) via the industry standard “RTK” hydrological analysis, whereby a synthetic unit hydrograph is estimated using calibrated “RTK” values in EPA’s SSOAP program. This was then use to project 5yr return 24hr duration design storm conditions RDII per sewershed using SCS Type 1 unit-less rainfall distribution. Given this projected RDII flow is only valid for existing sewer areas (as of 2017), future developed areas were assumed to contribute 600 gpd/acre of constant base infiltration, pursuant to City standards and WRTP assumptions.

A summary of the results in relation with the Spring Lake Pump Station are further discussed in proceeding sections.

#### Dry Weather Flow Results

An average dry weather flow diurnal curve (hourly hydrograph) is depicted in **Figure 1**. Note that it is a very typical residential land use system, with low flows occurring at 4 AM and peak flows at 8 AM and 9PM.



**Figure 1: Typ. Diurnal Curve for SLSP**

**Table 1: Existing DWF**

Representative DWF Period	ADWF (mgd)	Min DWF (mgd)	PDWF (mgd)
September 1-8, 2019	0.43	0.30	0.85

### Typical Wet Weather Flow

Typical wet weather flows are listed in Table 2, and round up approximately to 2.0 mgd.

**Table 2: Typ. Wet Weather Flow (2019)**

Storm Event	PWWF (mgd)
01/07/2019	1.7
01/15/2019	1.5
01/16/2019	1.9
12/01/2019	1.8
12/09/2019	1.5
12/16/2019	1.8

### Projected Design Storm RDII

Water Works calibrated RDII for the existing 2017 Spring Lake sewered areas and produced a projected 5yr/24hr design storm flow that is listed in Table 3.

**Table 3: Projected Design Storm RDII**

Area	RDII Updated Scenario	Acreage
2017 Sewered Areas <sup>1</sup>	2.1 <sup>2</sup>	637
Remainder Area <sup>4</sup>	0.68	1,135

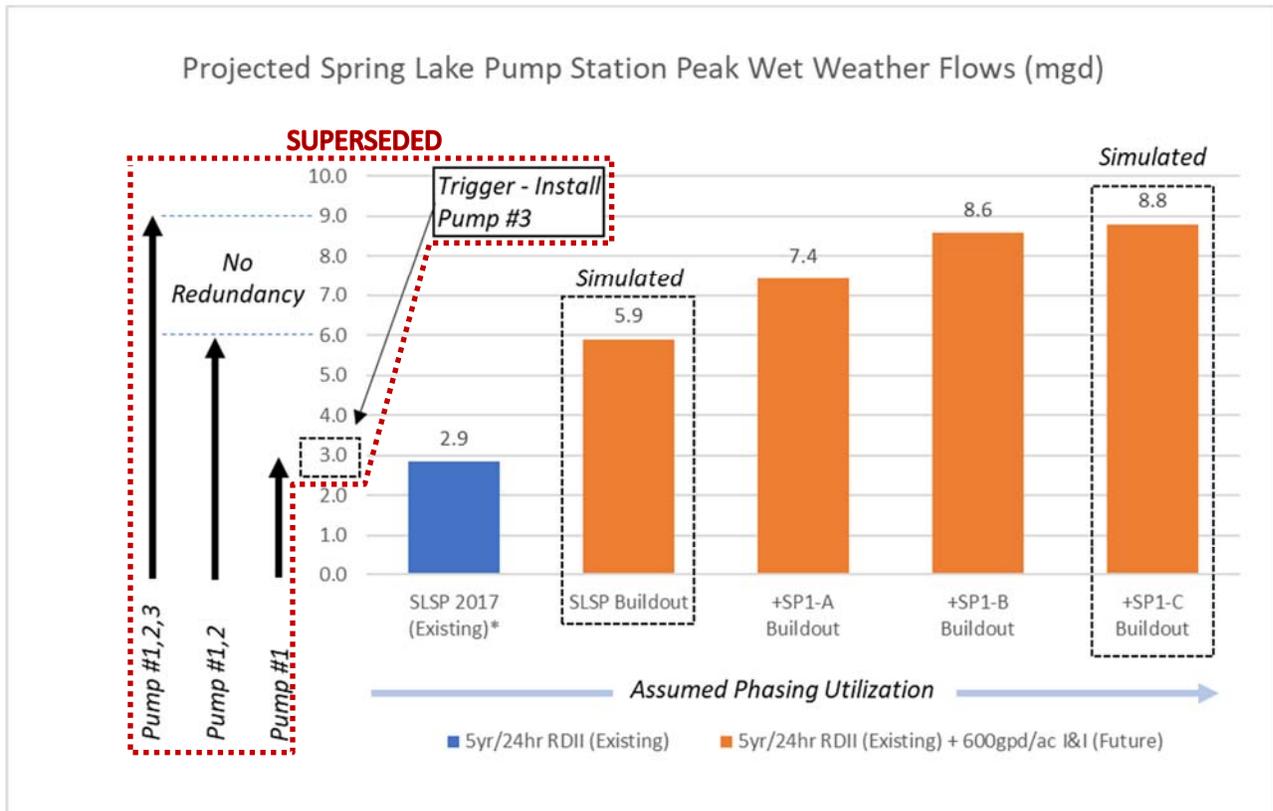
<sup>1</sup>RDII contributing area as defined previously

<sup>2</sup>RDII calculated using Jan/Feb 2017 observed Spring Lake storm responses scaled up to a 5yr/24hr design storm.

<sup>4</sup>SP-1 and Spring Lake areas that are not contributing towards existing RDII, set at 600 gpd/acre per the City's standards.

### Projected Peak Wet Weather Flow & SLPS Capacity Discussion

The projected peak wet weather flows for the Spring Lake Pump Station are depicted in Figure 2.



**Figure 2: Projected SLSP PWWF**

*\*2017 Existing Sewered Areas Calibrated with Jan/Feb 2017 observed storms*

Note the left hand most portion of the figure that is outlined in red and labeled as “SUPERSEDED”. The original pump station capacity information that has been hydraulically modeled to date is based on information provided by the City in 2010 and is listed below:

- Spring Lake Pump Station:
  - Wet Well Bottom Elevation: 5.35’ MSL
  - Wet Well Size: 13’- 6” x 15’- 0” (square)
  - Wet Well Maximum Depth = 35.00’
  - Lead Pump: Operating Point 2083 GPM @ 92’ TDH, On @ Depth = 10.00’
  - Lag Pump: Operating Point 2083 GPM @ 92’ TDH, On @ Depth = 11.00’
  - Pump Low Level (Off) Set Point: Depth = 9.00’
  - Force Main Diameter: 12”

This information listed the maximum capacity of each individual pump at 3.0 mgd. Similarly, the Woodland Research and Technology Park Applicant Memo lists the following information:

“The SLPS facility is designed to use three (3) 90-HP pumps to run at a maximum design capacity of 6.1 MGD. The facility is currently outfitted with two (2) 60-HP pumps to meet existing demands.

During the Water Works site visit, paper hard-copies of the submersible pump submittal at the Spring Lake Pump Station were searched for and located. Subsequently it was confirmed that the submersible pumps are Flygt 90-HP CP-3231 pumps with variable frequency drives (VFDs), not 60-HP pumps. Unfortunately, the VFD performance curves submittal data were not present, and subsequently Water Works reached out to the manufacturer Flygt who “reconstructed” the VFD curves based on the pump and motor type. The results of this are discussed in later sections.

