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Tabb Pressure Reducing Station and Offline Storage Facility

Preliminary Engineering Report
32562-000
October 2, 2020

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List of Acronyms

Abbreviation	Definition
ACH	Air Changes per Hour
ACI	American Concrete Institute
ADM	Aluminum Design Manual
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute

ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BMP	Best Management Practices
CBPA	Chesapeake Bay Preservation Areas
CFM	Cubic foot per minute
CMU	Concrete Masonry Units
CV	Control Valve
CWA	Clean Water Act
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
DHR	Virginia Department of Historic Resources
DI	Ductile Iron
EBRT	Empty Bed Residence Time
EL	Elevation
ENV SP	Envision Sustainability Professional
EPA	Environmental Protection Agency
EQ TANK	Equalization Tank
ESA	Endangered Species Act
FIT	Flow Meter
FM	Force Main
FRP	Fiberglass Reinforced Plastic
FRP	Fiberglass Reinforced Plastic
GPM	Gallons per minute
HDPE	High Density Polyethylene
HDS	Hydrodynamic Separator
HGL	Hydraulic Grade Line
HOA	Homeowner’s Association
HRSD	Hampton Roads Sanitation District
HSS	Hollow Structural Steel
HVAC	Heating Ventilation and Air Conditioning
IBC	International Building Code
IPAC	Information for Planning Consultation
ISI	Institute for Sustainable Infrastructure
JMT	Johnson, Mirmiran, and Thompson
JPA	Joint Permit Application
JRTP	James River Treatment Plant
LCU	Landscape Credit Units
LWB	Local Wetlands Board
MG	Million Gallons

MGD	Million Gallons per Day
MOV	Motor Operated Valve
MRC	Virginia Marine Resources Commission
MTD	Manufactured Treatment Device
NFPA	National Fire Protection Association
NNWW	Newport News Water Works
NPSHR	Net Positive Suction Head Required
NWP	Nationwide Permit
NWPR	Navigable Waters Protection Rules
O&M	Operation and Maintenance
OA	On-going Authorization
OLSF	Off-Line Storage Facility
PER	Preliminary Engineering Report
PCF	Pounds per cubic foot
PCI	Precast/Prestressed Concrete Institute
PIT	Pressure Transmitter
PLC	Programmable Logic Controller
PPM	Parts per million
PRS	Pressure Reducing Station
PSF	Pounds per square foot
PSI	Pounds per square inch
PVC	Polyvinyl Chloride
RC	Resource Conservation District
RMA	Resource Management Areas
ROW	Right of Way
RPA	Resource Protection Area
RR	Rural Residential District
RTU	Remote Terminal Unit
RWWMP	Regional Wet Weather Management Plan
SCADA	Supervisory Control and Data Acquisition
SCAT	Sewage Collection and Treatment
SDI	Steel Deck Institute
SF	Square Feet
SJI	Steel Joint Institute
SOC	Special Order by Consent
SWIFT	Sustainable Water Initiative for Tomorrow
SSO	Sanitary Sewer Overflow
TDH	Total Dynamic Head
USACE	US Army Corps of Engineers
USBC	Uniform Statewide Building Code
USFWS	US Fish and Wildlife Service
V-CRIS	Virginia Cultural Resource Information System

VDOT	Virginia Department of Transportation
VESCH	Virginia Erosion and Sediment Control Handbook
VRRM	Virginia Runoff Reduction Method
VSMP	Virginia Stormwater Management Program
VWP	Virginia Water Protection
WEF	Water Environment Federation
WQC	Water Quality Certification
YRTP	York River Treatment Plant

Executive Summary

Background

The proposed Tabb Pressure Reducing Station (PRS) and Offline Storage Facility (OLSF) (YR010800) is located in York County, Virginia within the HRSD North Shore Interceptor System near the intersection of Big Bethel Road and Victory Boulevard. The Regional Wet Weather Management Plan (RWWMP) identifies this Tabb PRS & OLSF project, JR-RWWMP-02, as a means to lower the hydraulic grade line (HGL) to accommodate the proposed terminal station improvements; specifically, one in Poquoson and another in York County. As part of the RWWMP development process, HRSD identified ways to incorporate operational flexibility where feasible. In addition to lowering the upstream HGL, the Tabb site was selected to provide operational flexibility to pump to both YRTP and JRTP if necessary. The Tabb PRS and Storage, location FDP-001, was slated to begin 1/1/30 and end 3/2/34 in the RWWMP schedule. Sustainable Water Initiative for Tomorrow (SWIFT) process flow equalization needs have expedited this schedule, requiring completion by January 2024.

Flow Equalization Requirements

As part of the SWIFT Program, it was determined that flow equalization is necessary at the James River Treatment Plant (JRTP) and York River Treatment Plant (YRTP). This flow equalization is based on maintaining a minimum inflow rate at each plant *(15.7 MGD at JRTP and 11.1 MGD at YRTP)* to facilitate effective SWIFT treatment processes. Further evaluation of the SWIFT related needs determined that the required flow equalization could be achieved at the originally proposed Tabb PRS and OLSF site due to its location in the HRSD interceptor system. All design flows and hydraulic grade line (HGL) values were provided by HRSD and generated by the Regional Hydraulic Model (RHM).

Facility Overview

The site is situated on a 5-acre portion of a 26.2-acre parcel owned by Harry Richard Ashe at 900 Yorktown Road. As of 10/2/2020, HRSD is in the process of acquiring and subdividing the 5-acre portion to be used for the Tabb PRS and OLSF. The site is approximately 675 ft by 320 ft.

