Preliminary Engineering Report

Tellico Village Property Owners Association

Tellico Village Wet Weather Storage Tank Alternatives Analysis
October 2022

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Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
BMP	best management practices
BOD	basis of design
DWF	dry weather flow
gpm	gallons per minute
hp	horsepower
HVAC	heating, ventilation, and air conditioning
kVA	kilovolt-ampere
kW	kilowatt
LUB	Loudon Utility Board
msl	mean sea level
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PLC	Programmable Logic Controller
PVC	polyvinyl chloride
RDII	rainfall-dependent inflow and infiltration
RGS	rigid galvanized steel
TDEC	Tennessee Department of Environment and Conservation
TDH	total dynamic head
TVPOA	Tellico Village Property Owners Association
v	volt
VFD	variable-frequency drive
WWF	wet weather flow

1. Introduction

Tellico Village Property Owners Association (TVPOA) collects wastewater flow from its service area of approximately 8 square miles and pumps it into the Loudon Utilities Board's (LUB) Care Inn Lift Station. TVPOA's collection system operates as a pressure system consisting of 84 miles of pressure sewers and 12 lift stations that do not include the Kahite system to the south. A scope of work for a separate model and master plan has been submitted to evaluate the Kahite system.

As a part of ongoing efforts to improve its sanitary sewer collection system, TVPOA has created a hydraulic model and master plan of its system. Identified in the master plan were several projects to improve the system and alleviate peak wet weather flows during rain events. One such project includes evaluating the installation of a peak wet weather storage facility at the Main Lift Station site.

This preliminary engineering report includes work to perform an alternatives analysis to evaluate four alternatives described in the following sections. The work includes hydraulic analysis and preliminary site planning for the following alternatives:

- Alternative No. 1 – New wet weather storage tank using the existing Main Lift Station.
- Alternative No. 2 – New wet weather storage tank with a new Main Lift Station.
- Alternative No. 3 – New wet weather storage tank with modifications to the existing Main Lift Station.
- Alternative No. 4 – New wet weather storage tank using the existing Toqua and Tanasi pumps and force main.

2. Existing Facilities

2.1 Location Map

The Main Lift Station is on the east side of Tellico Parkway, south of Sequoyah Road, as shown in Figure 2-1 and Figure 2-2. The entrance drive for the pump station is off Sequoyah Drive.

Figure 2-1. Main Lift Station Location Map

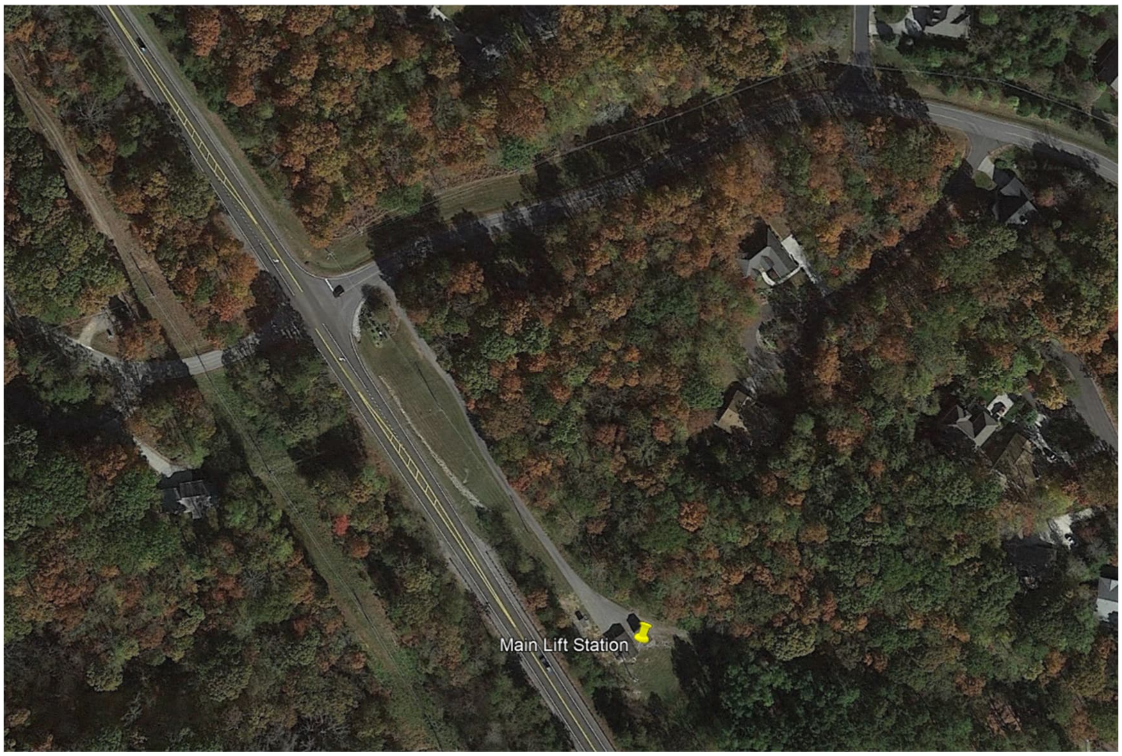
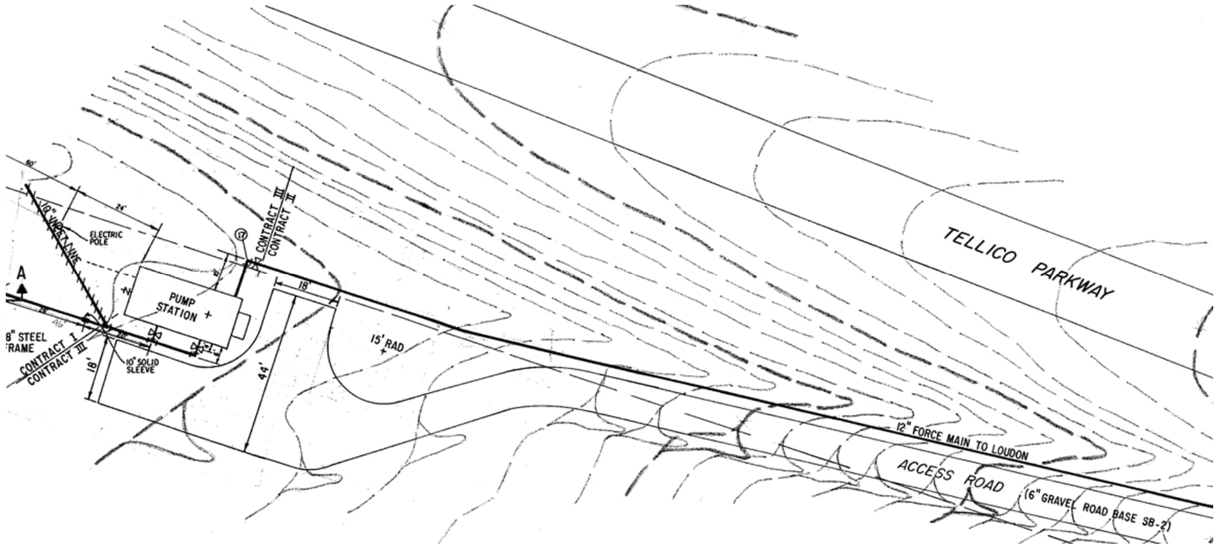


Figure 2-2. Main Lift Station Site Plan

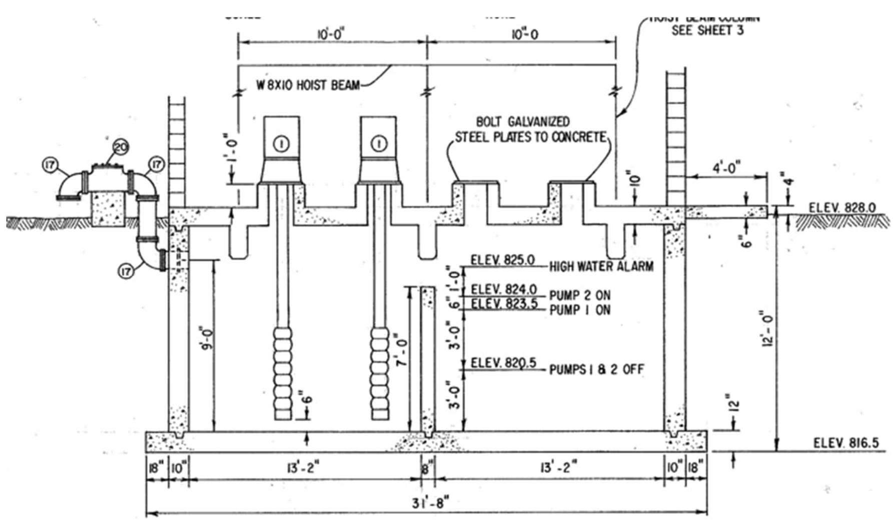


2.2 Evaluation

2.2.1 Building/Structure

The Main Lift Station was constructed in the 1980s as part of the original Tellico Village sewer collection system. The pump station consists of a 28'-8" by 14'-0" concrete block building with a wood frame roof and wood exterior siding over a dual chamber cast-in-place concrete wetwell. The interior pump station concrete floor elevation is at approximately 828.33 feet mean sea level (msl) and the wetwell bottom elevation is at 817.33 feet msl. The 12-inch inlet sewer enters the wetwell at approximately invert elevation 824.50 feet msl. The wetwell is separated into two chambers by a 7'-0" tall dividing wall that extends up to 824.33 feet msl. The wetwell has been lined with a sealant to slow concrete deterioration and to prevent groundwater flow into or wastewater flow out of the wetwell. Figure 2-3 shows a cross section of the wetwell section.

