BergerABAM

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Memorandum

Date: 25 April 2018

Subject: Strander Boulevard Extension Phase 3, Stormwater Pump Station Design

From: Tom Wilcox, PE BergerABAM; Brittany Sorenson, PE BergerABAM

To: Ryan Larson, Senior Engineer, City of Tukwila Public Works Department

EXECUTIVE SUMMARY

This memorandum has been developed to illustrate the design concepts and conclusions for the expanded storm water and new groundwater pump stations included in the scope of work for the Strander Boulevard Extension Phase 3 Project (project).

The existing storm water pump station currently transports collected storm runoff and groundwater for the current project boundary to the water quality detention pond on the south side of Strander Boulevard. This pump station will be upgraded to accommodate the 25-year peak storm flow rates anticipated for the entire project area at the end of phase 3 construction. The existing pumps will be retained and relocated to allow space for a third equally sized pump within the current wetwell structure. Reconfiguration of the discharge manifold within the existing valve vault structure will require the placement of one new set of valves in line with the new pump. New controls and telemetry system and an expanded motor control center (MCC) will be installed per the City of Tukwila (City) standards and incorporated into their system.

Groundwater will be separated from the existing stormwater system by means of a newly constructed underdrain system. A seal placed along the entire roadway will greatly reduce the volume of groundwater that would need to be consistently removed from the site. Low volumes of groundwater infiltration through the seal anticipated at the groundwater pump station will allow for a compact system to be installed with minimal construction impacts. A wet well structure will be placed at the low collection point for the under drain system. Two pumps will be located within the wetwell to accommodate the range of estimated flows. These include a duty pump to provide transport at average flows and a peaking pump to convey groundwater at a higher rate if ever required. The pumps will run independently of each other with telemetry and controls installed in the existing stormwater pump station control building. All valves will be placed in-line within the wetwell structure to reduce footprint and eliminate the need for a separate valve vault. A force main will be constructed in the new roadway to transport groundwater from the new pump station to a discharge manhole that will be located near the existing water quality treatment pond. The ground water will combine with a portion of the treated storm water from the detention pond prior to discharging to the Green River via a

newly constructed outfall. Power needs will be adjusted at the existing pump station to account for the additional load created by a third pump at the stormwater wet well and the new groundwater pump station.

BACKGROUND AND UNDERSTANDING

Phase 3, to be completed by the City of Tukwila, includes connecting an undercrossing of the Union Pacific Railroad (UPRR) and a four-lane arterial connection of Southwest 27th Street to Strander Boulevard and to the West Valley Highway.

A Stormwater System Conceptual Design Report was completed April 2017 by BergerABAM for the City of Tukwila. This report summarized results of a study to develop design concepts for the roadway stormwater system to support full buildout of the extension of Stander Boulevard. The City of Tukwila, utilizing the design information submitted in the report, made the following decisions pertinent to the design of the stormwater and groundwater pump stations:

- Construction of watertight bottom seal and wall system for the entire length of the existing phase 2 project, as well as phase 3 extension.
- Separate groundwater pump station.
- Expanded storm water pump station.
- Discharge of combined ground water and a portion of the treated storm water to the Green River at the existing southern outfall.

This memorandum describes upgrades to the existing stormwater pump station to accommodate full buildout storm flows as well as a new groundwater pump station and force main to remove flows from the underdrain system collecting above the seal.

EXISTING CONDITIONS

The existing pump system receives combined stormwater and groundwater from the constructed Phase 2 roadway storm drains and underdrain system. The flows combine at a manhole prior to entering the existing pump station via a 36-inch-diameter inlet line. The pump station is located on the south side of Strander Boulevard and is a standard duplex submersible facility with two pumps installed in a concrete wet well. The wet well houses two 50 horsepower (hP) solids handling submersible pumps. The firm pumping capacity (one pump) is equivalent to the estimated peak runoff resulting from the 100-year, 24-hour storm event plus an allowance for groundwater which totals approximately 3,200 gpm. In the event one pump fails, the remaining pump can handle one hundred percent of the required flow. The pumps operate based on water levels in the wetwell. A check valve and isolation valve are installed in each discharge line to prevent backflow into the wetwell and to isolate each pump for maintenance. The discharge lines are manifold together prior to the force main. The manifold and valves are located in a below-ground valve vault next to the wetwell. The

stormwater is then conveyed through a meter vault where the flow is recorded and totalized before discharging to the flow splitter via a 24-inch-diameter force main.