### Flow Definitions

The following flow definitions in order of increasing magnitudes is listed below:

- MIN DWF: Minimum Dry Weather Flow (@ 4AM)
- ADWF: Average Dry Weather Flow, PDWF: Peak Dry Weather Flow (~@ 1PM); TYP WWF
- TYP WWF: Typical Wet Weather Flow (typical storm)
- PWWF (EX): Peak Wet Weather Flow inclusive of 5yr/24hr projected rain derived inflow and infiltration and groundwater infiltration and PDWF
- PWWF (SLSP Buildout): PWWF Spring Lake Specific Plan Buildout
- PWWF (+ SP-1A): PWWF Spring Lake Specific Plan Buildout plus SP-1A
- PWWF (+ SP-1B): PWWF Spring Lake Specific Plan Buildout plus SP-1A & SP-1B
- PWWF (+ SP-1C): PWWF Spring Lake Specific Plan Buildout plus SP-1A, SP-1B, & SP-1C

## 3.2 Storage Sensitivity Analysis

Water Works conducted a storage sensitivity analysis and determined that approximately 0.30 mg of sewer collection system capacity is available from the crown of pipe up to the rim elevation of the manhole just upstream of the SLSP. This gives the system a bit of a safety margin which is dependent on time of year. During the summer, there are likely 12-18 hours of storage available if the pump station was shut down, while for winter, there are likely only 0.5-3 hours of storage. Alternatively, if a single pump was down during a storm, there are likely several hours of time to bring the downed pump back into service and pace the stormflow. This analysis is not exact and should not be relied upon in making standard operational decisions. Maintaining power backups (standby generator), one pump backup for redundancy, and bypass pumping during construction activities is always recommended to reduce or eliminate the risk of sanitary-sewer-overflows (SSOs).

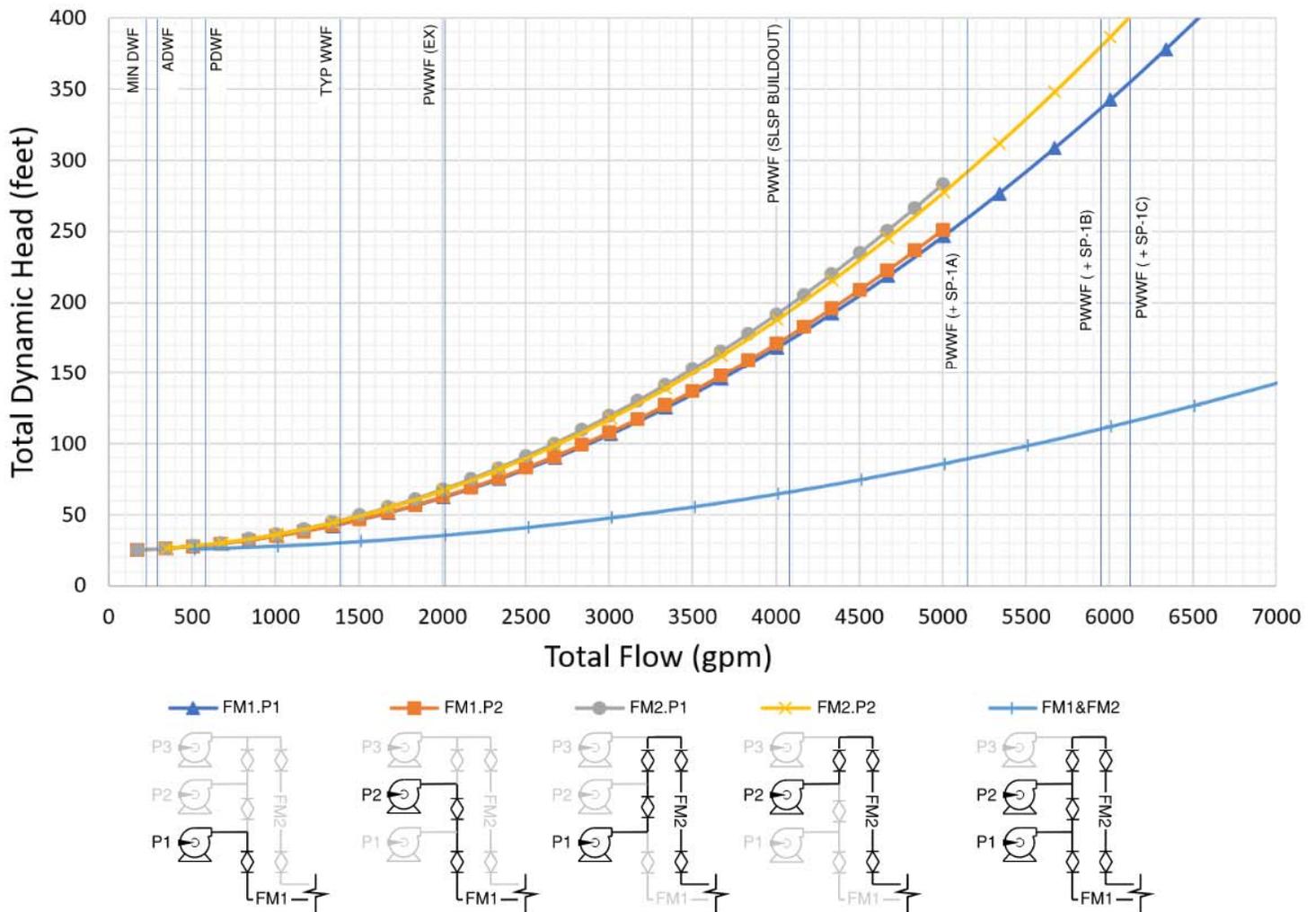
## 3.3 Pump Station and Forcemain System Curve

Water Works reviewed the pump station as-builts and inputted information about the mechanical piping and forcemains into a hydraulic modeling program (Fathom AFT) to quantify the hydraulic performance of the system across a range of flow scenarios. The resultant system curves which is total dynamic head at a given flow rate are depicted in Figure 3. Several flow scenarios are represented which highlight the potential “path” that the pumped flow could take through the valve tree. For instance, Pump #1 (P1) could take the route of FM1 or FM2. It is understood that Operations typically only runs FM1 during dry conditions to maximize velocities and reduce solids/FOG deposition as much as possible. Operation of both forcemains is assumed to occur during winter, when inflows and wet well elevations exceed single pump set points. Each pump is assumed to have a dedicated forcemain during winter conditions, with no

flow equalization occurring. Note that additional operational procedures, optimization/fine-tuning strategies, and programmable-logic-controller (PLC) set points are not discussed further as this analysis is focused on broader pump station performance under maximum flow conditions.

## SLSP System Curves

(Theoretical Hydraulic Performance Across Range of Pump & FM Scenarios)



**Figure 3: SLSP System Curve with projected/phased PWWF markers**

The theoretical capacity of a pump station is dependent on the hydraulic performance of the conveyance system (forcemains) and the capabilities of the submersible pumps. There are three major factors to understanding pump performance which are:

- Motor Size
  - Motor rating (HP) indicates “lifting” power of pump
- Variable frequency drive (VFD) performance
  - A pump VFD governs the frequency of electrical power that is sent to each submersible pump. By finetuning the frequency, the motor speed can be turned down, and the pump can be optimized to “pace” inflow at a more efficient rate and decrease the number of start-stop cycles which are harmful to the pump. VFDs typically operate from 60-hz (max) to 45-hz, which is minimum allowable to sufficiently turn-over product water inside the pump and keep the motor cool and protected from burning out. Newer high-efficiency submersible pumps can operate as low as 30-hz, but require specialized cooling features which are very expensive.
- Impeller Trim
  - The impeller is the component attached to the motor/shaft which lifts water through the pump. The larger the impeller, the greater the lift it produces.

## 4 PUMP CONSTRAINTS AND UPGRADE OPTIONS

Water Works gathered submersible pump data, identified hydraulic constraints, and assessed three pump scenarios for the Spring Lake Pump Station which are listed as following:

- Existing Pumps: Pump station continues to utilize existing 90-HP submersible pumps (Assumes 3<sup>rd</sup> 90-HP pump is installed for backup/redundancy)
- Replacement Pumps: Pump station is modestly enhanced with new 90-HP submersible pumps that match existing station electrical capabilities.
- Upsized Pumps: Pump station capacity is significantly expanded with new upsized 185-HP submersible pumps

### 4.1 Existing Pumps

Existing submersible pump information is listed in Table 4.