Figure 2-3. Main Lift Station Wetwell Section



2.2.2 Process Mechanical

The TVPOA Main Lift Station receives flow from all the other collection system pump stations and is the primary means for conveying flow to LUB for treatment. This station currently has two KSB-brand pumps that convey flow through a 12-inch force main to the Care Inn Lift Station operated by LUB. It was determined that the existing 12-inch force main discharge was modified at some point by LUB. The existing 12-inch line discharged into a Parshall flume. The modification eliminated this flume and ran a new 8-inch pipe approximately 950 linear feet into the Care Inn Lift Station, which is manifolded into the Care Inn 12-inch force main.

The Main Lift Station was originally constructed with dual 500-gallon per minute (gpm), 50-horsepower (hp) vertical turbine pumps. Those pumps were later replaced with dual 150-hp, constant speed, KSB submersible pumps that have trimmed impellers and pump approximately 800 gpm depending on discharge head conditions.

Figure 2-4 shows the upper floor of the Main Lift Station with the dual pumps.

Figure 2-4. Main Lift Station Upper Floor

2.2.3 Electrical

The incoming service from the electrical utility is an overhead distribution that connects to a 480-volt (v) switchboard. The switchboard powers the existing equipment, including a panelboard(120 v) via a 5-kilovolt-ampere (kVA) transformer, two existing pumps, and the air conditioning unit. Currently, the existing pump station does not have a backup power supply located onsite.

2.2.4 Instrumentation and Controls

The existing pump station is monitored and controlled using a packaged controller from US Filter (model D152). The existing wetwell is monitored and displayed by the controller and the pumps are started/stopped using level setpoint sliders as set by operations on the US Filter controller. Some signals appear to be monitored remotely using a Mission-brand telemetry panel.

The existing US Filter D152 controller seems to have been discontinued, so new controls will use a different means of pump control. There are similar packaged control systems available or a unified, customized control panel can be included in the design. Similarly, the Mission telemetry system can be expanded to include new signals or can be integrated into the new control panel customized for monitoring and control of the pump station and tank. A customized solution would use a programmable logic controller (PLC), a local touchscreen operator interface terminal, and communication equipment such as radio, cellular, or fiber optic technology depending on availability and signal strength. The station is monitored using a Mission M800 unit, which allows TVPOA to monitor parameters such as wetwell depth, system voltage, pump run times, pump starts, discharge pressure, and pump station alarms.

3. Need for the Project

3.1 Wet Weather Flow

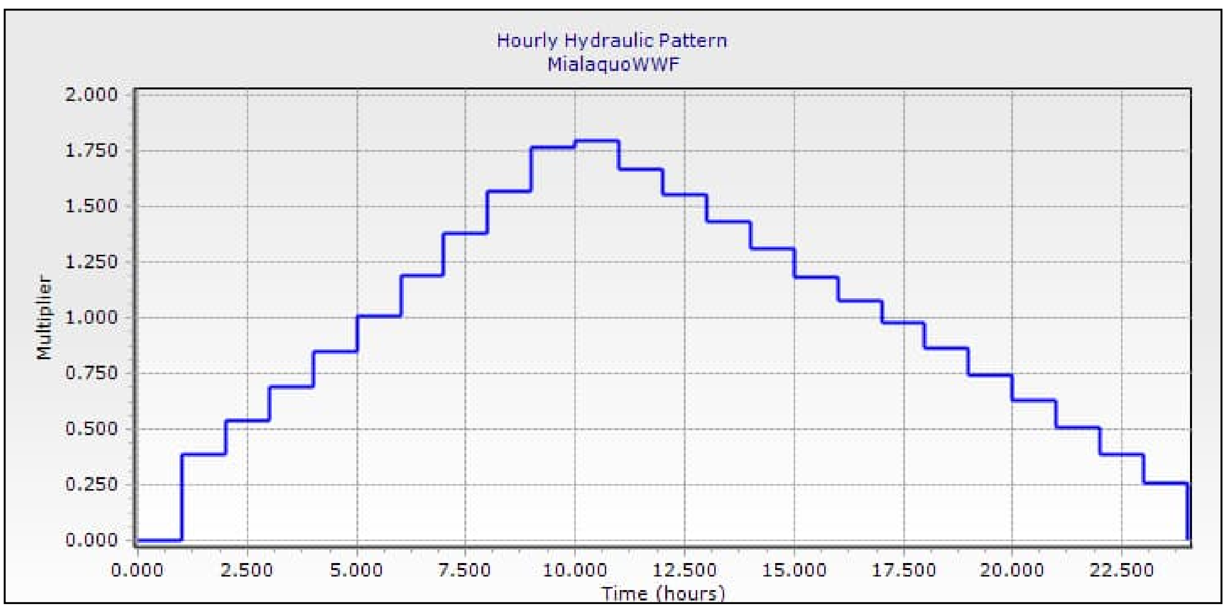
During dry weather flow (DWF) conditions, the Main Lift Station operates one pump at a time, but both pumps run to convey flow during wet weather. The pumps do not currently meet the firm capacity (one pump is out of service), since both pumps must run during wet weather flow (WWF). During a previous drawdown study, a notable pressure surge was observed in the pump discharge piping. While the Main Lift Station does have a surge valve installed, the surge requirements should be evaluated as part of any improvements at the pump station.

LUB does not guarantee available capacity for TVPOA, and LUB has historically had capacity concerns at the Care Inn Lift Station based on overflowing near the facility. Alternative solutions have been discussed with TVPOA personnel, which includes reducing the rainfall-dependent inflow and infiltration (RDII) flow into the system and incorporating storage at the Main Lift Station. A wet weather storage facility not only allows for improved operation during WWF conditions, but it also will allow for improved operational redundancy in the event of a force main break during DWF.

3.2 Inflow and Infiltration

Wastewater storage tanks are used to store excess flow coming into a pump station. Tank sizing assumes that the difference between the future WWF and future DWF volumes over a 24-hour period at the Main Lift Station will be stored. These future scenarios were developed as part of the *Collection System Modeling and Master Plan*. As described in the master plan report, a design storm is not used for the WWF model scenario. Instead, a hydrograph was developed for each lift station service area that gradually increases over 12 hours to the peak flow and then recedes for 12 hours to simulate typical RDII. Peak flows were calculated from pressure logger data at the system lift stations. A sample WWF hydrograph is presented in Figure 3-1.

Figure 3-1. WWF Sample Hydrograph



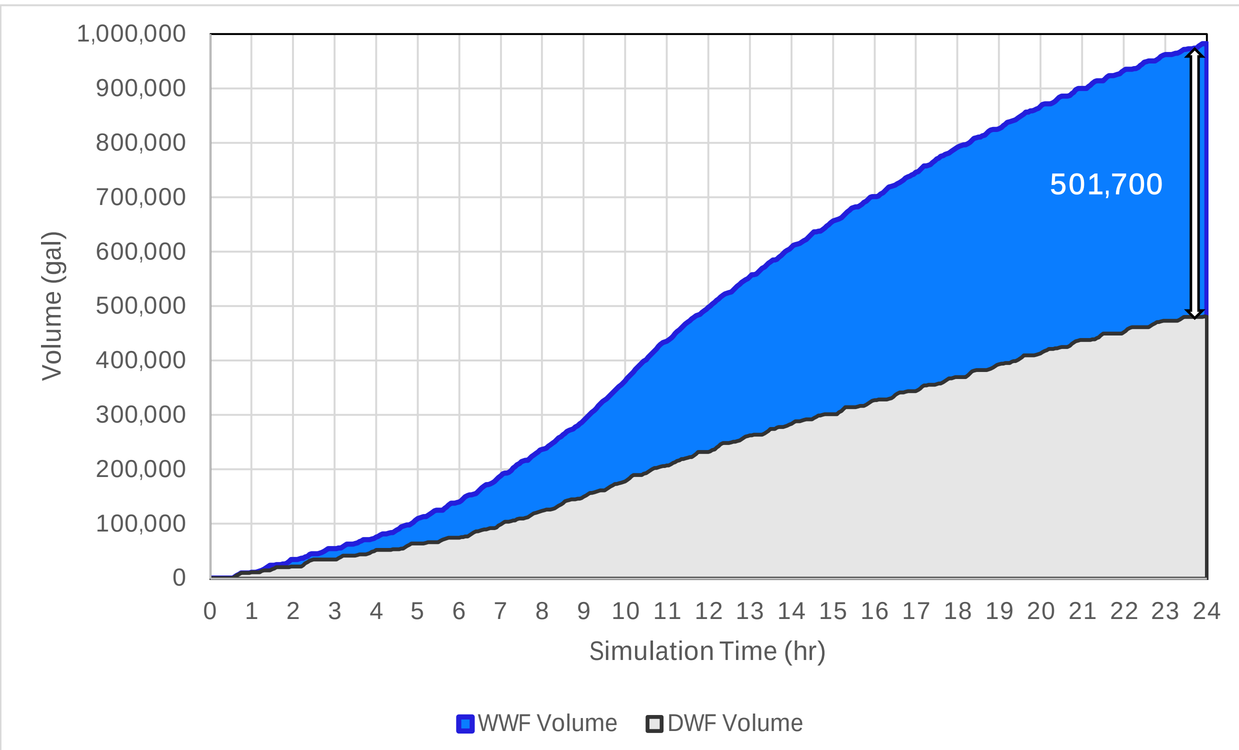
The future model scenarios also assume the other lift stations in the system have been updated (if needed) with the recommended solutions shown in Table 3-1.