The facility will consist of a building that houses the pumping equipment, generator, electrical equipment, control room and restroom. Approximately 6,000 SF resides below existing grade at approximately 35 ft of depth while and additional 2,600 SF of the facility is at grade.

The site is designed to accommodate two (2) 2.5 MG storage tanks of 155 ft diameter that are approximately 45 ft in height. Access to the site is proposed off Big Bethel road along the West end of Bethany Terrace and will be paved onto the proposed site.

Aesthetic considerations were addressed relative to the onsite vertical elements such the storage tanks and pump station as well as construction impacts to adjacent stakeholders.

Considerations

This Preliminary Engineering Report provides the preliminary design concepts and additional considerations for design of the site, pump station layout, offline storage tanks, pumping systems, odor control, environmental, geotechnical and permitting elements as well as stakeholder coordination.

Incorporating the functional needs for the proposed facility considered or included the following elements:

- Wet Weather Pressure Reducing
- Offline Storage Facility fill/discharge to/from the YRTP
- Offline Storage Facility fill/discharge to/from the JRTP
- Existing and conditions of the proposed site
- Hydraulic Analysis for the PRS and OLSF
- Preliminary Site Plan
- Conceptual layout off the Pump Station, including pump gallery, structural, generator, electrical, architectural
- Conceptual design of the Offline Storage Facilities and related appurtenances.
- Preliminary Opinion of Probable Construction Cost

Schedule

Task	Completion Date
Design Completion	August 2021
Construction NTP	June 2022
Project Completion	January 2024

Recommendations

Recommendations based on the preliminary engineering efforts provided in this report are summarized in the Table below.

DESCRIPTION	NO.	FIRM CAPACITY	APPROXIMATE DIMENSIONS	NOTES	OPINION OF PROBABLE COST *
Pressure Reducing Station	1	N/A	132 FT x 68 FT x 35 FT (DEPTH)	Preliminary design depth is conservative and is driven by assumed NPSHR of 34 ft.	$18,853,000
PRS Pumps	4	17,283 GPM @ 67 FT TDH	150 HP	3 Pumps + 1 Standby	
OLSF Pumps (JRTP)	3	5,141 GPM @ 75 FT TDH	75 HP	2 Pumps + 1 Standby Capacity driven by tank discharge operations	
OLSF Pumps (YRTP)	2	3,376 GPM @ 28 FT TDH	50 HP	1 Pump + 1 Standby Capacity driven by tank fill operations	
Offline Storage Tank	1	2.5 MG	100 FT DIA x 45 FT (HEIGHT)	Site design utilizes 155 FT Dia. tank to demonstrate maximum tank dia. allowed.	

** Cost includes engineering design and construction administration.*

1. Project Purpose and Overview

1.1 Background

The proposed Tabb Pressure Reducing Station (PRS) and Offline Storage Facility (OLSF) is located in York County Virginia. It was originally a component of the 2017 Integrated Plan / Regional Wet Weather Management Plan (RWWMP) but was removed because it was beyond the 10-year planning period.



Figure 1-1: Vicinity Map

At the end of 2019, a need for flow equalization related to the Sustainable Water Initiative for Tomorrow (SWIFT) Program at the James River Treatment Plant (JRTP) prompted a second look at the Tabb site.

HRSD determined a location near Tabb High School would be the most favorable and feasible location given the space available and force main connectivity between the York River Treatment Plant (YRTP) and JRTP service areas. A major benefit of the identified site is the ability to direct flow currently going to YRTP towards JRTP by constructing the Proposed Tabb PRS and OLSF, allowing greater flexibility of the interceptor system as seen in **Figure 1-1**.

1.2 Purpose

HRSD selected Hazen and Sawyer to prepare a Preliminary Engineering Report for the design and construction of the Tabb PRS and OLSF. This PER evaluates the following:

- Existing conditions of the proposed site
- Hydraulic Analysis for the PRS and OLSF
- Conceptual layout and site plan for the proposed PRS and OLSF
- Preliminary Opinion of Probable Construction Cost

1.3 Data Sources

The analyses and recommendations for the Tabb PRS and OLSF were conducted using HRSD-provided data, Engineer-obtained data, and previous investigations. The sources of data are listed below:

- HRSD GIS data
- HRSD Design and Construction Standards (revised January 2020)
- PMI Survey (Dated August 2020) provided in Appendix A
- GET Solutions Inc. Report of Subsurface Investigation and Geotechnical Engineering Services (Dated September 2020) provided in Appendix B
- HRSD Record Drawings provided in Appendix C
- HRSD Regional Hydraulic Model (RHM) Data provided in Appendix D
- HRSD Telog Data provided in Appendix D

1.4 Previous Investigations and Related Projects

1.4.1 HRSD Integrated Plan/Regional Wet Weather Management Plan

HRSD is obligated to satisfy requirements of a Consent Decree with the US Environmental Protection Agency (EPA) and a Special Order by Consent (SOC) with the Virginia Department of Environmental Quality (DEQ). The Regional Wet Weather Management Plan (RWWMP) was prepared to address system capacity during wet weather events to reduce the occurrence of SSOs within the system. The RWWMP is also part of HRSD's Integrated Plan which includes environmental benefits provided by HRSD's Sustainable Water Initiative for Tomorrow (SWIFT).