Other components of the pump station include a building, which houses the MCC, programmable logic controller (PLC), telemetry equipment, and disconnect panels. The telemetry equipment was installed per the City of Renton's specifications and currently signals Renton of any high or low levels, overflows, pump failures, or loss of primary power occurrences. A 200-kilowatt (kW) dedicated standby generator in an outdoor enclosure provides backup power with a permanent load bank connected for periodic turnover. The major components of the existing pump station are summarized in Table 1.

Table 1: Existing Stormwater Pump Station Components

Pump Station	
Pump Station Type	Duplex Submersible
Design Storm	100–Year, 24-Hour Recurrence Interval
Design Duty Point/Firm Pumping Capacity[1]	3,200 gpm @ 35 Feet Total Dynamic Head (TDH)
Maximum Capacity[2]	5,800 gpm
Pump Motor Data	50 hP, 460 Volt, 3 phase, 1150 RPM
Pump Manufacturer and Model	Barnes 8XSE-HA w/ 12.5" Trimmed Impeller
Wetwell	10-foot Internal Diameter Pre-cast Concrete
Wetwell Storage Volume	588 Gallons/Foot
Pump Operating Volume	6,322 Gallons
Collection System Storage Volume	4,264 Gallons
Emergency Standby Power Generator	200 KW, Diesel
Fuel Volume Storage	336 Gallons
Discharge Manifold	12-inch Schedule 80 (FLG x PE or Welded)
Valve Vault	12-foot x 12-foot Pre-Cast Concrete
Force Main	
Length	160 Lineal Feet (LF)
Diameter	24-Inch
Material	CL 52 Ductile Iron Pipe
Flow Meter	20-inch In-line Magnetic

[1] Capacity of pump station with one pump held in reserve.
[2] Capacity of pump station with no pumps in reserve (both pumps operating in parallel).

DESIGN CRITERIA

Representatives of the design team met with City of Tukwila engineering staff on 13 February 2018 to establish the requirements for the Phase 3 pumping system. In general, expansion of the existing pump station should minimize construction impacts and cost. The design should incorporate the existing wetwell and pumps without the addition of new structures or other costly upgrades to increase capacity. Post-phase 2 construction, the City of Renton raised the pump operating levels in the wetwell to reduce the pump cycling frequency and is surcharging the upstream collection system to increase operating volume. This practice of surcharging the system to provide operating storage will eliminate the need for additional structures and has been approved by the City of Tukwila for the Phase 3 project.

Per the City of Tukwila's Infrastructure Design and Construction Standards, surface water design shall meet the recently updated 2016 King County Surface Water Design Manual (KCSWDM). The KCSWD requires storm pumping facilities to have a firm pumping capacity equivalent to the estimated peak run-off flow rate resulting from the 25-year, 24-hour storm event. The upgraded and expanded pump station will thus be designed with a firm pumping capacity equivalent to the estimated 25-year, 24-hour storm peak flow for the collecting area of the full project buildout. The pump station will have one hundred percent redundancy for flows up to this event. Flows in excess of this event will be met with all pumps running in parallel but with no redundancy.

The new groundwater pump station will remove groundwater collected from behind the new retaining walls at a rate that is projected to be significantly reduced from what is currently experienced due to the addition of a roadway seal. Since the groundwater pump station is collecting only groundwater, treatment can be bypassed and effluent can be pumped directly towards the outfall.

This project is in part federally funded and has to meet "Buy American" regulations. To this extent all new equipment and materials that are purchased with federal money must be domestically sourced to the extent possible.