Table 3-1. Future Model Scenario Pump Capacities

Lift Station	Model Operating Point
Mialaquo	350 gpm @ 35 feet
Toqua	700 gpm @ 100 feet
Tanasi Cove	325 gpm @ 170 feet
Tanasi Shores	250 gpm @ 57 feet (existing)
Main	800 gpm @ 220 feet (existing)

During the future DWF scenario, 480,940 gallons enter the Main Lift Station, and during the future WWF scenario, 982,640 gallons enter the Main Lift Station. The difference between the WWF and DWF indicates that there is a difference of about 501,700 gallons that would need to be stored to keep flow leaving the Main LS to LUB from increasing during WWF. Figure 3-2 shows the difference in volume between the two model scenarios.

Figure 3-2. Future Model Scenario Main Lift Station Difference in Volumes



3.3 Aging Infrastructure

The Main Lift Station was originally constructed in the 1980s. While the pumps have been replaced in recent years, other main components of the pump station (building, electrical switchgear, and heating, ventilation, and air conditioning [HVAC]) are aging and approaching the end of their useful lives.

4. Alternatives Considered

Four primary alternatives were considered to convey flow to LUB and store the remaining peak design flow:

- Alternative 1 – Upgrade the existing Main Lift Station
- Alternative 2 – Construct a new Main Lift Station
- Alternative 3 – Expand the existing Lift Station
- Alternative 4 - Install the wastewater storage tank upstream of the existing Main Lift Station and use the existing Toqua and Tanasi pumps to pump into the storage tank.

Some overarching notes related to the alternatives:

- In each alternative the Main Lift Station pumps will have a design point of 800 gpm at 223 feet total dynamic head (TDH) and be equipped with new variable-speed drives.
- Two pumps (one duty, one standby) will convey sewage to LUB via the existing downstream force main and will be called force main pumps.
- All alternatives include new variable-frequency drives (VFDs) to modulate the force main pump speed to maintain the wetwell level.
- When the inflow exceeds the pump capacity of 800 gpm, the force main pump wetwell will overflow to the tank feed pump wetwell, and the tank feed pump will convey the overflow to the storage tank.
- When the peak flow passes, the force main pump wetwell will drop to the low low level and the tank return valve will open to allow the sewage to gravity flow back to the force main pump wetwell. The control valve will be modulated by an electric actuator to maintain the force main pump wetwell water level.
- All pump station improvements will include a diesel engine backup generator and Automatic Transfer Switch (ATS) for emergency power, a new electrical switchboard, and provisions for future odor control.
- A storage facility will be provided for all the alternatives to store the peak flow, which will include a storage tank, two pumps for pumping to the storage facility, and a return control valve station. The design criteria of the facility are listed in Table 4-1 and a rendering of the proposed storage tank is shown in Figure 4-1.

Table 4-1. Storage Facility Design Criteria

Item	Description
Storage Tank	
Type	Pre-stressed Concrete Tank
Manufacturers	CROM, PRECON
Dimensions	75 feet diameter. 25 feet tall
Number	One
Volume	750,000 gallons (nominal)
Tank Feed Pumps	
Type	Submersible Centrifugal
Manufacturer	KSB
Design Point	700 gpm at 45 feet TDH

Item	Description
Motor	15 hp, variable speed
Number	Two (one duty, one standby)
Tank Return Control Valve	
Type	Electrically actuated plug valve
Manufacturer	DeZurik
Flow Range	100 gpm to 700 gpm
Pressure Drop Range	0.5 psi to 12 psi
Size	6-inch
Number	One

Figure 4-1. Rendering of Proposed Concrete Wastewater Storage Tank

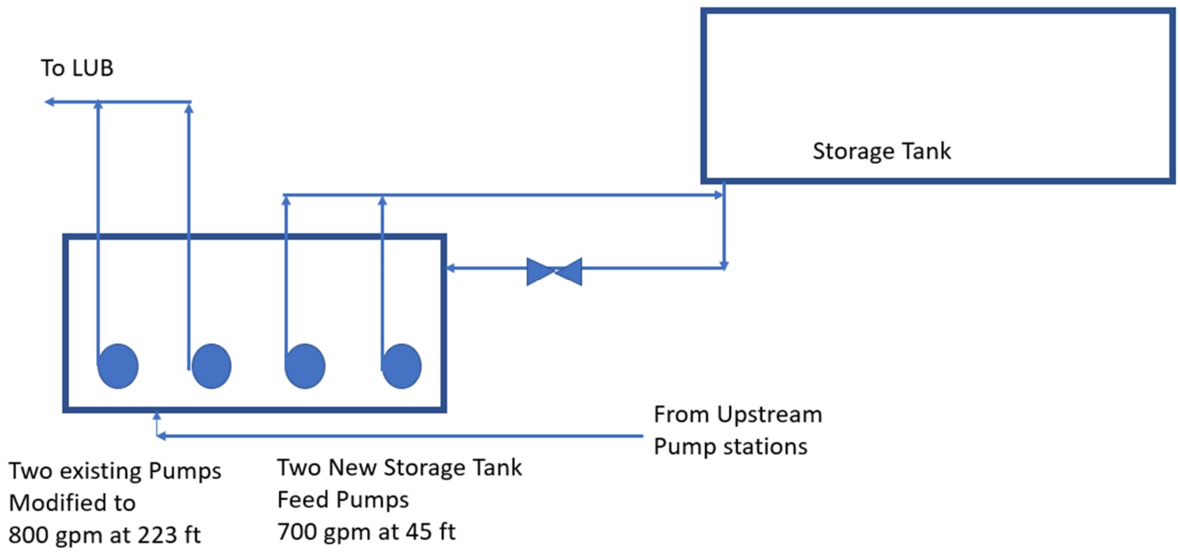
4.1 Pump Station Alternatives

4.1.1 Alternative 1 – Upgrade the Existing Main Lift Station

4.1.1.1 Description

Alternative 1 includes using the existing wetwell structure to house both the force main pumps and the new tank feed pumps. The existing wetwell has two chambers. One will be used for the storage tank feed pumps and the other for the force main pumps that conveys sewage to the LUB. The existing wet well has recently been rehabilitated utilizing a Spectrashield polyurea coating. Error! Reference source not found. describes advantages and disadvantages of this alternative and Figure 4-2 shows the schematic for the alternative.

Figure 4-2. Alternative 1 Schematic



4.1.1.2 Pump Station

For this configuration, the force main pump chamber will receive the flow from upstream pump stations. When the inflow exceeds the force main pump capacity, the chamber overflows over the dividing wall to the tank feed pump chamber and the tank feed pump will start. This is the least expensive alternative and requires the smallest amount of real estate.

The existing 12-inch discharge header and individual discharge pipes and valves will be used for the force main pumps. One pump and its associated piping and valve will be relocated. A 12-inch magnetic flowmeter will be installed on the discharge header outside of the building. The flowmeter will be a Proline Promag W 400 or similar type that requires minimal or no straight pipe runs.

The discharge pipe of the storage tank feed pumps will be 8-inch ductile iron pipe. Each pump will be equipped with lifting chains and lifting rails, a check valve, and a plug valve. A magnetic flowmeter will be installed on the discharge header to monitor the flow rate and volume diverted to the storage facility.

4.1.1.3 Electrical

With this alternative it is assumed that the existing switchboard can be modified for new breakers to be installed. The existing switchboards will power two 148-hp pumps and two15-hp pumps. All pumps are being powered via new VFDs. The existing switchboard can be fed from existing utility lines or a new 175-kilowatt (kW) generator via a new ATS.

Table 4-2. Alternative 1 - Advantages and Disadvantages

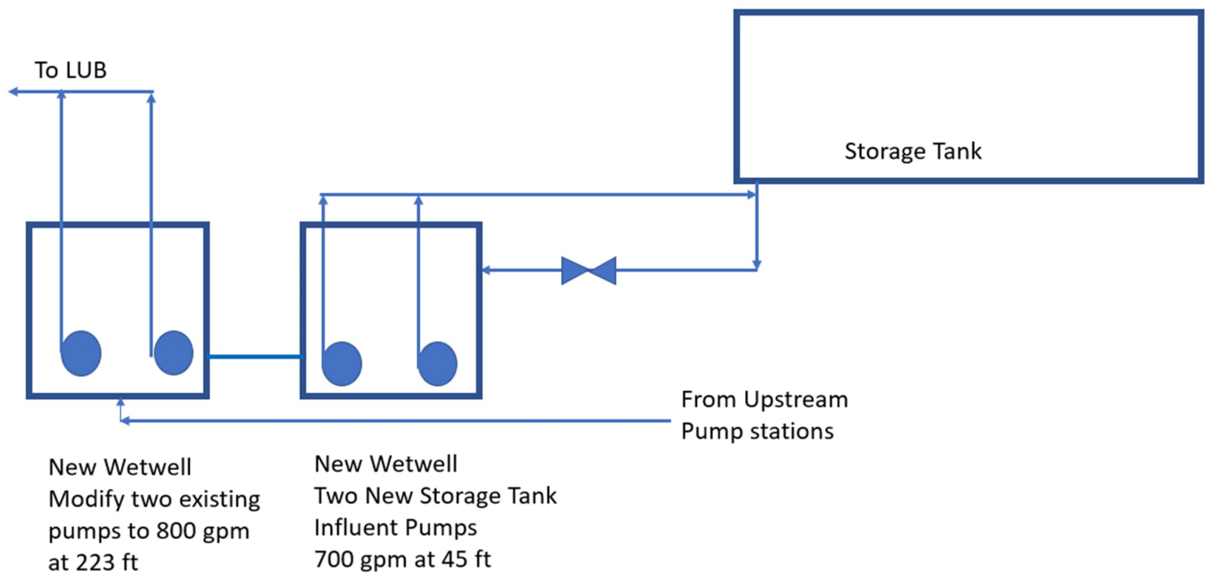
Advantages	Disadvantages
▪ Lowest upfront capital cost. ▪ Utilizes existing pump station "as-is." ▪ Operation of the facility is consistent with existing approaches (less change as compared to other alternatives). ▪ Smallest footprint because it uses existing wetwell and building.	▪ Relies on continued use of 35- to 40-year-old existing structures. The wetwell has been rehabilitated, but it will likely need further rehabilitation or renewal within the life cycle of Alternative 2. ▪ Relies on old mechanical and valve piping ▪ Requires close coordination to maintain operation during rehabilitation and upgrades; could require bypass pumping

4.1.2 Alternative 2 – Construct a New Main Lift Station

4.1.2.1 Description

Alternative 2 includes a new Main Lift Station to include two new wetwells. One structure will house the force main pumps and a new wetwell will house the tank feed pumps for the peak flow. This alternative also includes a new electrical control building. Error! Reference source not found. describes advantages and disadvantages for this alternative and Figure 4-3 shows the schematic for this alternative.