The RWWMP identifies this Tabb PRS & OLSF project, JR-RWWMP-02, as a means to lower the hydraulic grade line (HGL) to accommodate the proposed terminal station improvements; specifically, one in Poquoson and another in York County. As part of the RWWMP development process, HRSD identified ways to incorporate operational flexibility where feasible. In addition to lowering the upstream HGL, the Tabb site was selected to provide operational flexibility to pump north to both YRTP and JRTP

if necessary. In the RWWMP schedule Tabb PRS and Storage, location FDP-001, was slated to begin 1/1/30 and end 3/2/34. SWIFT flow equalization needs, as discussed in Section 1.1 have expedited this schedule, requiring completion by January 2024.

2. Existing Conditions

The Tabb PRS & OLSF site is located in Yorktown, Virginia. This project will involve impacts to three properties located along Big Bethel Road and Victory Boulevard. They are the following:

1. Tabb PRS & OLSF Property – 900 Yorktown Road
2. Access Road Property – 4411 Big Bethel Road
3. Tabb High School Property – 4431 Big Bethel Road

The three properties are shown in **Figure 2-1**: Properties Affected by the Project.



Figure 2-1: Properties Affected by the Project

The York County owns the Access Road Property, the York County School Board owns the Tabb High School Property and HRSD is in the process of acquiring the 5-acre parcel referred to as the Tabb PRS & OLSF Property that is currently owned by Harry Richard Ashe.

None of the properties are within a Hurricane Evacuation Zone or Flood Zone, Resource Protection Area, Resource Management Area, 200-foot Watershed Management Protection Area, or 500-foot Watershed Management Protection Area.

2.1.1 Tabb PRS & OLSF Property

2.1.1.1 *General Property Information*

The Tabb PRS & OLSF Property is being subdivided from a 26.2-acre parcel and is comprised of undeveloped and wooded areas. The bulk of the project's improvements are being constructed on this property.

2.1.1.2 *Easement Information*

There is a 200-foot-wide Virginia Dominion Energy permanent easement that runs northwest to southeast located east of the property. The Virginia Dominion Energy permanent easement crosses the proposed access road generally from northwest to the southeast, and to the east of the PRS & OLSF site. Work within the easement will require conformance with Virginia Dominion Energy development requirements.

There is also a 40-foot York County Drainage and Utility easement that borders the western property line and encompasses a drainage ditch that runs north to south.

2.1.1.3 *Other Site Information*

HRSD has existing 30 inch and 42-inch force mains that border the eastern portion of the site. The 42-inch force main travels north of the main parcel and follows along the Virginia Dominion Energy easement to the northwest, heading towards the HRSD York River Treatment Plant. The 30-inch force main turns to the west at the Tabb PRS & OLSF Property's southeastern corner and traverses west within the Victory Blvd right-of way, eventually connecting to the James River Wastewater Treatment Plant.

2.1.2 Access Road Property

2.1.2.1 *General Property Information*

The Access Road Property occupies approximately 3.6 acres. The area is partially developed and features the gravel road providing access to the Tabb PRS & OLSF Property and the Virginia Dominion Easement, a fleet fueling station for York County government vehicles, and undeveloped, wooded areas on the central and western portions of the property. The improvements to the Access Road property are largely related to improving the gravel road to a paved road to serve the Tabb PRS & OLSF Property.

2.1.2.2 *Easement Information*

The Virginia Dominion Energy easement runs northwest to southeast through the center of the property.

HRSD has existing variable width utility easements that encompass the gravel access drive and the southern portion of the property largely within the Virginia Dominion Energy easement.

2.1.2.3 *Other Site Information*

HRSD's 30-inch and 24-inch force mains parallel the gravel road on the north side and traverse west until they reach the Virginia Dominion Energy Easement. Once in the easement, the force mains turn slightly to the northwest and enter the Tabb High School Property where they continue west until they reach the eastern boundary of the Tabb PRS & OLSF Property.

2.1.3 Tabb High School Property

2.1.3.1 *General Property Information*

The Tabb High School Property occupies approximately 29.8 acres. The area is developed and includes a high school building, athletic fields, and a parking lot. The improvements to this property only consist of minor improvements to support stormwater infrastructure on the paved road being installed on the Access Road Property.

2.2 Site Investigations

Various site investigations were performed as part of this PER. The primary goal of these investigations was to determine any site constraints related to the proposed project and develop preliminary concepts and related costs to address those constraints. The following investigations were performed as part of this PER:

2.2.1 Topographic Survey

A topographic survey of the proposed 5-acre site and a portion of the access road to the East. was performed by Precision Measurements, Inc. on August 12, 2020 and is provided in Appendix A. This survey was used in part to develop conceptual plans for the Tabb PRS and OLSF.

2.2.2 Geotechnical Analysis

A limited field exploration program was performed which included one (1) 80-feet and two (2) 15-feet deep Standard Penetration Test (SPT) borings located in areas that did not require any clearing for the drill rig to access. In-situ infiltration tests were also conducted directly adjacent to each of the 15-feet deep SPT borings and a temporary groundwater monitoring well was installed at one of these borings to obtain a 24-hour stabilized groundwater level. A more extensive geotechnical program is recommended upon approval of the PER. See GET Solutions, Inc detailed report dated September 18, 2020 located in Appendix B. The following provides a brief description of the evaluation and preliminary recommendations of the preliminary geotechnical analysis:

- Uncontrolled FILL material was encountered at one of the boring locations that extended to a depth of 2 feet below existing grades. Uncontrolled FILL shall be undercut and removed from beneath all shallow foundations (where applicable) but may be suitable for slab and pavement support pending a further field investigation prior to final design.