PRELIMINARY BASIS OF DESIGN

Stormwater Pump Station

The estimated peak storm flow rates from the contributing Phase 3 areas were estimated using the methods set forth in the KCSWDM and are summarized in Table 2.

Table 2: Storm Water Predicted Peak Flow Rate (25-year, 24 hour storm)

Area	25-year, 24 hour Flow	Contributing Area
Strander	5588 gpm	4.78 acres
West Valley Highway	421 gpm	0.36 acres
Taco Bell & Jack in the Box[A]	61 gpm	**
Total Phase 3 Project	**6,070 gpm**	**5.14 acres**

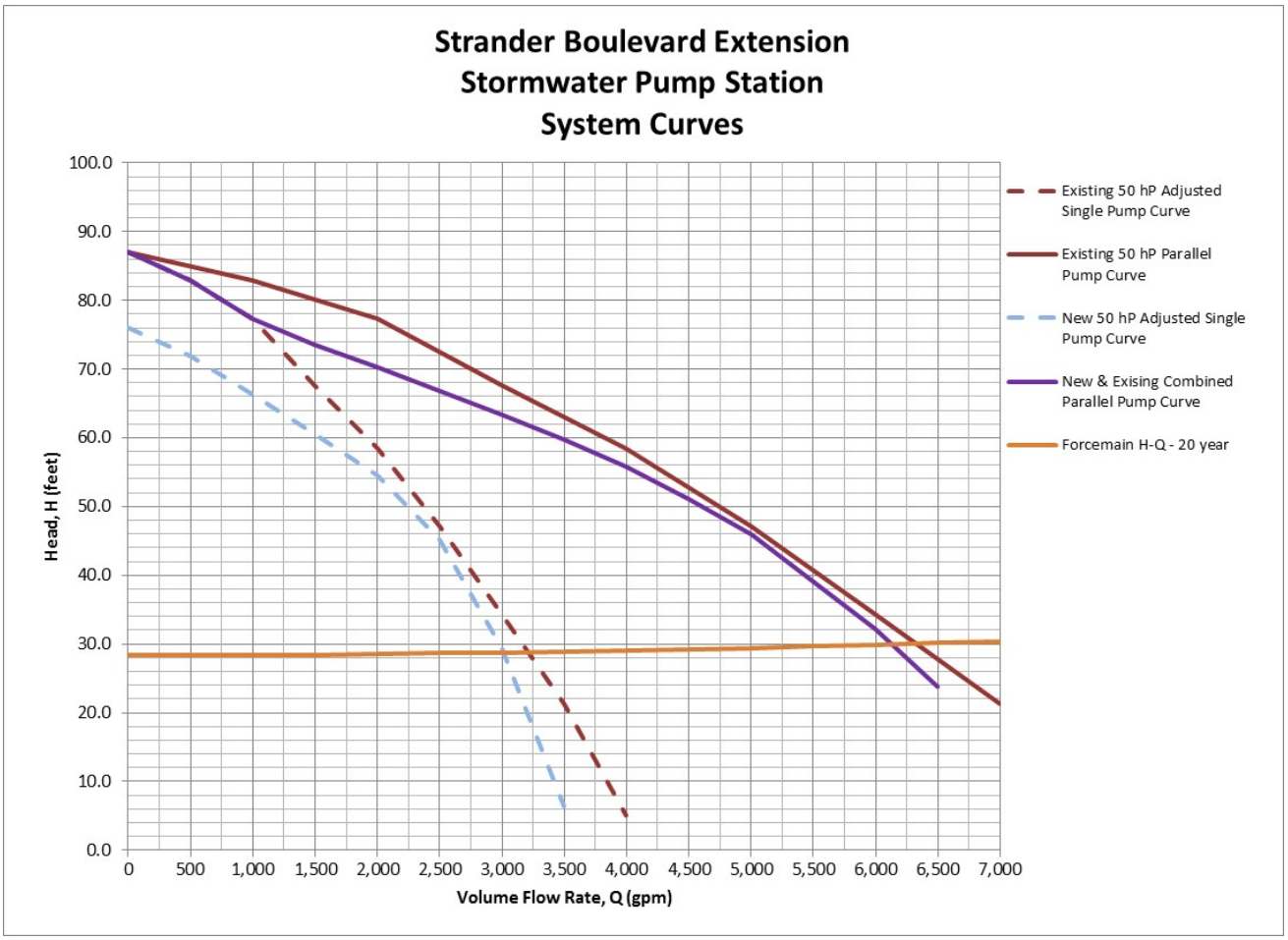
**diversion structures will direct portions of the Taco Bell runoff to the pond directly.
A – the 2 year water quality flow from these areas will be routed through the stormwater facility and into the detention pond for treatment.