Figure 4-3. Alternative 2 Schematic



4.1.2.2 Pump Station

The new main wetwell will be approximately 9 feet in diameter, 10 feet deep, and house two new 148-hp main pumps that convey sewage to the LUB. The new wetwell that will house the new 15-hp storage tank feed pumps will be approximately 8 feet in diameter and 10 feet deep. The force main pump wetwell will receive the flow from upstream pump stations. When the inflow exceeds the force main pump capacity, the wetwell overflows via a pipe to the tank feed pump wetwell and the tank feed pump will start. This is the most expensive alternative and requires the largest amount of real estate.

The discharge pipe for each set of pumps will be 8 inches. Each pump will be equipped with lifting chains and lifting rails, a check valve, and a plug valve. A magnetic flowmeter will be installed on each discharge header.

4.1.2.3 Electrical

A new switchboard will be installed to power two new 148-hp pumps and two15-hp pumps. All pumps are being powered via new VFDs. The new switchboard also provides power to a new 120-v/208-v panelboard via a new transformer to power the building loads. It is assumed that the new building will be provided with HVAC.

The new switchboard can be fed from existing utility lines or a new 175kW generator via a new ATS.

Table 4-3. Alternative 2 – Advantages and Disadvantages

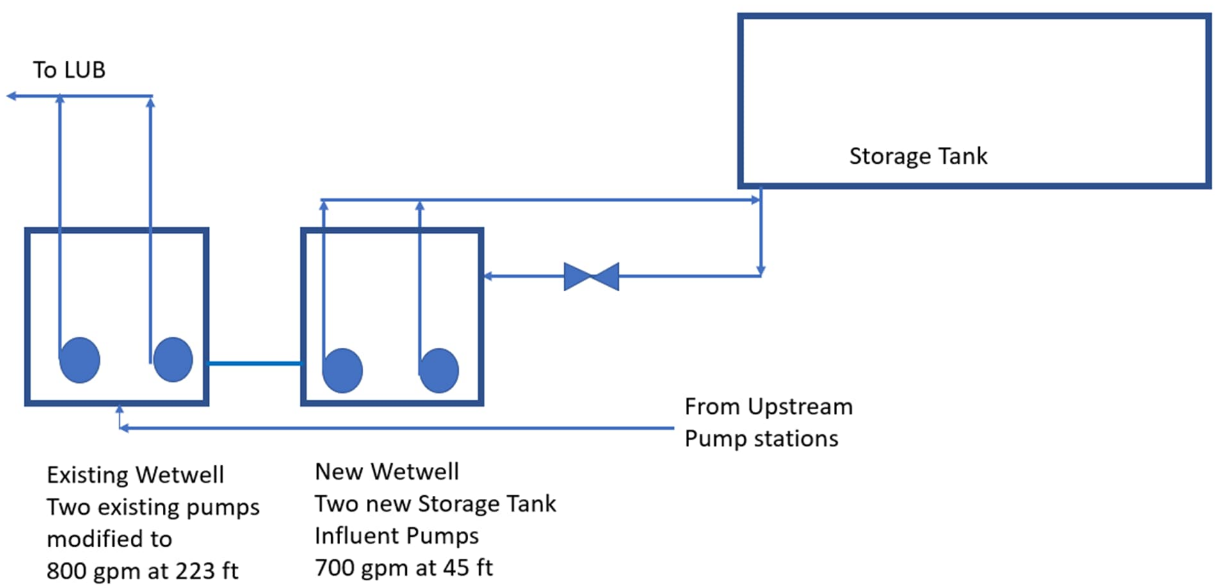
Advantages	Disadvantages
▪ Renews pump station assets (not reliant on concrete assets at or beyond end of useful life). ▪ Fewer operational disruptions during construction. ▪ Best alternative for operation and maintenance (ease of pump/piping/valves access and removal). ▪ Minimizes bypass pumping during construction.	▪ Highest upfront capital cost. ▪ Greatest impact to public during construction (more expansive and visible construction). ▪ Site layout may not be ideal based on the location of existing structures.

4.1.3 Alternative 3 – Expand the Existing Main Lift Station

4.1.3.1 Description

This alternative is a compromise between Alternatives 1 and 2. For this alternative, the existing Main Lift Station will be kept and will convey sewage to LUB via the downstream force main. A new storage tank feed pump station will be installed to receive the overflow from the existing wetwell. Error! Reference source not found. describes advantages and disadvantages for this alternative and Figure 4-4 shows the schematic for this alternative.

Figure 4-4. Alternative 3 Schematic



4.1.3.2 Pump Station

For this configuration, the force main pump chamber will receive the flow from upstream pump stations. When the inflow exceeds the force main pump capacity, the chamber overflows to a new tank feed pump wetwell. The tank feed pumps will start to convey flow to the tank based on the wetwell level.

The discharge pipe of the storage tank feed pumps will be 8-inch ductile iron pipe. Each pump will be equipped with lifting chains and lifting rails, a check valve, and a plug valve. A magnetic flowmeter will be installed on the discharge header to monitor the flow rate and the volume diverted to the storage facility.

For the existing force main pumps, a 12-inch magnetic flowmeter will be installed on the discharge header outside of the building. The flowmeter will be a Proline Promag W 400 or similar type that requires minimal or no straight pipe runs.

4.1.3.3 Electrical

With this alternative, it is assumed that the existing switchboard can be modified for new breakers to be installed. The existing switchboards will power two 148-hp pumps and two15-hp pumps. All pumps are being powered via new VFDs. The existing switchboard can be fed from existing electrical utility lines or a new 175-kW generator via a new ATS.

Table 4-4. Alternative 3 – Advantages and Disadvantages

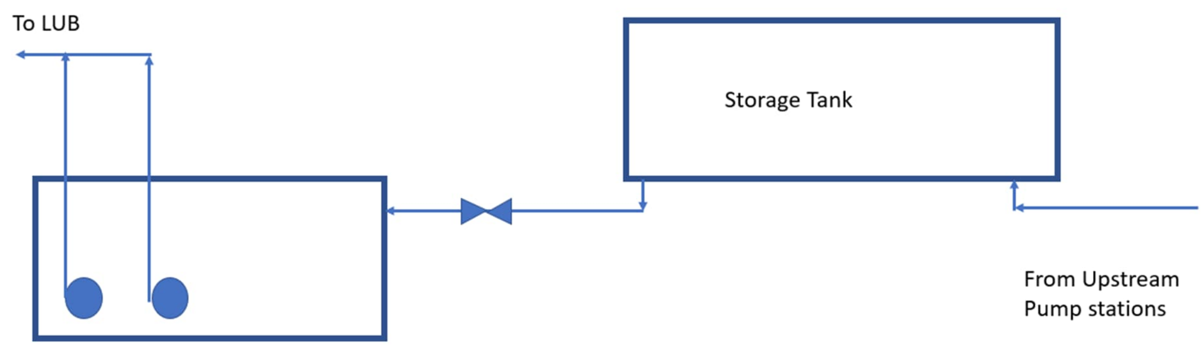
Advantages	Disadvantages
▪ Fewer operational disruptions during construction. ▪ Operations and maintenance consistent with existing approaches, with a wet weather pump removal process because of the new wetwell. ▪ Construction phase has fewer impacts than Alternative 2 (New Main Lift Station). ▪ Access to valve piping in gallery is improved over Alternative 1 (Upgrade the Existing Main Lift Station)	▪ Relies on continued use of 35- to 40-year-old existing structure. The wetwell has been rehabilitated, but it will likely need further rehabilitation or renewal within the life cycle of Alternative 2.

4.1.4 Alternative 4 – Install the Wastewater Storage Tank Upstream of the Existing Main Lift Station and Use the Existing Toqua and Tanasi Pumps to Pump into the Storage Tank

4.1.4.1 Description

In this alternative, there is no need for the storage tank feed pumps; instead, all inflow gets pumped to the storage tank via a control valve on the existing force main. Error! Reference source not found. describes advantages and disadvantages for this alternative and Figure 4-5 shows the schematic for this alternative.

Figure 4-5. Alternative 4 Schematic



There are several significant problems with this alternative.

1. The upstream pumps, at the Toqua and Tanasi pump stations, need to generate higher head (pressure) to flow to the tank. The pumps will need to be replaced and the electrical systems will need to be upgraded.

2. In addition to the Toqua and Tanasi pump station improvements, all household grinder pumps that currently pump directly to the Main Lift Station also will need to be replaced with higher head units because the system head curve will change, causing the individual grinder pumps possibly to operate outside of their curves.