**Table 4: Existing Submersible Pumps**

Existing Submersible Pump #1 & #2	
Description	Submersible non-clog wastewater pump
Product	90-HP CP 3231/615-630
Impeller	430 or 440 mm
VFD	45-60HZ

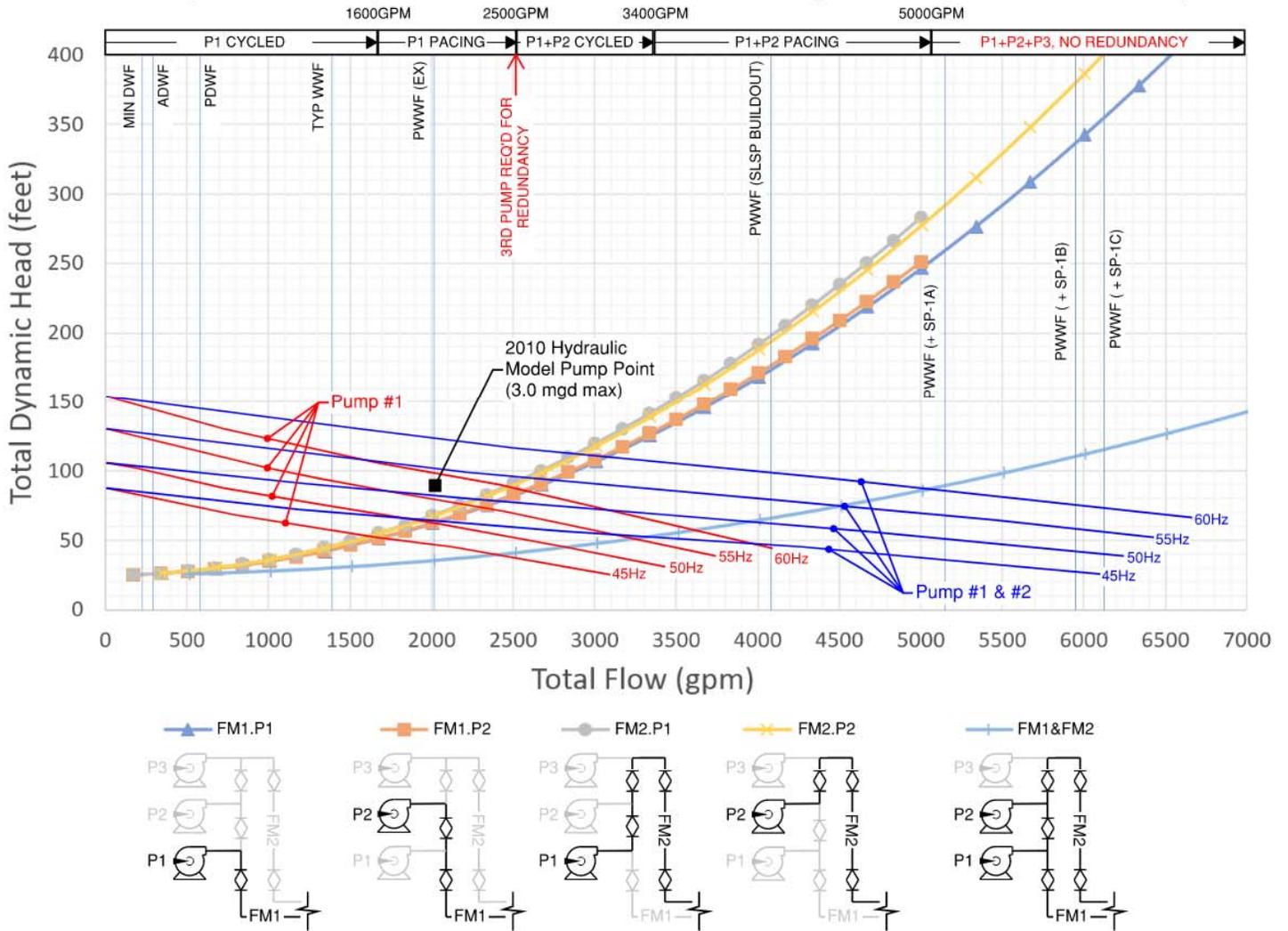
The existing submersible pump performance data (VFD curves) overlaid on the system curve is depicted in Figure 4. The station is likely being operated as a start-stop (“cycling”) station during low flows up to 1600 gpm. Pump 1 is then able to match flow (“pacing”) up to 2500 gpm. At this point Pump 2 turns on, and then the station cycles again until 3400 gpm. At that point the flows are large enough that Pump 1 and 2 pace the inflow until 5000 gpm. At this point the 3<sup>rd</sup> pump (not currently installed) would kick in an

emergency capacity, and the three pumps would pace flow until the storm flow ceased. If the backup 3<sup>rd</sup> pump is required, then the station effectively loses redundancy, which is not recommended.

EXISTING PUMPS  
 FLYGT C3231/615-630 3 ~ 460  
 90HP 430mm

### SLSP System Curves

(Theoretical Hydraulic Performance Across Range of Pump & FM Scenarios)



**Figure 4: Existing Pump Hydraulic Performance**

Note that the results show the maximum capability of the dual submersible pumps at the highest available frequency (60hz) is approximately 5000 gpm (7.2mgd) through both forcemains. This is significantly more than the static 6.0 mgd (2 x 3.0 mgd) that has been reported as the previous maximum, but is slightly less than the projected 7.4 mgd PWWF in the + SP-1A development scenario (SLSP Buildout + SP-1A).

## 4.2 Replacement Pumps

Water Works reached out to Flygt for recommendations for the 3<sup>rd</sup> pump and any replacement pumps in the future that match the current pumps (90-HP). Flygt responded that the existing pumps in SLSP are no longer manufactured and recommended a 90-HP pump from their current product lineup (“NP” Style submersible pumps). Information is listed in Table 5.

**Table 5: Replacement Pumps**

Replacement Submersible Pumps 1, 2, & 3	
Description	Submersible non-clog wastewater pump
Product	90-HP NP 3231 / 615 3~680
Impeller	410 mm (largest impeller trim)
VFD	45-60HZ

Generally these pumps are very similar to existing but give the station a modest performance boost with a max dual pump capacity of 5200 gpm (7.5 mgd), which is slightly greater than the 7.4 mgd PWWF projected in the + SP-1A development scenario (SLSP Buildout + SP-1A). The replacement pump performance data (VFD curves) overlaid on the system curve is depicted in Figure 5. The station would likely cycle during low flows up to 1600 gpm. Pump 1 is then able to pace flows up to 2600 gpm. At this point Pump 2 turns on, and then the station cycles again until 3100 gpm. At that point the flows are large enough that Pump 1 and 2 pace the inflow until 5200 gpm. At this point the 3<sup>rd</sup> pump (not currently installed) would kick in an emergency capacity, and the three pumps would pace flow until the storm flow ceased. If the backup 3<sup>rd</sup> pump is required, then the station effectively loses redundancy, which is not recommended.