Utilizing the anticipated peak flow rate of 6,070 gpm, a triplex pumping system was selected with two pumps maintaining a peak flow rate of approximately 3,050 gpm per pump with a third pump installed to meet redundancy requirements. The firm pumping capacity of 6,070 gpm will be met with two pumps running in parallel. Total dynamic head at each pump will remain approximately the same as the force main and discharge piping will remain the same.. The duty point for pump selection is 3,050 gpm at 35 feet total dynamic head.

The existing 50 hP Barnes 8XSE-HA pumps have been in operation since the completion of phase 2 in 2014. The designed duty point for both pumps is 3,200 gpm at 35 feet total dynamic head, which more than accommodates the anticipated future peak flows per pump. City of Renton operations staff reported no major issues with the current pumps and they perform regular maintenance to ensure they continue to function properly. This project will retain both pumps. However, since the completion of phase 2, Barnes has rendered the 8XSE model obsolete so the new third pump will have different performance characteristics. The preliminary selection for the third pump is a Barnes series 8XSHTM submersible pump with a 50 hP motor. motor. This selection was made as the performance curve most closely matches the existing pumps. The Barnes brand retains commonality with the existing pumps and meets the Buy American requirements of this project. The frame is slightly smaller than the existing pumps so all three pumps will fit inside the existing 10 foot diameter wet well with spacing that meets Hydraulic Institute (HI) standards.

Figure 1 represents anticipated system curves depicting two scenarios. These include the two existing pumps running in parallel and the new pump running in parallel with one existing pump. As can be seen the estimated Phase 3 storm water design flow is attainable with the selected configuration.

Figure 1 – Phase 3 Stormwater System Curves



Installing a third pump will require the reconfiguration of the wetwell and valve vault to accommodate the addition of a third discharge pipe and valves. Existing discharge piping will be salvaged with the two existing pumps. The third pump will require the installation of new 12″ discharge piping and appurtenances as well as a 12″ swing check valve and plug valve. The discharge will manifold together and connect to the existing 20-inch manifold. The existing flow meter will remain as will the 24-inch force main which directs flow to the water quality facility. The anticipated flow rates through the pump discharge, existing manifold and existing force main are shown in Table 3.

Table 3 Stormwater Pump Station Discharge

	Pump Discharge	Manifold	Force Main
Pipe Length	41 feet	31 feet	187 feet
Pipe Material	Schedule 80 SS	DI Class 53	DI Class 53
Pipe Nom. Diameter	12-inch	20-inch	24-inch
Flow Velocity	9.6 fps	5.8 fps	4.0 fps

The current pump controller, telemetry panel, and SCADA are installed per the City of Renton's standards. Replacement equipment, provided by Rugged, will be installed in the existing control building per the City of Tukwila's standards. The new controls will incorporate a third pump and settings will be adjusted to cycle pumps accordingly. New conduit will be installed in the existing cable trench to provide power to the third pump as well as an upgraded load bank. The existing standby generator and load bank may be replaced although this determination will be made during final design. The need for soft starters will also be evaluated during final design.

Groundwater Pump Station

The design of the groundwater pump station will be optimized to reduce construction costs and footprint. The original design of the groundwater pump station, as described by the Stormwater System Conceptual Design Report (BergerABAM 2017), recommended converting an existing manhole into a wetwell by installing two submersible pumps and a valve vault to house the check and isolation valves. Due to recent design changes to the roadway, the manhole selected to become the groundwater pump station will need to be relocated and the collection system reconfigured to accommodate the seal.