3. Instead of pumping the excessive flow during peak flow to the tank as in other alternatives, all the flow will be pumped to the tank all the time, which will create higher energy consumption.

4. The tank will always have sewage so the potential for odor generation is much higher than with the other alternatives.

Table 4-5. Alternative 4 - Advantages and Disadvantages

Advantages	Disadvantages
▪ No need for tank feed pumps.	▪ Need to replace all upstream pumps. ▪ Higher energy cost. ▪ Higher odor potential. ▪ Likely to have an impact on operation point of individual septic-tank effluent pumping (STEP) system pumps. Increased pump size will change system hydraulic curve.

Based on the significant disadvantages noted previously, this alternative was not retained for further evaluation. A cost estimate was not done for this alternative.

5. Construction Cost Estimates

A preliminary cost estimate was developed for each retained alternative. The costs represented in Table 5-1are construction costs only and do not include design services, geotechnical exploration, upgraded foundation requirements because of unsuitable soils or retaining walls.

The concept level cost estimates were prepared from project descriptions provided to the estimating team, and cost estimates for major equipment obtained from potential vendors. The information provided represents a level of project definition of between 2% and 5%, consistent with a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International. A Class 5 estimate has an accuracy range of +50% to -30%. Based on the level of detail and assumptions made in preparing the estimates to increase the level of project definition, and the routine nature of the work, a project contingency of 30% has been applied.

These costs are based on conceptual-level information and intended for alternative comparison and screening purposes only. The overlapping ranges are close, with Alternative 1 and Alternative 3 being considered equal in terms of construction costs. Therefore, the nonmonetary factors (advantages and disadvantages) should be used to select the best fit alternative for the TVPOA. Alternative 2 has the highest construction cost because of the need to build a new wetwell, valve vault, and new electrical buildings. However, as noted in [a] Costs are presented in millions of 2022 U.S. dollars.

Figure 5-1, there is still overlap within the definition of a Class 5 estimate.

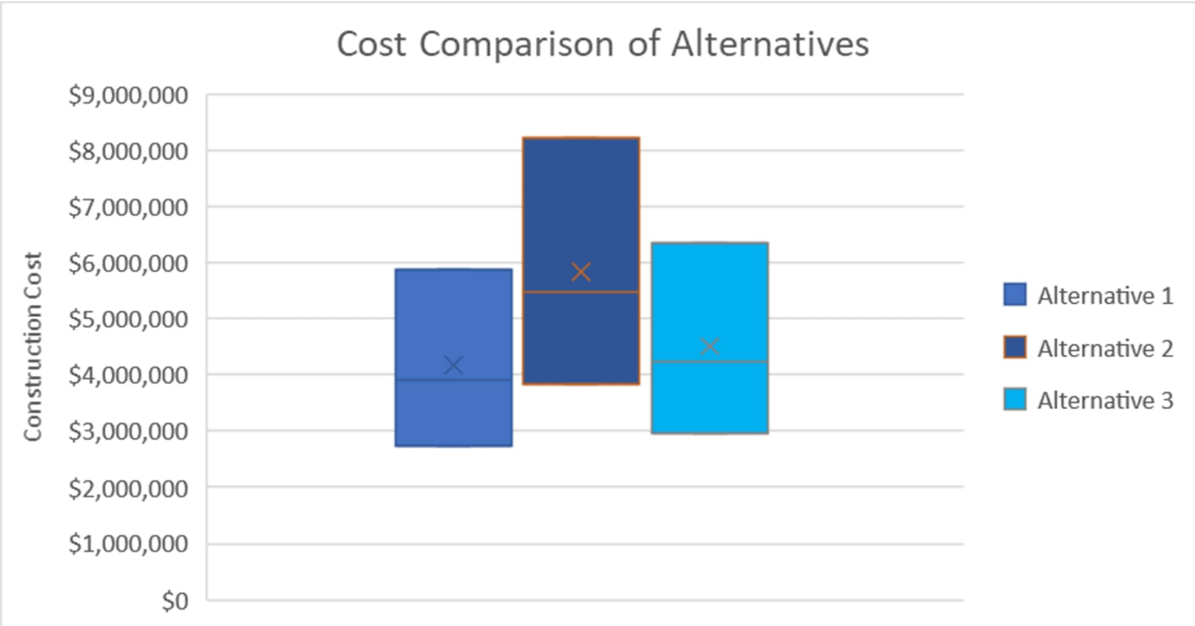
It should be noted, in comparing these options, that the current market and availability of equipment could significantly impact the costs at the time of bid.

Table 5-1. Comparison of Alternative Costs

Alternative	Costs[a]		
	Low (-30%)	Base	High (+50%)
Alternative 1: Upgrade the Existing Main Lift Station	$2.74	$3.91	$5.87
Alternative 2: Construct a New Main Lift Station	$3.83	$5.48	$8.22
Alternative 3: Expand the Existing Main Lift Station	$2.96	$4.23	$6.34

[a] Costs are presented in millions of 2022 U.S. dollars.

Figure 5-1. Cost Comparison of Alternatives



6. Conclusions and Recommendations

6.1 Summary of Alternatives

Table 6-1. Comparison of Alternatives

Alternative	Advantages	Disadvantages
Alternative 1 – Upgrade the Existing Main Lift Station	▪ Lowest upfront capital cost. ▪ Uses existing pump station "as-is." ▪ Operation of the facility is consistent with existing approaches (less change as compared to other alternatives). ▪ Smallest footprint because it uses existing wetwell and building.	▪ Relies on continued use of 35- to 40-year-old existing structures. The wetwell has been rehabilitated, but it will likely need further rehabilitation or renewal within the life cycle of Alternative 2. ▪ Relies on old mechanical and valve piping ▪ Requires close coordination to maintain operation during rehabilitation and upgrades; could require bypass pumping.
Alternative 2 – Construct a New Main Lift Station	▪ Renews pump station assets (not reliant on concrete assets at or beyond end of useful life). ▪ Fewer operational disruptions during construction. ▪ Best alternative for operation and maintenance (ease of pump/piping/valves access and removal). ▪ Minimizes bypass pumping during construction.	▪ Highest upfront capital cost. ▪ Greatest impact to public during construction (more expansive and visible construction). ▪ Site layout may not be ideal based on location of existing structures.
Alternative 3 – Expand the Existing Main Lift Station	▪ Fewer operational disruptions during construction. ▪ Operations and maintenance consistent with existing approaches, with a wet weather pump removal process because of the new wetwell. ▪ Construction phase has fewer impacts than Alternative 2 (Construct a New Main Lift Station) ▪ Access to valve piping in gallery is improved over Alternative 1 (Upgrade the Existing Main Lift Station)	▪ Relies on continued use of 35- to 40-year-old existing structure. The wet well has been rehabilitated, but it will likely need further rehabilitation or renewal within the life cycle of Alternative 2.

6.2 Recommended Alternative

Alternative 2, Construction of a new Main Lift Station is recommended for the following primary reasons.

- A new pump station will be designed and constructed in accordance with current safety and ease of maintenance standards. Alternative 1 and 3 largely rely on the original pump station layout, which is difficult to access and maintain.
- A new pump station will be designed in accordance with the updated standards for wet well design, thereby improving pump performance and extending the useful life of the pump and associated equipment.

- Alternative 2 maximizes TVPOA's capital investment in new assets. A large part of the investment in alternative 1 and 3 is lost costs due to extended by-pass pumping during construction. This is costs that is not invested in assets.
- Alternative 2 allows TVPOA to avoid continued reliance and future investment in a structure and facility that is currently at or beyond its useful life.

6.2.1 Preliminary Engineering of Selected Alternative

Upon selection of a preferred alternative, it is recommended that a basis of design (30 percent design level) report be completed prior to detailed design (60-, 90-, and 100 percent design). The items discussed below are recommended considerations for the next phase of design.

7. Discipline Design Criteria

7.1 Applicable Codes and Standards

The design will be based on the following codes and standards:

- Codes
  - 2017 National Electrical Code (NEC)
  - Life Safety Code (National Fire Protection Association [NFPA]-101)
- Standards
  - American Water Works Association (AWWA)
  - American Society of Mechanical Engineers
  - American National Standards Institute
  - Hydraulic Institute
  - National Electrical Manufacturers Association (NEMA)
  - Institute of Electrical and Electronic Engineers
  - Instrument Society of America
  - Insulated Cable Engineers Association
  - Occupational Safety and Health Administration (OSHA)
  - ASTM International
  - Underwriters Laboratory
  - Illuminating Engineering Society
  - NFPA

7.2 Equipment Preferences

The following is a list of equipment manufacturers for TVPOA's consideration:

- Submersible Pumps: KSB
- Prestressed Concrete Storage Tank: Crom, PreCon
- Gate, Check and Plug Valves: American Flow Control, M&H, Mueller
- Air Release Valves: ARI
- ATS: ASCO, Cummins, or Eaton
- Generators: Cummins, Caterpillar, Kohler
- 480-v Motor Controls/Switchboards: Square D, Eaton, or GE
- VFDs: Square D, Eaton, or Allen-Bradley
- Lighting and Power Panels: Square D, Eaton, or GE
- Dry-Type Transformers: Square D, Eaton, or GE

7.3 Civil

7.3.1 Introduction

This section describes the site civil design approach and set basic civil design criteria for the project.