REPLACEMENT PUMP  
 FLYGT NP3231/ 615 3 ~ 680  
 90HP 410mm (largest  
 impeller trim)

### SLSP System Curves

(Theoretical Hydraulic Performance Across Range of Pump & FM Scenarios)

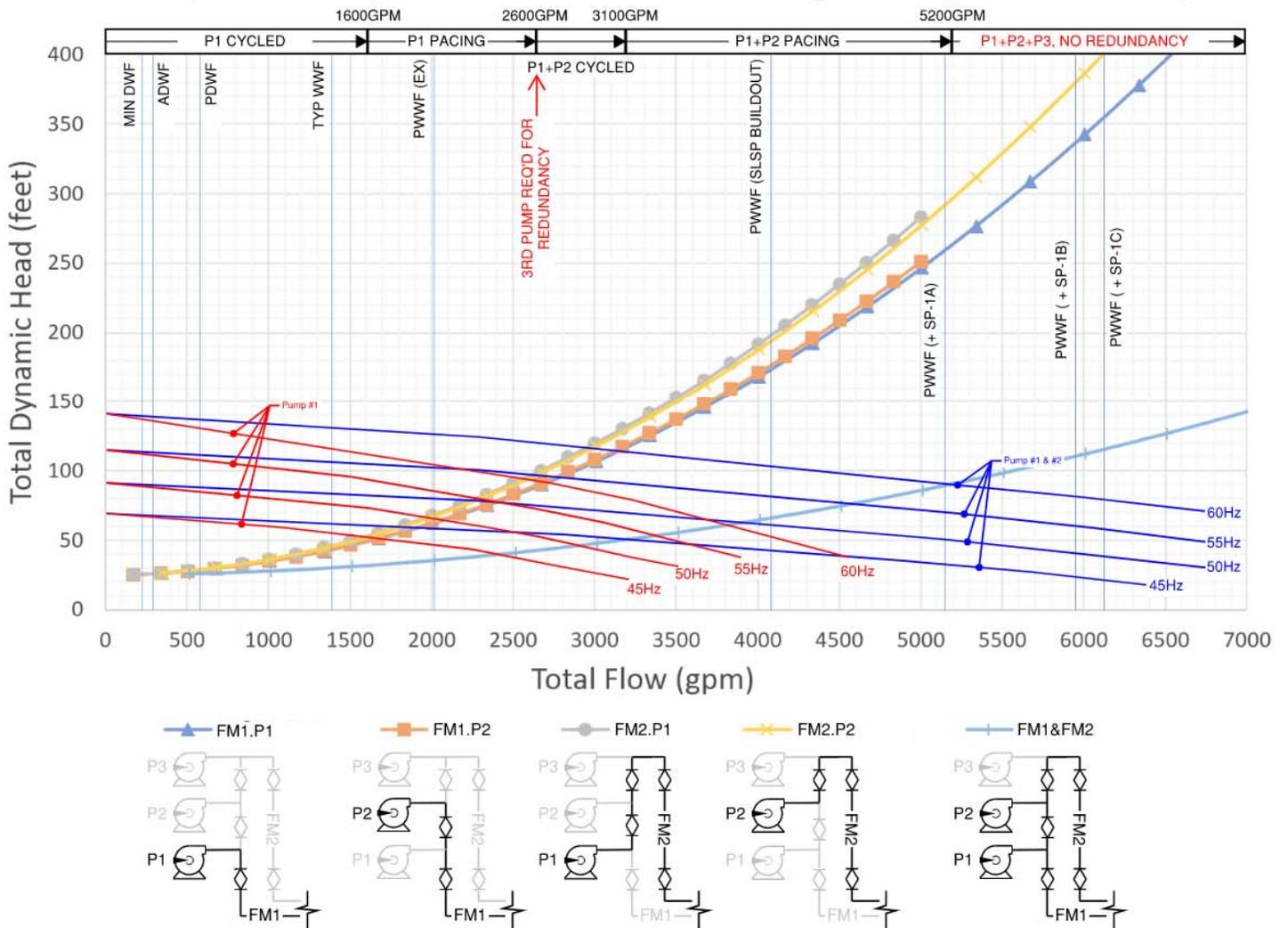


Figure 5: Replacement Pump Hydraulic Performance

### 4.3 Upsized Pumps

Water Works developed a theoretical pump station scenario whereby the station’s capacity is significantly expanded with upsized submersible pumps. The station has relatively low dry weather flow requirements, but scales up significantly to peak wet weather storm flow at the furthest development window + SP-1C (SLSP Buildout, SP-1A, SP-1B, and SP-1C). This system requires a larger pump than existing to expand the max flow capacity, but also requires significant turn-down capabilities (VFD) and smaller impeller to cover the lower end of the flow range efficiently. Water Works consulted with Flygt for a recommended submersible pumps for this scenario and received the following pump information in Table 6.

**Table 6: Upsized Pumps**

Upsized Submersible Pumps 1, 2, & 3	
Description	Submersible non-clog wastewater pump
Product	185 HP FLYGT NP 3231/716 3 ~ 480
Impeller	310 mm (smallest)
VFD	30-60HZ (Premium Efficiency)

The station would likely cycle during low flows up to 1100 gpm. The premium cooling efficiency capabilities of the pump mean that the VFD can turn down to as low as 30-Hz. Pump 1 is then able to pace flow up to 3300 gpm. At this point Pump 2 turns on, and then both pumps pace inflow until the max capacity of 6500 gpm is reached.

UPSIZED PUMP  
 FLYGT NP3231/ 716 3 ~ 480  
 185HP 310mm (smallest  
 impeller size)

### SLSP System Curves

(Theoretical Hydraulic Performance Across Range of Pump & FM Scenarios)