- The subsurface SAND (SP and SP-SM) and some of the Silty SAND (SM) soils encountered at the boring locations meet the criteria recommended in this report for reuse as structural fill. However, moisture manipulation will likely be required due to shallow groundwater conditions encountered at this site.
- The weight of the pump station structure is expected to be less than the weight of the soil that will need to be removed to reach an elevation of (-)5-feet MSL or deeper, thus resulting in the structure heaving upward instead of settling. In addition, the base of the structure will be located well below the groundwater table, so buoyancy will also contribute to the structure heaving upward. It does not appear economically feasible to counteract these uplift forces with just increasing the thickness of the mat foundation and for these reasons it is recommended to support the proposed pump station on a deep foundation system likely consisting of Square Precast Prestressed Concrete (SPPC) piles in order to address these uplift forces.
- It is expected that an enclosed coffererdam or dewatering system will be required to construct the pump station considering the preliminary finish floor elevation of (-)5-feet MSL for the lower level, which is well below (Approx. 30 feet) the groundwater table.
- The proposed 2.5 million-gallon offline storage tank(s) could be supported by a deep foundation system likely consisting of Square Precast Prestressed Concrete (SPPC) piles. Preliminary pile capacity recommendations and pile testing program are discussed in Section 4.6 of the detailed report. These recommendations cannot be considered final until the specific tank locations have been finalized, access to these locations is obtained, and the completion of a more comprehensive geotechnical investigation.
- Based on previous experience in the vicinity of the project site and the composition of the soils recovered within the upper 80 feet (maximum explored depth during feasibility study) at the boring locations, it is our opinion that the site characteristics are indicative of a Site Class “D” in accordance with Table 20.3-1 of ASCE 7-10 as referenced by the 2018 International Building Code (IBC).

2.2.3 Environmental Evaluation

The Preliminary Environmental Evaluation is provided in Section 7 of this PER.

3. Pressure Reducing Station and Offline Storage Facility Overview

This section will review the basis of design for all three conditions. Appendix H provides a visual representation of the operating scenarios and coordination between PRS and OLSF components.

3.1 Site Piping and Flows

The proposed project site consists of four existing force mains as shown in **Figure 3-1**.

- NF-024, 30” - Conveying system flows from the YRTP service area
- NF-206, 24” - Conveying system flows from the YRTP service area
- NF-011, 42” - Directing flows to YRTP
- NF-207, 30” - Directing flows to JRTP

This infrastructure was installed as part of the Kiln Creek Interceptor Force Main and Route 171 Interceptor Force Main (Contracts A and B) in 2009 and 2011. NF-011 is a 42-inch force main designed to convey flow to the YRTP. NF-207 is a 30-inch force main designed to convey flow to the JRTP. Existing flows in NF-207 are isolated west of the proposed site via mainline valve near Kiln Creek, effectively directing all inflow east of the valve to the YRTP. This project will adjust that isolation point to the Tabb PRS and OLSF site, redirecting the associated flows to the JRTP.



Figure 3-1: Existing Force Mains

Valve guide Y.R.-2001 (Included in Appendix C) shows how these two lines were installed to provide flexibility between the two service areas. This interconnection will serve as the tie-in location for the Tabb PRS and OLSF.

3.2 Summary of HRSD-Provided Model Results

HRSD performed several hydraulic modeling simulations of various flow scenarios to evaluate design points for the Tabb PRS & OLSF. Data provided by HRSD (Included in Appendix D) provides summarized model results for multiple scenarios:

- 6/15/2020 Preliminary EQ calculations
- 7/23/2020 Wet weather flow and HGL at Tabb
- 9/1/2020 Simulated pressures for JR/YR split point at Tabb
- 9/3/2020 Simulated pressures with EQ discharge time series added to JR from Tabb
- 9/16/2020 Existing pressure data from MMP S-270: Victory Boulevard at Poquoson

The preliminary EQ calculations provide hourly average dry weather flow data that were developed from four-minute increment raw model data. These hourly averages demonstrate the dry weather diurnal curves at each treatment plant.

Wet weather modeling results indicated the system peak flow HGL is elevation 106 (at node FIT-NF-024-17966) at the Tabb site. Using flow through the two existing force mains adjacent to the Tabb site (NF-024-30837 and NF-024-30842), the maximum wet weather flowrate at the Tabb PRS & OLSF site was determined to be 17,283gpm.

4. Pressure Reducing Station Hydraulics

The Tabb PRS element of this project is designed to alleviate the YRTP service area pressures during wet weather events. Preliminary design and layout of the key elements were based on the specific project needs at the proposed site, feedback from interceptor operations staff as well as hydraulic analysis provided by HRSD.

4.1.1 Pressure Reducing Station Layout

Layout of the facility includes three separate but interconnected pumping systems that consist of pressure reducing pumps and separate tank drain/fill pumps for the YRTP and JRTP systems. This section focuses on the pressure reducing elements of the design, while Section 5 focuses on the tank drain and fill elements. See **Figure 4-1** for the overall facility layout. Refer to Appendix H for Flow Scenarios and schematics that demonstrate the functional elements of the interconnected systems.