7.3.2 Applicable Civil Codes and Standards

At a minimum, the following codes and regulations should be observed by the designer and referenced, as applicable, in the contract drawings:

- *Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), latest edition

- *Loudon County Stormwater Management Resolution,* latest edition
- *Loudon County Water Quality Buffer Resolution,* latest edition
- *Tennessee Permanent Stormwater Management and Design Guidance Manual*, Tennessee Department of Environment and Conservation (TDEC), latest edition
- *Tennessee Erosion & Sediment Control Handbook*, TDEC, latest edition

7.3.3 Site Characteristics and Improvements

As shown in Figure 2-1, the existing site lies to the north of Tellico Parkway and immediately adjacent to a Little Tennessee River cove. The existing lift station site is at the end of an approximately 530-foot-long, 10-foot-wide drive off the south side of Sequoyah Road. The asphalt drive slopes gradually down to the lift station at an approximate 10% grade. Woodland immediately north of the lift station slopes down to the site with the gravel road being the toe of slope. Offsite stormwater runoff appears to be conveyed via natural swales along the north side of the road to the adjacent body of water. No stormwater infrastructure appears to be present on site, but further surveying activities will confirm.

The proposed site features for all alternatives will be roughly equivalent. Each alternative will require site improvements to account for the storage tank, future odor control, electrical standby power generation, and proposed stormwater management. Alternative 2 will require the largest new site area because it needs additional footprint space for a new lift station. The storage tank is proposed to be situated north of the existing road in an area of the woodland that will exclusively require cut excavation.

7.3.4 Pavement

The existing driveway will be replaced with a 12-foot-wide asphalt driveway down to the lift station site. A passenger car turn around will be included outside the perimeter fence. Inside the fence line, concrete pavement will be proposed to access all facilities. Pavement will be designed for AASHTO HS20 load-rated vehicles. Pavement will have no curbs and will have roadside grading to accommodate site drainage requirements.

7.3.5 Perimeter Fencing

The proposed site will include a perimeter security fence encompassing all proposed above grade facilities. Unless otherwise requested by TVPOA, fencing will consist of 72-inch tall, galvanized steel chain-link fence with three strands of barbed wire at the top. Manual swing gates of varying width will be required at road crossings and sewer easements at the site. Additional lighting, security, or control requirements at the gate location may be added per TVPOA's request.

7.3.6 Erosion Control

For the construction of the storage tank and other site features, clearing, grubbing, and other excavation activities will take place onsite. Erosion control best management practices (BMPs) will be used during construction to minimize the production of sediment from soil erosion and control it from entering waterways offsite. Plans will be developed to follow requirements set forward in the TDEC's *Erosion & Sediment Control Handbook*, latest edition. It is anticipated that the site may disturb more than 1 acre and will, therefore, be subject to National Pollutant Discharge Elimination System (NPDES) TNR100000 permit requirements.

Plans and details will direct the contractor to install perimeter erosion control BMPs prior to any site disturbance, including clearing and grubbing, sediment trap construction, or any other soil-disturbing activity. Where applicable, requirements for erosion control and permanent stormwater management will be combined to minimize site disturbance. The 60-foot natural riparian buffer zone adjacent to the site will not be disturbed for this project.

Where groundwater conditions require excavation dewatering operations, discharges will be treated to remove suspended solids as required by state and local regulation.

7.3.7 Grading and Drainage Requirements

Finished grade will be designed not only to align with the hydraulic profile, but also to balance the earth work to reduce import and export of soil. Geotechnical soil borings are to be referenced to analyze the suitability of onsite material for structural and earthen fill.

Finished grading will provide drainage away from buildings, structures, slabs, and other critical areas where the accumulation of storm water is not desirable. Graded areas will drain to ditches, swales, or catch basins and be conveyed at nonerosive velocities to the nearest receiving water. Generally, to maintain good drainage characteristics, the following slopes will be used in design:

- Paved cross slopes – 2% recommended; 4% maximum
- Access roads – 6% maximum grade
- Unpaved cut and fill slopes –
    - Fill slopes: 3:1 (V:H) maximum, 10:1 minimum, 6:1 normal
    - Cut slopes: 3:1 maximum, 4:1 normal

Landscape retaining walls of varying height may be necessary to accommodate finished grades and to reduce the limits of disturbance. If required, local codes for height limits and permitting requirements will be consulted. If using segmental block retaining walls, details and performance requirements will be provided in the drawings in accordance with the National Concrete Masonry Association *Design Manual for Segmental Retaining Walls*, latest edition.

Since it is anticipated that the site may disturb greater than 1 acre of land, stormwater management per local standards will be required. The design will include provisions to provide runoff reduction requirement, water quality treatment of 80% total suspended solid removal, and stormwater storage requirements meeting local standards. Offsite stormwater will be conveyed around the proposed facilities. Any storm inlets, manholes, and piping that may be needed will be designed to avoid surcharge conditions. Pre- and post-development stormwater runoff characteristics will be analyzed to accurately quantify the stormwater entering and exiting the site and to meet permitting requirements. A Stormwater Pollution Prevention Plan will be prepared and submitted for approval before construction activities will take place.

7.3.8 Survey

A topographic survey should be conducted to provide updated site information of all above grade facilities and features. Utility locate services should be contacted and utilities marked before survey is performed. Adjacent stormwater infrastructure within 200 feet of the site should be located with the survey. It is not anticipated that any historical or archaeological survey will be required for this project.

7.3.9 Geotechnical

A subsurface investigation should be conducted for the selected alternative consisting of several borings (with rock coring if needed) positioned within the proposed improvement site. The exact quantity, location, and depth of these borings should be determined after selection of a final site configuration. The depth of the borings should be at least 5 feet below the lowest level of the pump station. Installation of a piezometer and slug testing also may be recommended. Subsequent laboratory testing should be performed from the collected samples to determine the design properties of the soil and rock.

7.4 Process Mechanical

7.4.1 Introduction

This section describes the process mechanical discipline basis of design (BOD). All mechanical work associated with the Main Lift Station will comply with the following BOD and with the applicable requirements. These requirements will be further defined during the design phase.

7.4.2 Pumps

7.4.2.1 Pump Types and Applications

The following general descriptions of pumps and their applications will apply:

- Submersible nonclog pumps: Submersible nonclog pumps will be used for the Main Lift Station pumps and for the storage tank transfer pumps.

7.4.2.2 Pump Shaft Sealing

7.4.2.2.1 Seals and Packing

Generally, pumps will be furnished with mechanical seals, not packings. Single seals will suffice for most applications. Packings will not be considered for pump shaft sealing because of generally greater maintenance requirements than for mechanical seals.

7.4.2.2.2 Mechanical Seals

Seals will be high-quality, split mechanical, cartridge type or equivalent.

7.4.2.2.3 Bearing Rating Lives

The minimum antifriction (rolling element) bearing rating life (B-10 Life) for this project is to be specified as 100,000 hours for 24-hour continuous duty and maximum reliability.

7.4.2.2.4 Couplings

Couplings will be spring-grid or gear-type flexible couplings with OSHA coupling guards for pumps, which carry their own thrust load.

7.4.2.2.5 Critical Speed and Vibration

The critical speed of all rotating members and the critical speed frequency of the motor will be at least 25% above the maximum motor operating speed.

Vibration levels of the pumping unit, when it has been installed on the structural foundation, will not exceed the limits recommended by the manufacturer.

7.4.2.2.6 Casing Rings

Renewable casing wear rings, heat treated to a hardness of at least 50 Brinell greater than the impeller or impeller wear rings, will be provided on medium and large pumps.

7.4.2.2.7 Pumping System Design

Where two or more pump systems of the same type or size are required, the pumps will be procured from the same manufacturer. Pumps will be selected and sequenced so that they normally operate within their allowable operating region in accordance with the Hydraulic Institute Pump Standards. All centrifugal pumps will have a continuously rising curve. In no case will the required power at any point on the performance curve exceed the rated power of the motor or encroach on the service factor.

7.4.3 Piping

7.4.3.1 General Piping Standards and Design Criteria

All sewage piping will be ductile iron pipe. All drainpipes will be polyvinyl chloride (PVC). The pipe design criteria are as follows:

- Flanges will be provided as necessary to remove valves and equipment.
- The minimum depth of cover will be 3 feet. Exceptions will be allowed on a case-by-case basis.
- A 10-foot horizontal separation and an 18-inch positive vertical separation between potable water and all other pipelines will be maintained throughout (unless the potable water pipe is concrete encased). Water pipelines will be installed at a higher elevation than wastewater pipelines.
- Support piping will be connected to equipment with a pipe support and not the equipment. Pipe supports will withstand the dead loads imposed by the weight of the pipes filled with water and will have a minimum safety factor of 5.
- In general, test pressures will be 1.5 times the maximum possible operating pressure for the pipe, such as pump shutoff head or peak surge pressure.
- Pipe will be labeled using Brady Snap-On labels or the equivalent. Process pipes will be color-coded per federal color-coding standards.

7.4.3.2 Pipe Support and Anchorage

The unbalanced forces at all pipe bends, tees, and valves will be evaluated for all gravity and pumped lines. Unbalanced forces will be evaluated using the concepts presented in the *Thrust Restraint Guide for Ductile Iron Pipe* (Ductile Iron Pipe Research Association, sixth edition, 2006), and the recommendations of the geotechnical report when it is complete. Acceptable types of pipe restraint for buried pipe include the following:

- Manufacturer’s proprietary restrained joints
- Manufacturer’s proprietary field kits for field cutting pipe (requires use of gauge pipe)
- Tie rods across flexible couplings and valves

All pipes will be restrained.

Acceptable types of supports include guides, saddles, penetrations, and structural attachments for general pipe support. Piping will be vertically supported by anchor brackets, guides, saddles, or hangers. Each run at each change of direction will be supported.

Pipe anchors, where required, will be located and sized. Anchors will resist hydraulic thrust and thermal forces and also direct and control thermal expansion.