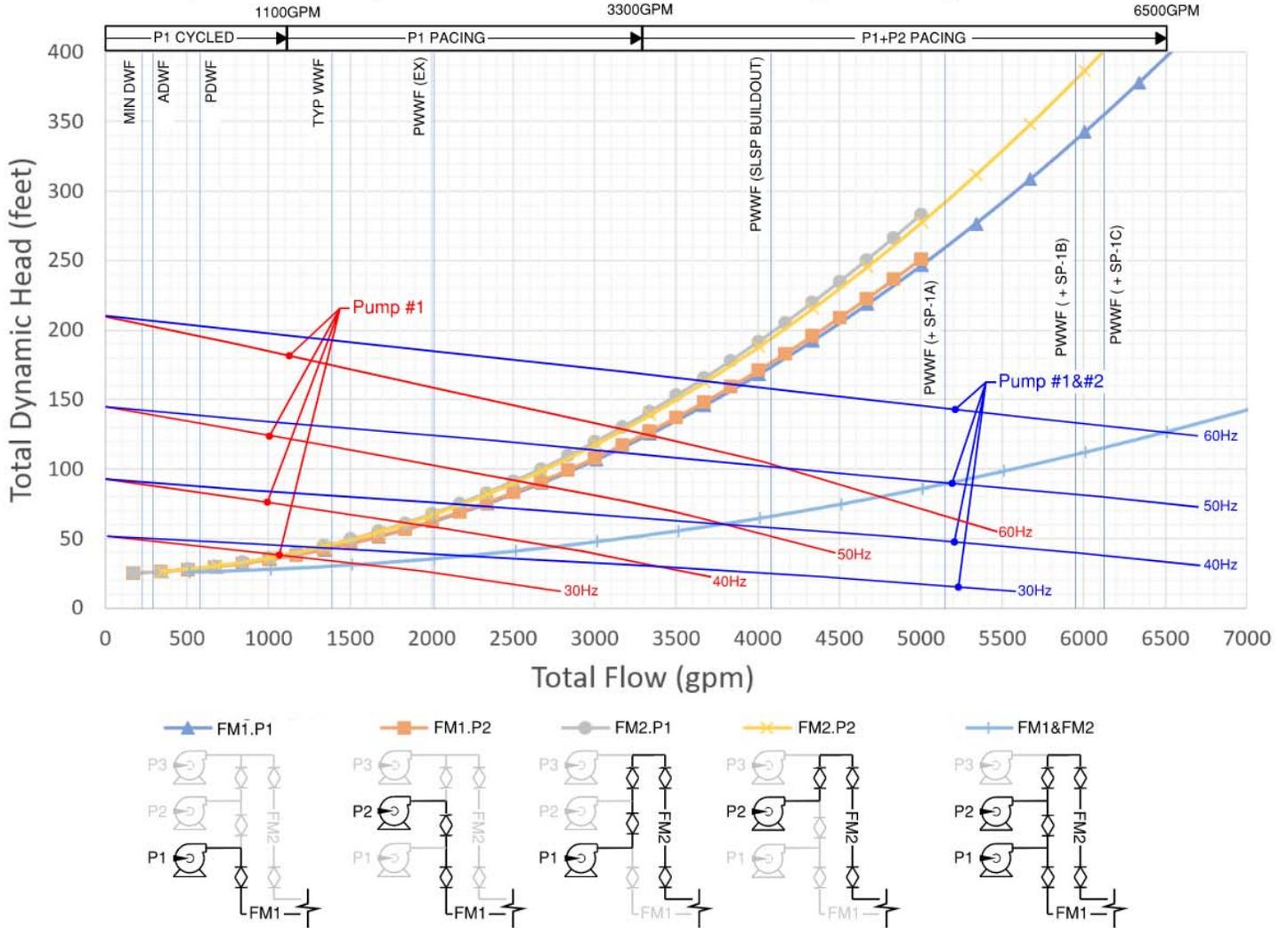


Figure 6: Upsized Pump Hydraulic Performance

## 5 ELECTRICAL CONSTRAINTS AND UPGRADE OPTIONS

Water Works electrical engineering subconsultant Frisch Engineering identified electrical-related constraints, assessed pump upgrade scenarios, and identified required improvements.

### 5.1 Electrical Constraints

#### 5.1.1 Pump Options

A full range of potential pumping electrical modification options were identified and are listed below. Note that only three of these options which are **bolded** produce a scenario that provides a redundant pump (Options 1, 3, & 6) and were further assessed in the hydraulic analysis presented herein.

- 1. Keep the existing 90Hp pumps and install a 90Hp third pump.**
2. Keep the existing 90Hp pumps and install a larger 185Hp third pump.
- 3. Replace the existing pumps with new 90Hp pumps and install a 90Hp third pump.**
4. Replace the existing pumps with new 90Hp pumps and install a larger 185HP third pump.
5. Replace the existing pumps with one 90Hp pump and one 185Hp pump.
- 6. Replace the existing pumps with 185Hp pumps.**
7. Replace the existing pumps with 185Hp pumps and install a 90Hp third pump.
8. Replace the existing pumps with 185Hp pumps and install a 185Hp third pump.

These options are in progression from the least disruptive to the most disruptive in terms of electrical work required.

#### 5.1.2 Work Required for All Options

All the above options will require the upgrade of conduits from the wetwell to the sump termination panel at a minimum. If the use of VFD cable from the VFD enclosure all the way to the pump motor is desired (highly recommended) then the conduits from the Sump Termination Panel to the VFD enclosures will need to be replaced as well. The existing conduits are insufficient in both size and number to support the existing 90Hp pump cabling as seen in the photos above. Upgrading to 185Hp pumps would be infeasible with the existing conduits.

Pulling integrated pump cabling through a conduit virtually the same size as the cable is extremely difficult and violates code for conduit wire fill capacity. Installing VFD cable from the VFD itself to the Sump Termination Panel would also be extremely difficult in the existing 2" conduit with the power requirements of 90Hp motors and impossible for 185Hp motors.

In the main switchboard the surge suppressive device currently installed is blown out on one phase and needs to be replaced.

It is strongly recommended no matter the option chosen to review the Arc Flash hazard ratings, perform an Arc Flash Study and lower breaker settings accordingly wherever possible to reduce this hazard.

The PLC programming will need to be reviewed for all options. Similarly, the OI/SCADA applications will need to be reviewed. There are some indications in existing drawings that a third pump has been accommodated but that will need to be verified in all programming.

### 5.1.3 Utility and Switchgear Upgrades

The pump station currently has a 600A service supplied by PG&E. A 600A service can supply approximately 480A of useful power once cable and wire derating traveling in conduit are taken into consideration. As such the current service is adequate to supply power to options 1 through 6 above. Options 7 or 8 would require upsizing the utility service and consequently all the electrical gear in the electrical room.

If larger utility service is required investigation into the size and capability of the existing transformer would need to be performed. This transformer may have sufficient capacity to supply more power to the station or may need to be replaced. The single 3" conduit for utility service from the transformer to the Main Switchboard is vastly inadequate and would need to be replaced. PG&E current standard is minimum (2) 5" conduits.

### 5.1.4 Motor Control Center

The motor control center is currently being used as a breaker switchboard only. This is perfectly adequate for any 90Hp motor with no changes required. For any 185Hp motor the associated feeder breaker would have to be upsized accordingly to match the requirements of the bigger motor.

In the case of installing (3) 185Hp motors or (2) 185Hp motors and (1) 90Hp motor the entire motor control center would need to be replaced as the main power bus would be inadequate to handle the current required for this much load.

### 5.1.5 Variable Frequency Drives

The presently installed VFDs are Allen Bradley Powerflex 700S models with 125A maximum capacity. This model is rated for 100Hp normal duty – 75HP heavy duty motor usage. They are driving 90Hp pumps currently. Consequently, these VFDs are working at the top end of their rated capability. They are also the largest unit in their model family frame size meaning any larger capacity VFD would require a physically larger enclosure. It would be recommended to replace the existing VFD enclosures with appropriately sized cabinets to house the new VFDs for the new pumps being installed. Any 185Hp motor will require an upgrade in VFD size both electrically and physically.

### 5.1.6 Standby Generator

The current standby generator is adequate for pump options 1, 3 and 5. Any other option will require a larger generator to have the capacity to run all pumps together. Alternatively, any combination of pumps totaling less than 275Hp could operate on the current generator with no changes.

## 5.2 Electrical-Related Improvements

### 5.2.1 Yard Work

Replace the existing wetwell conduits with appropriately sized and sufficient number of new conduits to carry the intended power and signal loads for each new pump installed. Replace the Sump Termination Panel with one sized to handle the increased conduit and wire sizes of up to (3) 185Hp pumps. The large cabling for these pumps is very heavy and awkward to maneuver. It is important to not undersize this panel.

If the owner requires VFD cable from the VFD drive to the Sump Termination Panel, which is recommended, new larger conduits will be required to accommodate the cabling.

If options 7 or 8 are chosen an upgrade in utility service will be required and at a minimum new conduits will need to be installed from the transformer to the main switchboard. PG&E requirement will be (2) 5" conduits minimum.

### 5.2.2 Control Software

Review and upgrade the existing PLC programming and OI application programming for any shortcomings in capability to operate a (3) pump pump-station. Review the SCADA application to assess any upgrades required for the additional pump.

### 5.2.3 Station Electrical Equipment

Determine the desired size and number of pumps required to adequately perform the pumping task for this station. Based on required load determine if the existing electrical utility service, switchgear and controls are adequate to operate the pumps.

A new 90Hp pump can be added to the third pump bay with no changes to the meter/main switchboard or the motor control center. An identical VFD to the existing units could be installed in the third VFD enclosure to operate this pump. Although an upgrade in the VFD model size is recommended it is not required to operate the 90Hp pumps.

If any of the pumps are to be upgraded to the 185Hp units a whole new VFD enclosure and larger VFD module will be required to operate each pump of this size.

If (3) 185Hp pumps or (2) 185Hp and (1) 90Hp pumps are to be used then the all the electrical gear will need to be replaced with equipment sized for the increased load.