A new location for the groundwater pump station was selected to ensure maintenances access would be provided and the underdrain system could connect at the lowest point in the system. Following original concept design for the groundwater pump station, a 48-inch manhole will be installed to collect the gravity feed from the underdrain system. The pump station will be located at the southeast corner of the intersection of Strander Boulevard and the beginning of the ramp transition to connect to the Tukwila Station Access Road. This position is in close proximity to the existing stormwater pump station and allows for the installation of a standard manhole at a depth easily constructed and maintained.

With the installation of the seal across the entire roadway, the groundwater pump station in theory should receive little to no incoming groundwater. The underdrain system will provide a conduit for the removal of groundwater should any migrate through the seal. Preliminary estimations of groundwater inflow for the entire underpass are low, ranging from 0.5 gpm to 5.0 gpm. This assumes a standard amount of care during construction and maintenance during

the life of the structure to address cracks that could produce water. Experience gathered from construction of phase 1 and 2 as well as high groundwater levels in the construction area require the consideration of the possibility of higher flow rates in the event the seal is compromised. For this reason, the pump station will be equipped with a pumping system capable of handling flows from 5 gpm to 100 gpm.

Due to the limited space available in the roadway corridor, check and isolation valves will be placed inside the wet well to avoid a separate valve vault. The force main will consist of approximately 245-feet of 3-inch pipe. Pump selection will be based on the following duty points: 5 gpm at 20 feet total dynamic head (TDH) for the duty pump and 100 gpm at 26 feet TDH for the peaking pump. Velocities anticipated through the force main at these peak flow rates are shown in Table 4.

Table 4 Groundwater Pump Station Discharge

	Pump Discharge	Force Main
Pipe Length	5 feet	245 feet
Pipe Material	Schedule 80 SS	DI Class 53
Pipe Nom. Diameter	3-inch	3-inch
Flow Velocity at 5gpm	0.24 fps	0.18 fps
Flow Velocity at 100gpm	4.9 fps	3.7 fps

The smaller pump will act as the duty pump. The larger pump will act as the reserve pump and handle peak flows in excess of 5 gpm up to 100 gpm. Float levels will be set to keep pump starts to a maximum of ten cycles per hour. The 48-inch manhole can store 94 gallons per foot. The 5 gpm pump will only require 0.35 feet of storage to reduce starts. The 100 gpm pump will kick on when the underdrain system is surcharged and levels within the manhole reach the lag pump float.

Long retention times with subsequent bacterial growth will foul pumps and pipes, and reduce the overall efficiency of the groundwater. Therefore, it is recommended that the 100 gpm pump be cycled intermittently to ensure flushing velocity of the force main is achieved to prevent settling of solids and limit detention times.

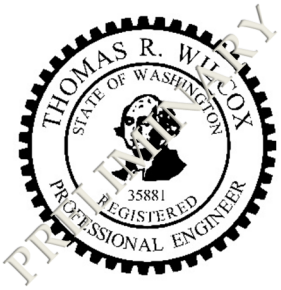
A discharge manhole will be placed at the end of the force main and will gravity feed via 12-inch HDPE approximately 75 feet to the connection manhole downstream of the treatment facility where it will gravity flow to the outfall.

A local hands-off-auto controller and disconnect panel will be placed next to the groundwater pump station to facilitate maintenance. Telemetry and automatic pump controls will be installed at the existing storm water pump station building. Power will be sourced from the existing stormwater pump station building. The new ground water pump station will share standby power with the storm water pump station.

PROJECT ENGINEER'S CERTIFICATE

I hereby certify that this Pump Station Design Memo for the Strander Boulevard/ Southwest 27th Street Extension Phase 3 project has been prepared by me or under my direct supervision and meets minimum standards of care and expertise, which is usual and customary in this community for professional engineers. I understand that the City of Tukwila does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

Reviewed by,



Tom Wilcox, PE
Project Manager