All pipe supports will be concrete or Type 316 Stainless Steel. All fasteners will be Type 316 Stainless Steel.

7.4.4 Valves

The following valve standards will be followed:

- All valves will comply with AWWA standards and be constructed of the appropriate materials for wastewater use.
- Valve operators will be accessible from the ground or from adequate platforms.
- Check valves will be provided on all pumped discharge lines.
- Check valves with rugged, repeatable visual position indicators and NEMA 4X single-pole, double throw valve CLOSED position switches capable of switching 5 amps at 120-volt alternating current will be designed. Valve CLOSED position switches will be connected to the appropriate PLC for use in process monitoring and control.
- Valve boxes for buried valves will be cast iron, screw-type adjustable.
- Resilient seat plug valves for use in wastewater will conform to AWWA standards.

7.4.5 Storage Tanks

7.4.5.1 Material Selection and Tank Features

The storage tank material will be determined based on the characteristics of the liquid that is to be stored. Features that will be provided on tanks will include:

- Nameplates
- Access ports (for large tanks)
- Vent lines and overflow
- Platforms
- Conservation valves and rupture discs

7.4.5.2 Access Ports

Each tank will have a way to enter the vessel for periodic inspection and cleaning. Ports will meet OSHA standards for size and function. Ports of at least 24 inches in diameter will be provided.

7.4.5.3 Vent Lines and Overflow

Atmospheric tanks will have vent lines provided with an insect screen and desiccant breather to protect tank contents. The vent line will run outside, or into a suitable ventilation system for exhausting fumes and moisture. Vent lines will be sized to prevent collapsing the tank during pump out or drainage activities. The overflow line will be routed to a drain or containment system, where the contents can be safely and efficiently handled.

7.4.5.4 Platforms

Platforms will be provided to reach tank access port inspection doors, top-mounted relief valves, and other tank accessories. Platforms will be designed to meet OSHA safety standards.

7.5 HVAC

The lift station is classified as Class 1 DIV 2. Continuous ventilation at a minimum rate of 6 air changes per hour will be provided for declassification as required per NFPA 820. The ventilation system will consist of roof-mounted exhaust fans and wall louvers for makeup fresh air intake. Heating will be provided via space electric heaters controlled thermostatically. A monitoring ventilation alarm system including strobe light and ventilation monitoring stations located near entrances will be provided to indicate ventilation failure. HVAC equipment will be provided with protective coatings and/constructed from corrosion-resistant materials to withstand hydrogen sulfide or any other corrosive gas.

7.6 Electrical and Controls

7.6.1 Electrical

7.6.1.1 Design Goals

This section summarizes the design basis electrical modifications required for the Main Lift Station.

The basic goals of the design criteria are to:

1. Develop safe, reliable, and maintainable electrical systems.
2. Promote a consistent and uniform design approach and standardize the types and quality level of equipment specified.
3. Establish a uniform basis for specifications and drawings.
4. Provide a means of incorporating TVPOA input on items of preference and experience.

The pump station electrical work on this project includes power distribution equipment, a generator, ATS, and VFDs for the new pumps. The electrical work will require reconnecting the existing electrical utility feed from the local electrical utility.

7.6.1.2 Basic Materials

The following is a list of the proposed conduit materials on the project based on the area in which the material will be installed:

- Inside, dry, exposed: Rigid Galvanized Steel (RGS)
- Outside, exposed: RGS or PVC-coated RGS
- Concrete-encased: PVC or RGS
- Direct burial: PVC-coated RGS

All outdoor area control panels not in a classified area will be NEMA 250, Type 4X, 304 stainless steel, aluminum, or fiberglass, depending on location. The indoor process area will be a NEMA 4X enclosure. NEMA 12 and NEMA 1 are allowed in electrical rooms.

7.6.1.3 Distribution Voltage Selection

The following standard distribution systems will be used:

- 480-v, three-phase for low voltage switchgear, switchboards, Motor Control Cabinets, and panelboards
- 480-v, three-phase for motors over 0.5 hp
- 208-v/120-v solidly grounded, three-phase, four-wire for building lights and receptacles

7.6.1.4 Variable Frequency Drives

VFDs will be provided as required to vary the speed of a motor within a particular process. The VFDs will be standalone drives sub-fed from upstream switchboards. The design will be based on the vendor Square D. The drive will be a pulse width modulated drive.

Drives also are one of the major contributors to harmonics within an electrical distribution system. These harmonics can have adverse effects on sensitive electrical equipment such as computers and PLCs. Therefore, the drives will be designed to meet the following requirements:

- Drive rating based on motor full load current, not on horsepower
- Input power factor greater than 0.95 at all speeds
- Passive harmonic filter integral to each VFD for motors less than 100 hp
- 18-pulse front-end or active front-end integral to each VFD for motors greater than 100 hp
- Drives provided with output filters to minimize over-voltages at motor terminal
- Minimum 5% line reactors for smaller drives mounted in original equipment manufacturer panels

7.6.1.5 Motor Protection and Control

Generally, all motors 25 hp and larger will be provided with space heaters to prevent condensation from accumulating inside the motor. Additionally, temperature protection systems to prevent motors from operating outside the normal operational temperature limits will be provided.

Alternating current induction motors will be the premium efficiency type. Motors will have a 1.15 service factor, when supplied by sinusoidal power supply and 1.0 service factor when supplied by VFDs. NEMA design letter to fit the application (usually NEMA design B), and locked rotor kVA Code G or lower. Motor supplied power by VFD will be inverter duty rated.

Motors also will be provided with an enclosure that is suitable for operating in the environment in which the motor is installed.

7.6.1.6 Grounding

A separate ground conductor sized in accordance with NEC requirements will be installed in raceways for power feeders and branch circuit raceways for motor control, lighting, and receptacle loads. Shields of shielded instrumentation cables will be grounded to the ground bus at the power supply for the analog or low voltage discrete signal circuit. Shielded instrumentation cables will not be grounded at more than one point. The building ground system will be tied into the existing ground grid for a transformer.

7.6.1.7 Lightning Protection

Lightning protection will be provided at the new building.

7.6.1.8 Lighting

New lighting will be provided at the new building(s). Light fixtures will be light-emitting diode. In accordance with life safety code, emergency lighting will be provided at doors and means of egress inside a building. In general, the following minimum foot candles will be provided:

- Electrical Rooms: 40
- Process Area, inside: 20
- Process Area, outside: 5

7.6.2 Instrumentation and Controls

Instrumentation design will include level monitoring of the station wetwells, level monitoring of the storage tank, and discharge flow monitoring. Level instrumentation may use radar, ultrasonic, or pressure (submersible) technology and may include float switches for critical alarms and backup controls. Discharge flow metering will use magnetic flowmeter technology.

7.7 Potential Permit Requirements

Loudon County

- Construction Permit
- Air Quality Permit (for operation of emergency generators)

Tennessee Department of Environment and Conservation

- NPDES Stormwater Construction Permit
- Aquatic Resource Alteration Permit
- U.S. Army Corps of Engineers Section 404 (wetland) Permit

Appendix A
Alternatives Engineer's Opinion of Probable Cost

Jacobs

10/31/2022

Tellico Village POA
Main Pump Station Improvements
Alternative 1 - Existing Pump Station Rehab and 0.75MG Wastewater Storage Tank
Conceptual Cost Estimate

Item Description	Quantity	Unit		Unit Cost $		Total Cost $
Main Pump Station Improvements						
Earthwork						
Structural excavation	0	cu yd	$	20	$	-
Compacted fill	0	cu yd	$	25	$	-
Granular fill	0	cu yd	$	35	$	-
Filter Fabric	0	sq yd	$	6	$	-
Concrete, cast in place						
Pre-Cast Vault (flowmeter + tank flow control)	2	Lump Sum	$	15,000	$	30,000
Slab on grade/footings	0	cu yd	$	750	$	-
Walls	0	cu yd	$	1,000	$	-
Suspended	0	cu yd	$	1,500	$	-
Fill	0	cu yd	$	500	$	-
Embedded accessories	0	Lump Sum	$	50	$	-
Painting	0	Lump Sum	$	15,000	$	-
Equipment						
Submersible Pumps, 800 gpm @ 273' TDH, 150 hp, VFDs - Rebuild Exis	2	each	$	17,400	$	34,800
Submersible Pumps, 700 gpm @ 45' TDH, 15 hp, VFDs	2	each	$	38,500	$	77,000
Equipment Installation	20%				$	22,360
Bypass Pumping	1	Lump Sum	$	50,000	$	50,000
Electrical						
Engine Generator, 200kW w/ Fuel Tank, Sound Enclosure, ATS	1	each	$	90,000	$	90,000
Motor Control Center, 460v, VFDs - 150 hp	2	LS	$	40,500	$	81,000
Motor Control Center, 460v, VFDs - 15 hp	2	LS	$	20,000	$	40,000
Equipment Installation	20%				$	42,200
Mechanical						
Demolition	1	LS	$	10,000	$	10,000
Yard piping						
Ductile iron pipe,12"	200	LF	$	300	$	60,000
Ductile iron pipe, 8"	200	LF	$	200	$	40,000
Process piping						
Ductile iron pipe	8,000	pound	$	6	$	48,000
Plug Valve, motorized						
6"	1	each	$	20,000	$	20,000
Plug Valves						
6", HW	2	each	$	2,500	$	5,000
Check Valve						
6", Swing Check, Class 150	2	each	$	3,500	$	7,000
Air Release						
2"	0	each	$	5,000	$	-
Flowmeters, Mag						
8"	1	each	$	8,000	$	8,000
6"	1	each	$	6,000	$	6,000
4"	0	each	$	4,000	$	-
Surge Anticipator Valve	1	each	$	15,000	$	15,000
Pipe supports	1	LS	$	20,000	$	20,000
SubTotal - Main LS					$	706,000
Sitework	5%				$	35,000
Instrumentation	6%				$	42,000
Electrical	25%				$	177,000
HVAC/Building Mechanical	10%				$	71,000
					$	1,031,000
Wastewater Storage						
0.75 MG Ground Storage Reservoir, Crom - turnkey sub	1	LS	$	1,125,000	$	1,125,000
Earthwork						
Structural excavation	2,000	cu yd	$	20	$	40,000
Compacted fill	200	cu yd	$	25	$	5,000
Granular fill	50	cu yd	$	35	$	1,750
Filter Fabric	350	sq yd	$	6	$	2,100
Sitework	10%				$	113,000