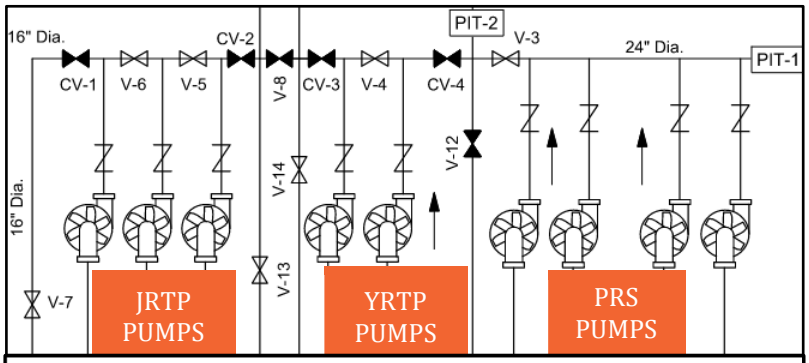


Figure 4-1: Facility Layout

4.1.1.1 *Pressure Reducing Pump Design*

The PRS pumps are considered to be part of a closed system, therefore Net Positive Suction Head available (NPSHA) is based solely on the system HGL at the proposed site without assistance from atmospheric pressure. Therefore, the PRS pump suction set point and pump Net Positive Suction Head Required (NPSHR) are the primary drivers for PRS pump elevation setting and resulting pump station depth. The suction set point considers two important elements, maintaining NPSHA vs NPSHR by the selected pumps and ensuring the system HGL remains above the top of the upstream forcemains. This is generally accomplished by setting the suction set point HGL at 10-feet above the adjacent yard piping or upstream forcemain high point. For the Tabb site, there are two upstream force mains. The Kiln Creek Interceptor Force Main and Route 171 Interceptor Force Main record drawings show high points east of the project site near Big Bethel Road (Stations 435+18 and 426+81) the elevation of the force mains is 29.5 feet. Applying a 10-foot HGL buffer to the high point results in a suction set point HGL of 39.5 feet. (See **Figure 4-2**) Vertically offsetting the PRS pump volute centerline at a distance equal to the selected pump's NPSHR at its top speed determines the pump volute centerline. Reduction of the pumps NPSHR

at lower speeds provides a buffer that significantly reduces potential for pump cavitation. For PER purposes it is assumed that the NPSHR for any pump selected would be equal to or less than atmospheric pressure of 14.69 PSI or 34 FT of head. Using atmospheric pressure (34 feet) as a conservative estimate for NPSHR, and the height of the pumps, the resulting finished floor elevation of the station is approximately -3 feet.

As identified in section 3.2, existing model data shows a maximum wet weather HGL of 106-feet. A suction set point of 39.5 feet will provide the upstream system with a 66.5-foot reduction in HGL. It should be noted that this is a conservative estimate. Actual NPSHR for a selected group of pumps will be used to reduce the depth of the PRS.

Table 4-1: PRS Design

Site Conditions	
51	ft = Peak Dry Weather HGL
106	ft = Peak Wet Weather HGL
29.5	ft = Top of suction FM*
39.5	ft = Suction HGL: Top of FM +10' buffer
66.5	ft = Peak Wet Weather Design TDH