## 6 RECOMMENDATIONS

### 6.1 Enhancement Assessment Summary

The hydraulic assessment results for each pump scenario (Existing, Replacement, and Upsized) is depicted in **Error! Reference source not found.**

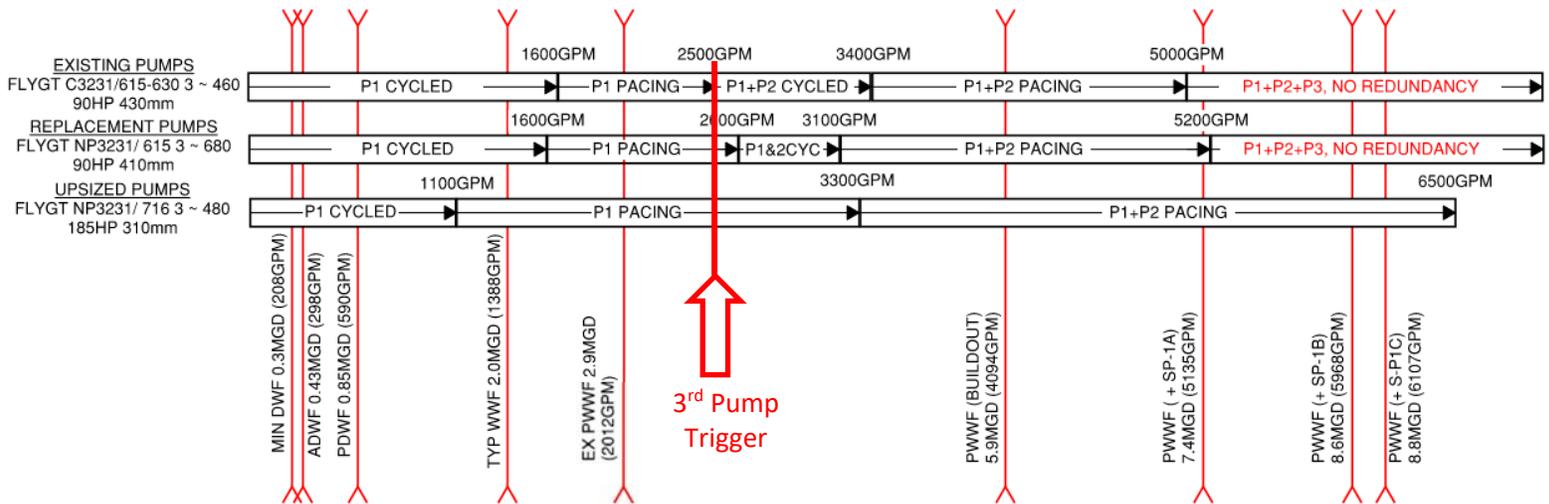


Figure 7: Pump Scenario Results Summary

The existing dual 90-HP pumps will both be required at 2500-GPM (3.6 MGD) which is effectively the trigger point for a 3<sup>rd</sup> backup pump to be installed to ensure redundancy. This projected PWWF trigger will likely be met by 2025 depending on existing SLSP growth and natural increases in RDII from aging sewer pipelines and manholes.

The existing dual 90-HP pumps do not quite reach the full capacity required for the + SP-1A scenario (SLSP Buildout + SP-1A) while the replacement pumps slightly exceed it. The dual 90HP pumps (existing or replaced) are insufficient to cover SP-1B and SP-1C development, however, without losing redundancy.

Installing new 185-HP pumps would provide the expanded capacity to accommodate the furthest development window +SP-1C (SLSP Buildout, SP-1A, SP-1B, and SP-1C) but would require a complete electrical retrofit to the pump station.

### 6.2 Recommendations

Based on these results, Water Works recommends the following next steps organized by implementation year:

- By 2025: Install 3<sup>rd</sup> backup pump (90-HP NP3231 / 615 3 ~680 410 mm) and associated improvements to provide redundancy by 2025. See Section 6.2.1 for required improvements and costs.

- By 2026 or next City hydraulic model update: Reassess Spring Lake Pump Station sewer shed hydraulic performance in 2026 and update hydraulic model and re-simulate with projected design storm peak wet weather flows. This could coincide with an overall City hydraulic model update.
- By 2026 or end of existing pump useful life: The existing 90-HP submersible pumps will be over 20 years old by 2026 and at the likely end of their useful life. It is recommended that the City take this opportunity to use updated hydraulic model results and reassess the desired long-term capacity of the pump station and run a condition assessment of major electrical equipment. The City will likely have three options to pursue:
  1. Replace pumps with new 90-HP units (with 7.5 MGD max limit) and explore retrofitting the station with 185-HP pumps by 2046. This option means the City could maintain pumping redundancy by the time Buildout and SP-1A are completed. The City may want to include replacing major electrical equipment such as VFDs, MCC or PLC components as deemed appropriate via a condition assessment. See Section 6.2.2 for required improvements and costs.
  2. Expand station and replace pumps with 185-HP units (9.4 MGD max limit). This option appears most applicable if the SP-1B through SP-1C development window were to occur soon. In actuality, the likely development window for SP-1B and SP-1C could be 20 or 30 years. With 185-HP pumps, the station would be oversized for a long time. See Section 6.2.3 for required improvements and costs.
  3. Rebuild pumps and add 10-15 years of useful life (with 7.2 MGD max limit) and explore retrofitting the station with 185-HP pumps by 2036-2041. A pump rebuild is approximately \$40K per pump. This option could mean the City losing backup pump redundancy by the time Buildout and SP-1A are completed. The City may want to include replacing major electrical equipment such as VFDs, MCC or PLC components as deemed appropriate via a condition assessment.

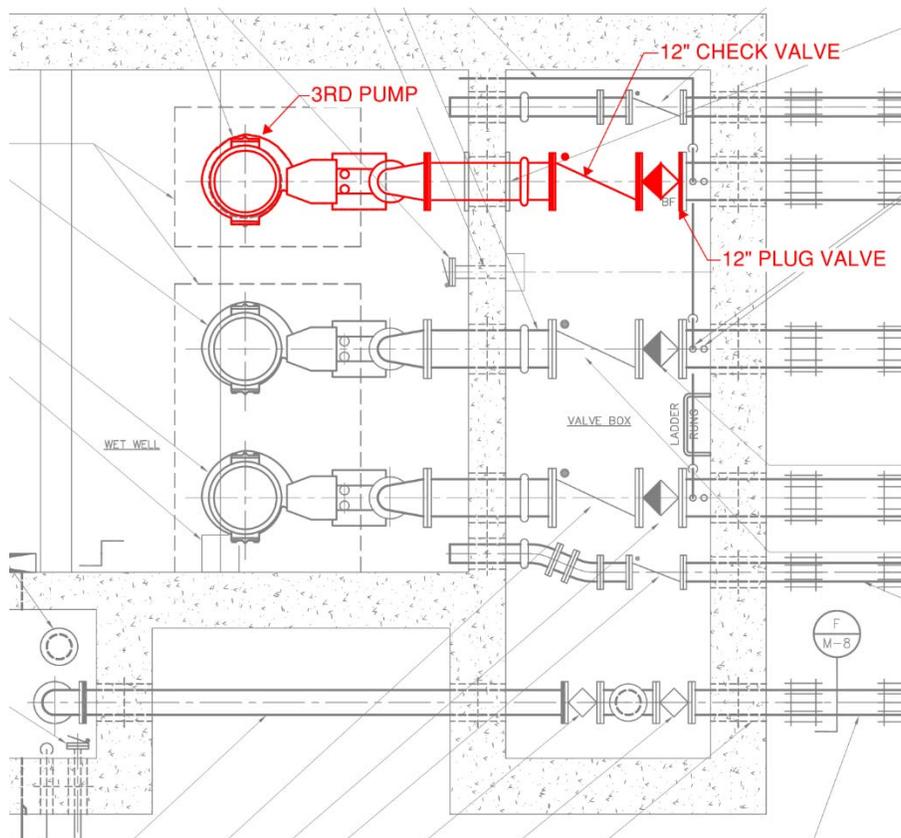
### 6.2.1 New 3<sup>rd</sup> Pump Required Improvements