Instrumentation	5%	$	56,000
Electrical	3%	$	34,000
HVAC/Building Mechanical	0%	$	-
		$	1,377,000
Subtotal Construction		$	2,408,000
Contractor General Requirements			
Mobilization	2%	$	48,000
Supervision	2%	$	48,000
Temporary facilities	2%	$	48,000
Bonds and Insurance	2%	$	48,000
Overhead	7%	$	169,000
Profit	10%	$	241,000
Subtotal - Contractor General Requirements	25%	$	602,000
Contingencies	30%	$	903,000
Total Construction Cost		**$**	**3,913,000**

Jacobs

10/31/2022

Tellico Village POA
Main Pump Station Improvements
Alternative 2 - New Pump Station and 0.75MG Wastewater Storage Tank
Conceptual Cost Estimate

Item Description	Quantity	Unit		Unit Cost $		Total Cost $
New Main Pump Station						
Earthwork						
Structural excavation	500	cu yd	$	20	$	10,000
Compacted fill	50	cu yd	$	25	$	1,250
Granular fill	20	cu yd	$	35	$	700
Filter Fabric	200	sq yd	$	6	$	1,200
Concrete, cast in place						
Pre-Cast Vault (flowmeter + tank flow control)	2	Lump Sum	$	15,000	$	30,000
Slab on grade/footings	25	cu yd	$	750	$	18,750
Walls	35	cu yd	$	1,000	$	35,000
Suspended	17	cu yd	$	1,500	$	25,500
Fill	0	cu yd	$	500	$	-
Embedded accessories	1	Lump Sum	$	2,000	$	2,000
Painting	0	Lump Sum	$	15,000	$	-
Building						
New Pump Station Electrical Building	1	LS	$	200,000	$	200,000
Equipment						
Submersible Pumps, 800 gpm @ 273' TDH, 150 hp, VFDs	2	each	$	90,000	$	180,000
Submersible Pumps, 700 gpm @ 45' TDH, 15 hp, VFDs	2	each	$	38,500	$	77,000
Equipment Installation	20%				$	51,400
Bypass Pumping	1	Lump Sum	$	20,000	$	20,000
Electrical						
Engine Generator, 200kW w/ Fuel Tank, Sound Enclosure, ATS	1	each	$	90,000	$	90,000
Motor Control Center, 460v, VFDs - 150 hp	2	LS	$	40,500	$	81,000
Motor Control Center, 460v, VFDs - 15 hp	2	LS	$	20,000	$	40,000
Equipment Installation	20%				$	42,200
Mechanical						
Demolition	1	LS	$	50,000	$	50,000
Yard piping						
Ductile iron pipe,12"	200	LF	$	300	$	60,000
Ductile iron pipe, 8"	200	LF	$	200	$	40,000
Process piping						
Ductile iron pipe	20,000	pound	$	6	$	120,000
Plug Valve, motorized						
6"	1	each	$	20,000	$	20,000
Plug Valves						
6", HW	4	each	$	2,500	$	10,000
Check Valve						
6", Swing Check, Class 150	4	each	$	3,500	$	14,000
Air Release						
2"	0	each	$	5,000	$	-
Flowmeters, Mag						
8"	1	each	$	8,000	$	8,000
6"	1	each	$	6,000	$	6,000
4"	0	each	$	4,000	$	-
Surge Anticipator Valve	1	each	$	15,000	$	15,000
Pipe supports	1	LS	$	30,000	$	30,000
SubTotal - Main LS					$	1,279,000
Sitework	15%				$	192,000
Instrumentation	6%				$	77,000
Electrical	25%				$	320,000
HVAC/Building Mechanical	10%				$	128,000
					$	1,996,000
Wastewater Storage						
0.75 MG Ground Storage Reservoir, Crom - turnkey sub	1	LS	$	1,125,000	$	1,125,000
Earthwork						
Structural excavation	2,000	cu yd	$	20	$	40,000
Compacted fill	200	cu yd	$	25	$	5,000
Granular fill	50	cu yd	$	35	$	1,750
Filter Fabric	350	sq yd	$	6	$	2,100

Sitework	10%	$	113,000
Instrumentation	5%	$	56,000
Electrical	3%	$	34,000
HVAC/Building Mechanical	0%	$	-
		$	1,377,000
Subtotal Construction		$	3,373,000
Contractor General Requirements			
Mobilization	2%	$	67,000
Supervision	2%	$	67,000
Temporary facilities	2%	$	67,000
Bonds and Insurance	2%	$	67,000
Overhead	7%	$	236,000
Profit	10%	$	337,000
Subtotal - Contractor General Requirements	25%	$	841,000
Contingencies	30%	$	1,264,000
Total Construction Cost		**$**	**5,478,000**

Jacobs

10/31/2022

Tellico Village POA
Main Pump Station Improvements
Alternative 3 - Existing Pump Station Rehab, New Wetwell, and 0.75MG Wastewater Storage Tank
Conceptual Cost Estimate

Item Description	Quantity	Unit		Unit Cost $		Total Cost $
Main Pump Station Improvements						
Earthwork						
Structural excavation	250	cu yd	$	20	$	5,000
Compacted fill	25	cu yd	$	25	$	625
Granular fill	10	cu yd	$	35	$	350
Filter Fabric	100	sq yd	$	6	$	600
Concrete, cast in place						
Pre-Cast Vault (flowmeter + tank flow control)	2	Lump Sum	$	15,000	$	30,000
Slab on grade/footings	15	cu yd	$	750	$	11,250
Walls	20	cu yd	$	1,000	$	20,000
Suspended	10	cu yd	$	1,500	$	15,000
Fill	0	cu yd	$	500	$	-
Embedded accessories	1	Lump Sum	$	1,200	$	1,200
Painting	0	Lump Sum	$	15,000	$	-
Equipment						
Submersible Pumps, 800 gpm @ 273' TDH, 150 hp, VFDs - Rebuild Exis	2	each	$	17,400	$	34,800
Submersible Pumps, 700 gpm @ 45' TDH, 15 hp, VFDs	2	each	$	38,500	$	77,000
Submersible Pump Guide Rails	2	each	$	38,500	$	77,000
Equipment Installation	20%				$	37,760
Bypass Pumping	1	Lump Sum	$	35,000	$	35,000
Electrical						
Engine Generator, 200kW w/ Fuel Tank, Sound Enclosure, ATS	1	each	$	90,000	$	90,000
Motor Control Center, 460v, VFDs - 150 hp	2	LS	$	40,500	$	81,000
Motor Control Center, 460v, VFDs - 15 hp	2	LS	$	20,000	$	40,000
Equipment Installation	20%				$	42,200
Mechanical						
Demolition	1	LS	$	10,000	$	10,000
Yard piping						
Ductile iron pipe,12"	200	LF	$	300	$	60,000
Ductile iron pipe, 8"	200	LF	$	200	$	40,000
Process piping						
Ductile iron pipe	8,000	pound	$	6	$	48,000
Plug Valve, motorized						
6"	1	each	$	20,000	$	20,000
Plug Valves						
6", HW	2	each	$	2,500	$	5,000
Check Valve						
6", Swing Check, Class 150	2	each	$	3,500	$	7,000
Air Release						
2"	0	each	$	5,000	$	-
Flowmeters, Mag						
8"	1	each	$	8,000	$	8,000
6"	1	each	$	6,000	$	6,000
4"	0	each	$	4,000	$	-
Surge Anticipator Valve	1	each	$	15,000	$	15,000
Pipe supports	1	LS	$	20,000	$	20,000
SubTotal - Main LS					$	838,000
Sitework	5%				$	42,000
Instrumentation	6%				$	50,000
Electrical	25%				$	210,000
HVAC/Building Mechanical	10%				$	84,000
					$	1,224,000
Wastewater Storage						
0.75 MG Ground Storage Reservoir, Crom - turnkey sub	1	LS	$	1,125,000	$	1,125,000
Earthwork						
Structural excavation	2,000	cu yd	$	20	$	40,000
Compacted fill	200	cu yd	$	25	$	5,000
Granular fill	50	cu yd	$	35	$	1,750
Filter Fabric	350	sq yd	$	6	$	2,100

Sitework	10%	$	113,000
Instrumentation	5%	$	56,000
Electrical	3%	$	34,000
HVAC/Building Mechanical	0%	$	-
		$	1,377,000
Subtotal Construction		$	2,601,000
Contractor General Requirements			
Mobilization	2%	$	52,000
Supervision	2%	$	52,000
Temporary facilities	2%	$	52,000
Bonds and Insurance	2%	$	52,000
Overhead	7%	$	182,000
Profit	10%	$	260,000
Subtotal - Contractor General Requirements	25%	$	650,000
Contingencies	30%	$	975,000
Total Construction Cost		**$**	**4,226,000**