*High points for both incoming FMs were considered

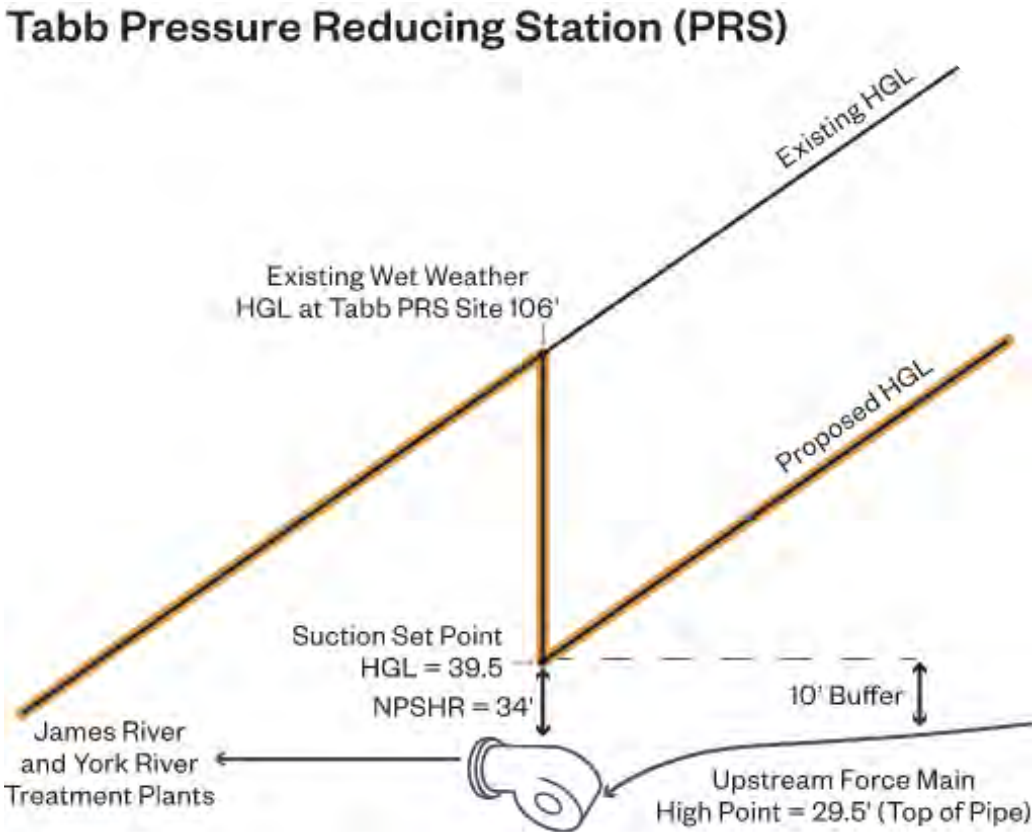


Figure 4-2: PRS Pump Design

4.1.2 System Curve Development

Wet weather data provided by HRSD on July 23, 2020 illustrates system HGL and corresponding flow through the Tabb site assuming no storage at Coliseum PRS. The PRS system curve (TDH vs Flow Rate) was developed by subtracting the suction set point elevation of 39.5 feet from the wet weather HGLs at the corresponding flow rates.

4.1.3 Pump Selection and Design

4.1.3.1 *Pump Selections*

Potential pump models from manufactures Flygt, Fairbanks Nijhuis, and WEMCO were evaluated to meet the identified design points. WEMCO centrifugal screw pumps were used as the preliminary basis of design for pump and pipe layout presented in this report. To meet the design conditions shown in **Figure 4-2**, the PRS component of the station was designed with three identical pumps and one standby. **Figure 4-3** illustrates how the WEMCO pumps are able to operate under the variety of design conditions. Additional pump selections are included in Appendix F.

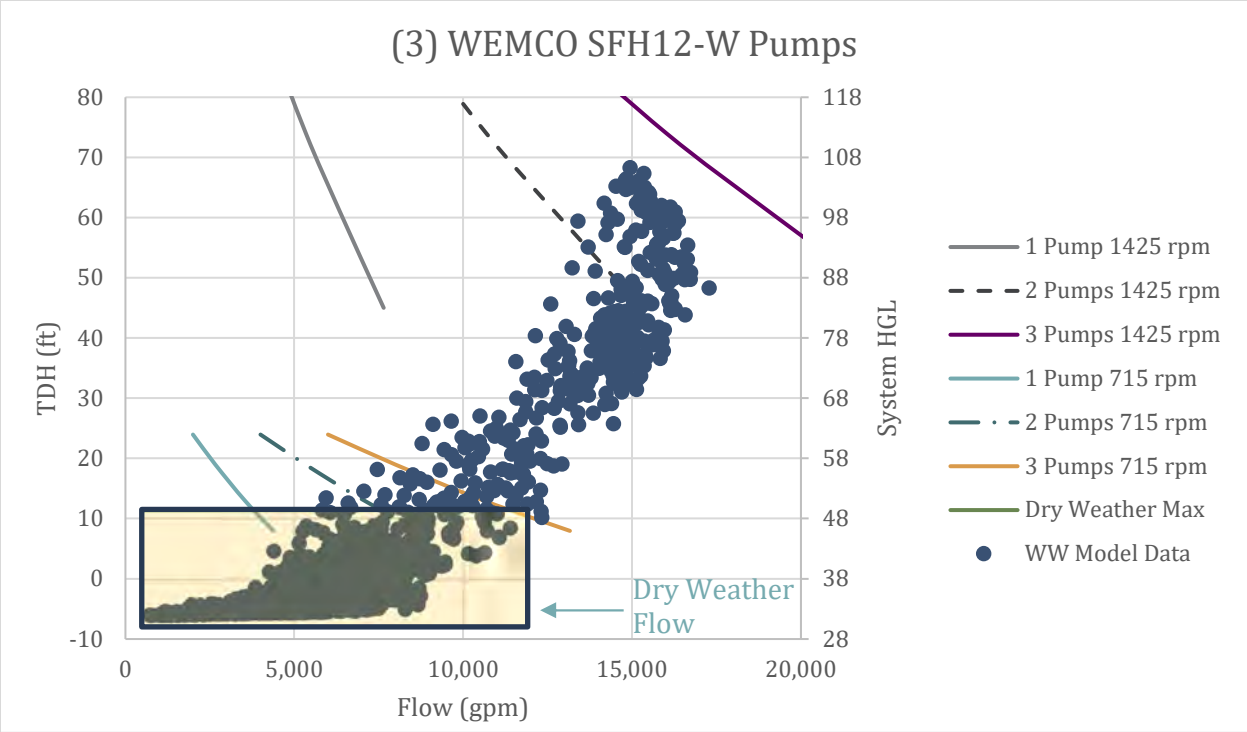


Figure 4-3: PRS Pump Selection

The existing maximum dry weather system HGL is 51 feet. PRS pumps will not operate below this point.

4.1.4 Pump Station Pipe Sizing

PRS piping is to be sized based on requirements outlined in the Virginia Department of Environmental Quality (DEQ) Sewage Collection and Treatment (SCAT) Regulations and guidelines from Hydraulic Institute standards.

Table 4-2: Pipe Velocity Standards

	SCAT Regulations	HI Standards
Suction Pipe	Not to exceed 6 fps	Between 3 and 8 fps
Discharge Pipe	Not to exceed 8 fps	Not to exceed 15 fps

The Tabb PRS and OLSF experiences a wide range of flowrates. Flow through the PRS ranges from 10,148gpm up to 17,283gpm. The OLSF flow ranges from 629gpm to 6,694gpm.