#### Required Improvements

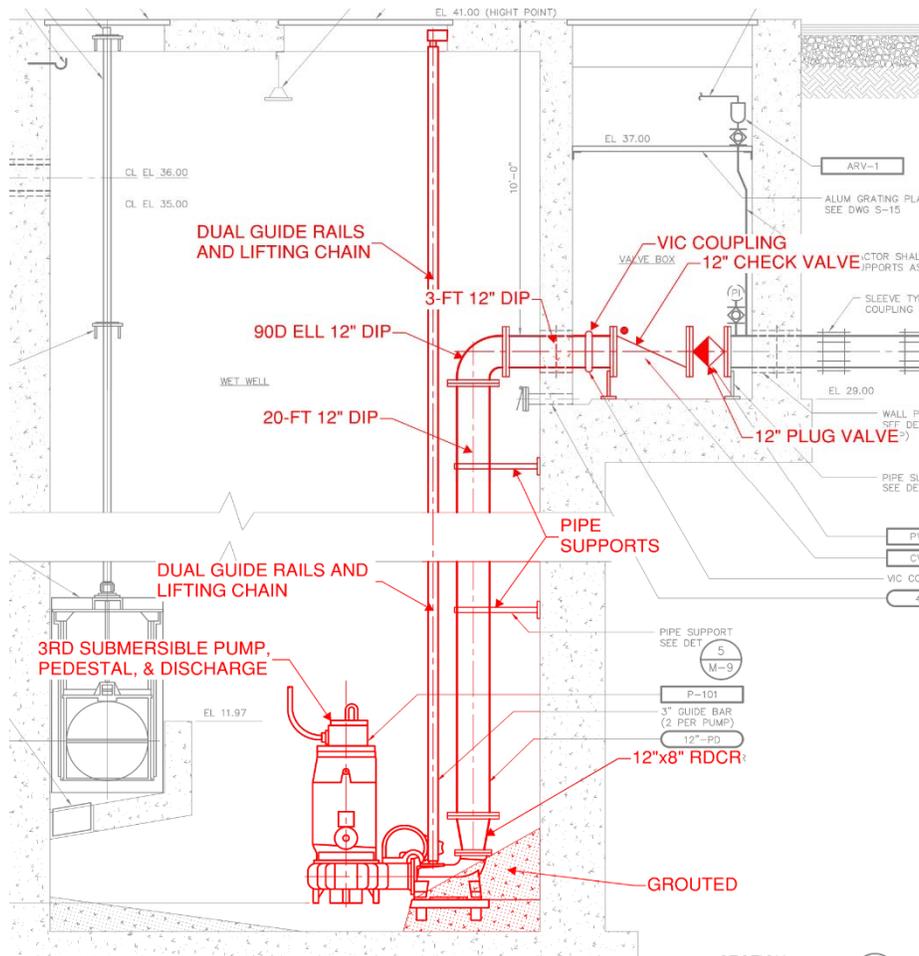
The existing wet well is phased for a 3<sup>rd</sup> pump and requires relatively modest improvements to accommodate its addition. A summary of the required improvements are listed below and depicted in Figure 8 and Figure 9.

- Mechanical:
  - 12" Check Valve
  - 12" Plug Valve
  - FLYGT Submersible Pump (90-HP NP 3231 / 615 3~680 410mm impeller trim), pedestal, discharge, guide rails, and chains
  - 23-FT 8" CL50 DIP P401
  - Pipe supports
  - Grout in pump pedestal. Coordinate work with wet-well PVC/HDPE liner manufacturer.
- Civil:

- None
- Miscellaneous:
  - Close slide gate and activate sewer bypass pumping (0.30 ADFW to worst case 3.0 MGD PWWF) from upstream vault for 3-5 days.
  - Drain wet well. Use opportunity to clean out FOG and debris.
- Electrical (not depicted in plan)
  - New 6" conduit and cabling from Sump Termination Panel to Wet Well. Minor modifications to existing Sump Termination Panel.
  - Install new 3rd pump Allen Bradley Powerflex 700S (100hp/125A Frame size 5 VFD) in existing empty enclosure.
  - Replace surge suppressive device (currently blown out on one phase)
  - Perform Arc Flash Study and lower breaker settings accordingly.
  - Perform review of PLC programming and OI/SCADA applications. There are some indications in existing drawings that a third pump has been accommodated but that will need to be verified during programming efforts.



**Figure 8: 3rd Pump Addition Plan**



**Figure 9: 3rd Pump Addition Section**

### Estimated Construction Costs

Conceptual engineering level estimated construction costs for this option are listed in Table 7.

**Table 7: 3rd Pump Addition Estimated Construction Costs**

New 3 <sup>rd</sup> Pump Estimated Construction Costs	
<b>Mechanical</b>	
Piping	\$ 15,000
Valves	\$ 15,000
Misc.	\$ 8,000
<b>Civil</b>	\$ 5,000
<b>Miscellaneous (Bypassing Pumping, etc.)</b>	\$ 25,000
<b>Electrical</b>	
90-HP Pump	\$ 112,800
Meter/Main, ATS, Distribution, Switchboard	\$ 3,500
MCC	\$ 2,800
VFDs	\$ 52,734
PLC Panel (main)	\$ 24,514
Sump Termination Panel	\$ 1,470
Instrumentation	\$ 3,843
Site Electrical Materials	\$ 18,844
Site Electrical Labor	\$ 46,200
<b>Subtotal</b>	\$ 334,705
<b>30% Design+Const. Contingency</b>	\$ 100,412
<b>Total*</b>	\$ 436,000

*\*Rounded Up to Nearest \$1000. Assumes work provided by independent contractor. Does not include management, design, and inspection costs.*

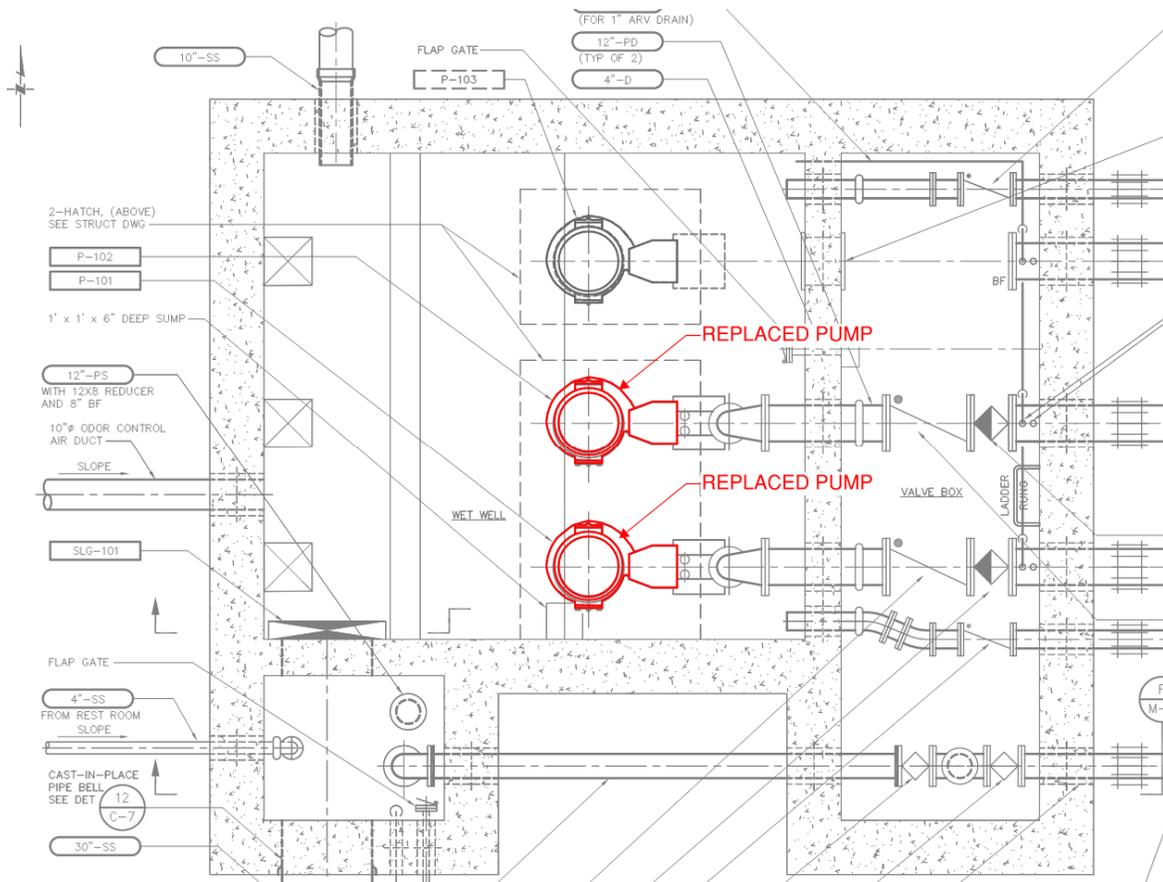
### 6.2.2 Replace Two Existing Pumps with New 90-HP units