The OLSF suction and discharge piping has preliminarily sized at 16-inch diameter. For this portion of the facility, the driving flow rate is the high flow and the need to remain below a maximum discharge velocity less than 15fps. At 6,694gpm the force main will experience a velocity of 11 fps. When the OLSF is transitioning between drain and fill cycles the velocity will be zero for a relatively short period of time. Any solids deposition related to this lack of flow will be mitigated daily with the 11fps velocity during the drain pumping operation.

The PRS suction and discharge piping has preliminarily been sized at 24-inch diameter. For this portion of the facility, the driving flow rate is the high flow and the need to maintain a maximum discharge velocity less than 15fps. At 17,283gpm the force main will experience a velocity of 12fps. The low flow condition of 10,148gpm results in a force main velocity of 7fps.

Additional flow rate analysis, including minor losses, will be performed during the design phase to ensure all pumps along each header are receiving the appropriate volume of flow to operate within their preferred operating ranges (POR).

5. Offline Storage Facility Hydraulics

5.1.1 Offline Storage Facility Capacity Analysis

Offline storage analysis was performed to determine the required volume to be stored at the Tabb PRS and OLSF. The SWIFT team indicated a target inflow rate of 15.7 MGD or greater at the JRTP and 11.1 MGD or greater at the YRTP. These targets represent the minimum inflow rate necessary to optimize SWIFT processes. To achieve these minimum flow rates on their respective diurnal curves, HRSD calculated a minimum 2.1 MG of equalization storage at the Tabb site is required to achieve the target minimum flows. Using the force main interconnections at the Tabb site identified in Section 3, this equalization (EQ) volume can be diverted off the YRTP system during dry weather peak flows, stored at the Tabb OLSF, then discharged back into the JRTP and YRTP systems during the low flow periods. **Figure 5-1** and Figure 5-2 demonstrate the equalization volumes to be stored and directed to the respective treatment plants.

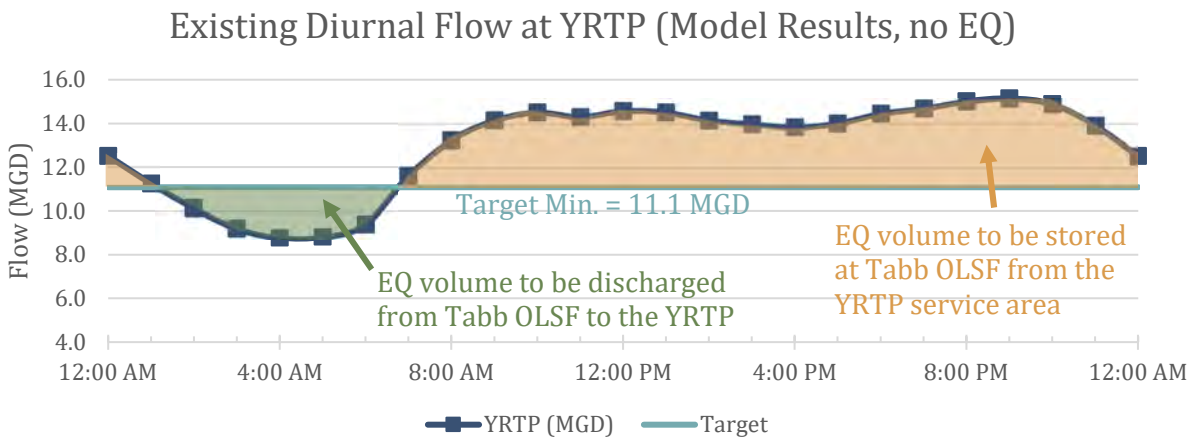


Figure 5-1: Diurnal Flow to York River Treatment Plant

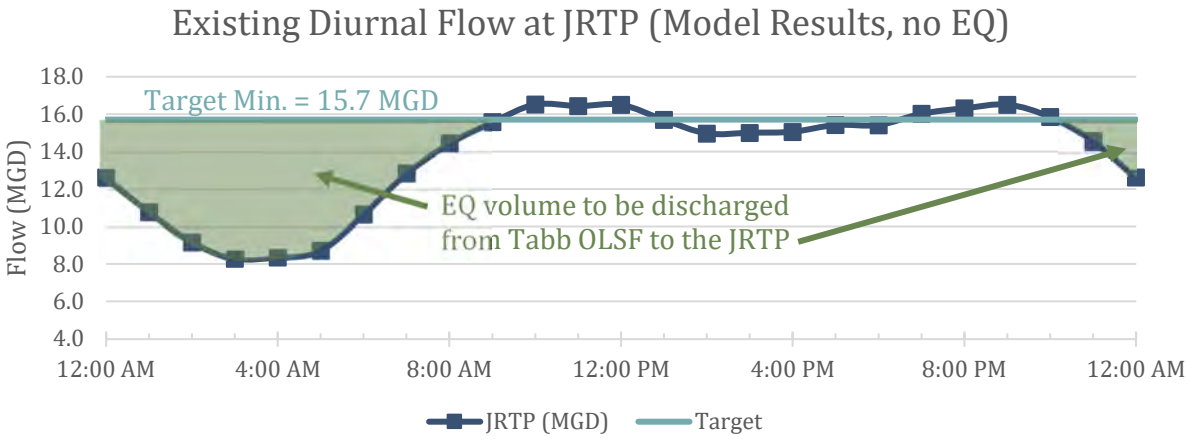


Figure 5-2: Diurnal Flow to James River Treatment Plant

5.1.2 Offline Storage Facility Fill and Drain Operations

5.1.2.1 *Methods of OLSF Fill and Discharge*

5.1.2.1.1 System Pressure Fill / Tank Pressure Discharge

The dry weather system HGL during the fill period ranges from 36 feet to 38 feet. Based on the volume required and preliminary tank operating levels (32 feet – 64 feet), the proposed OLSF cannot be filled by system pressure. Lowering of the proposed tank below ground level could provide the flexibility to use this method, however depth of the required structure and associated construction costs to achieve the required fill rates are cost prohibitive. Based on the preliminary tank operating levels noted above, the tank HGL would not be sufficient to overcome interceptor system HGL and develop the target EQ discharge flow rates.