#### Required Improvements

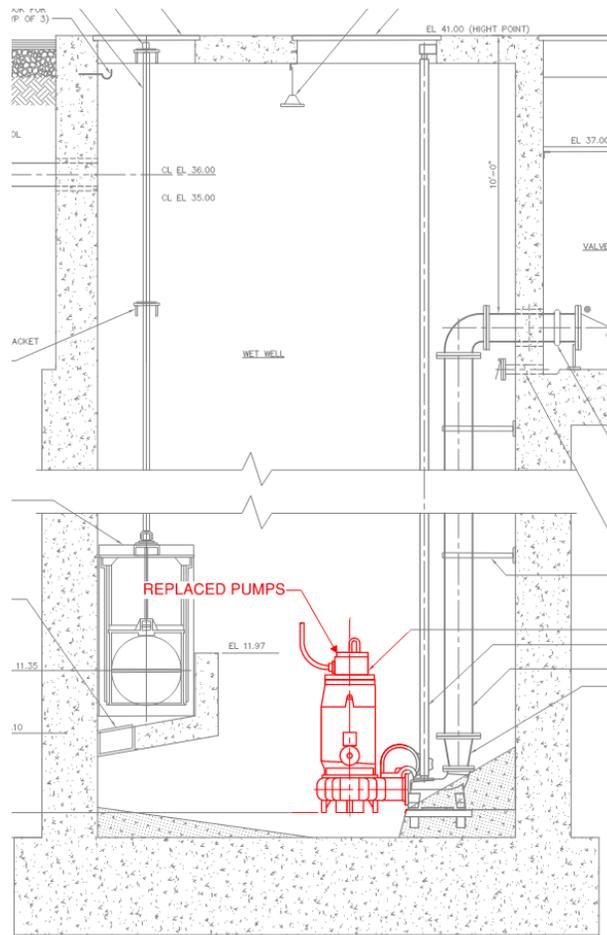
The pump station would require modest improvements to replace the existing two 90-HP C3231 submersible pumps with current/enhanced 90-HP Flygt NP3231 models. This assumes that the 3<sup>rd</sup> pump (also Flygt NP3231 has already been installed). A summary of the required improvements are listed below and depicted in Figure 10 and Figure 11.

- Mechanical & Civil
  - FLYGT Submersible Pump (90-HP NP 3231 / 615 3~680 410mm impeller trim). Assumes existing pedestal, discharge, guide rails, and chains can be reused.
- Miscellaneous:

- Close slide gate and activate sewer bypass pumping (0.30 ADWF to worst case 3.0 MGD PWWF) from upstream vault for 3-5 days.
- Drain wet well. Use opportunity to clean out FOG and debris.
- Electrical (not depicted in plan)
  - New conduit and cabling from Sump Termination Panel to Wet Well. Major modifications to existing Sump Termination Panel.
  - New conduit and cabling from Sump Termination Panel back to VFD Panel in Electrical Building (not required, but strongly recommended)
  - Perform review of PLC programming and OI/SCADA applications



**Figure 10: Replacement Pump Plan**



**Figure 11: Replacement Pump Section**

### Estimated Construction Costs

Conceptual engineering level estimated construction costs for this option are listed in Table 8.

**Table 8: 90-HP Replacement Pumps Estimated Construction Costs**

90-HP Replacement Pumps Estimated Construction Costs	
<b>Mechanical</b>	
Piping	\$ -
Valves	\$ -
Misc.	\$ -
<b>Civil</b>	\$ 20,000
<b>Miscellaneous (Bypassing Pumping, etc.)</b>	
	\$ 25,000
<b>Electrical</b>	
2x 90-HP Pumps	\$ 205,200
PLC Panel (main)	\$ 9,506
Sump Termination Panel	\$ 7,840
Instrumentation	\$ 22,677
Site Electrical Materials	\$ 37,408
Site Electrical Labor	\$ 71,680
<b>Subtotal</b>	\$ 399,311
<b>30% Design+Const. Contingency</b>	\$ 119,793
<b>Total*</b>	\$ 520,000

*\*Rounded Up to Nearest \$1000. Assumes work provided by independent contractor. Does not include management, design, and inspection costs.*

### 6.2.3 Replace Three Existing Pumps with New 185-HP Units

The pump station would require a significant retrofit to replace current 90-HP pumps with 185-HP Flygt NP3231 pumps.

- Mechanical & Civil:
  - FLYGT Submersible Pump (185=HP FLYGT NP3231/ 716 3 ~ 480 310mm impeller trim). Existing pedestal, discharge, guide rails, and chains could likely be reused but would require confirmation from Flygt inspection.
- Miscellaneous:
  - Close slide gate and activate sewer bypass pumping (0.30 ADWF to worst case 3.0 MGD PWWF) from upstream vault for 2 months.
  - Drain wet well. Use opportunity to clean out FOG and debris.
- Electrical (not depicted in plan)
  - New conduit and cabling from Sump Termination Panel to Wet Well. Sump termination panel would require replacement.

- New conduit and cabling from Sump Termination Panel back to VFD Panel in electrical room
- Complete electrical rebuild in electrical room
  - VFDs
  - VFD enclosures/cabinets
  - MCC
- PGE Utility service upgrade and new conduits will need to be installed from the transformer to the main switchboard. Unknown if current transformer could be utilized.
- New larger standby generator. It is unknown if existing generator room could accommodate an upgraded generator.
- Perform review of PLC programming and OI/SCADA applications.

### Estimated Construction Costs

Conceptual engineering level estimated construction costs for this option are listed in Table 9.

**Table 9: 185-HP Replacement Pumps Estimated Construction Costs**

185-HP Replacement Pumps Estimated Construction Costs	
<b>Mechanical</b>	
Piping	\$ -
Valves	\$ -
Misc.	\$ -
<b>Civil</b>	\$ 20,000
<b>Miscellaneous (Bypassing Pumping, etc.)</b>	\$ 300,000
<b>Electrical</b>	
3x 185-HP Pumps	\$ 492,000
Meter/Main, ATS, Distribution, Switchboard	\$ 105,409
VFDs	\$ 268,254
PLC Panel (main)	\$ 155,218
Sump Termination Panel	\$ 18,323
instrumentation	\$ 53,463
SCADA System	\$ 35,280
Site Electrical Materials	\$ 213,717
Site Electrical Labor	\$ 143,360
Emergency Generator	\$ 180,000
Utility Costs - Estimate	\$ 117,302
<b>Subtotal</b>	\$ 2,102,326
<b>30% Design+Const. Contingency</b>	\$ 630,698
<b>Total*</b>	\$ 2,734,000

*\*Rounded Up to Nearest \$1000. Assumes work provided by independent contractor. Does not include management, design, and inspection costs.*