5.1.2.1.2 Pump Assisted Fill / Pump Assisted Discharge

Due to the limitations of the system pressure fill method described above, pump assisted fill and discharge is proposed for the Tabb OLSF. This approach provides flexibility to manage the range of flows required to fill and discharge the OLSF at the target flow rates shown in Table 5-1.

5.1.2.2 *Fill Conditions*

During tank fill operations the flowrate ranges from 629gpm to 3,376gpm based on target inflow rates at the JRTP and YRTP. Pressures were determined using HRSD-provided Telog data from HRSD NF-Victory Blvd Rt 171 (MMPS-270) for dry weather fill design. Existing system HGL during the fill period generally ranges from 36 feet to 38 feet. Based on a maximum tank height HGL of approximately 64 feet, the highest TDH the pumps will experience is 28 feet. Pressures lower than this will be managed using control valves inside the station.

5.1.2.3 *Discharge Conditions*

These same pumps will be used to empty the OLSF, generally between midnight and 8AM. Once again, the pressure condition will be managed using control valves inside the station.

During tank drain operations, approximately 82% of the flow will be directed towards JRTP. Leaving the Tabb site towards JRTP, the existing force main NF-207 is 30-inch diameter. Once flow reaches NF-179 the force main diameter is reduced to 24-inch (as installed in 1987 with the Colony Area INT FM Section 2). This reduction in pipe size causes an increase in the JRTP system HGL when the OLSF is discharged back into the system between midnight and 8AM. As a result, the HRSD-provided modeling indicates the instantaneous peak HGL* for the JRTP system at the Tabb site will be approximately 106.9 feet during tank drain. This is the peak HGL condition the OLSF pumps will experience. Assuming an empty tank at elevation 32 feet, the highest TDH condition the pumps will experience is 74.9-feet. TDH lower than this will be managed using control valves inside the station.

Instantaneous peak HGL was noted and provided for in the pump selection, however **Table 5-1 represents 4-Min running averages of the modeled HGL for the JRTP system during tank drain operations.*

5.1.3 Offline Storage Pumping Capacity

The offline storage pumping capacity is based on the required OLSF fill and discharge rates associated with the YRTP and JRTP dry weather diurnal flows and their target minimum flow rates as defined in Section 5.1.1 and in the OLSF drain/fill schedule shown in **Table 5-1**. Preliminary pump evaluations for this application included Fairbanks, WEMCO, and Flygt. See Appendix F for pump and system curve information.

Table 5-1: Offline Storage Facility Drain/Fill Schedule

				To JRTP		To YRTP		
Time	Dry Weather System HGL (ft)	Tank Operation	Required Rate (gpm)	Tank Rate (gpm)	Model HGL	Tank Rate (gpm)	Low HGL (ft)	High HGL (ft)
0:00	34	Drain	1,144	1,144	49	0	35	55
1:00	33	Drain	3,299	3,299	65	0	35	55
2:00	32	Drain	5,174	4,516	78	658	35	55
3:00	32	Drain	6,441	5,141	81	1,300	*35*	*55*
4:00	32	Drain	6,694	5,098	80	1,596	*35*	*55*
5:00	32	Drain	6,399	4,827	67	1,573	*35*	*55*
6:00	33	Drain	4,653	3,493	51	1,160	*35*	*55*
7:00	35	Drain	1,594	1,594	40	0	35	55
8:00	37	Fill	629			629	35	55
9:00	38	Fill	2,039			2,039	35	55
10:00	38	Fill	2,945			2,945	35	55
11:00	38	Fill	2,745			2,745	35	55
12:00	38	Fill	2,982			2,982	35	55
13:00	37	Fill	2,377			2,377	35	55
14:00	37	Fill	1,616			1,616	35	55
15:00	36	Fill	1,524			1,524	35	55
16:00	36	Fill	1,454			1,454	35	55
17:00	36	Fill	1,840			1,840	35	55
18:00	37	Fill	2,143			2,143	35	55
19:00	38	Fill	2,726			2,726	35	55
20:00	38	Fill	3,152			3,152	35	55
21:00	38	Fill	3,376			3,376	35	55
22:00	37	Fill	2,741			2,741	35	55
23:00	36	Fill	1,171			1,171	35	55

5.1.3.1.1 Additional Offline Storage

The preliminary design utilizes a 2.5 MG tank to manage dry weather flows, however accommodations for a second 2.5 MG tank have been provided on the proposed site. Considerations for including the second tank in the current design are noted below:

- Provides backup EQ capacity in the event the primary tank is out of service for cleaning, repair or replacement
- Provides additional system pressure relief during wet weather events
- Construction of two tanks simultaneously, while increasing overall project cost, would reduce the cost/tank

Scenario 5 in Appendix H demonstrates how the station can direct excess flow to the OLSF during wet weather conditions.

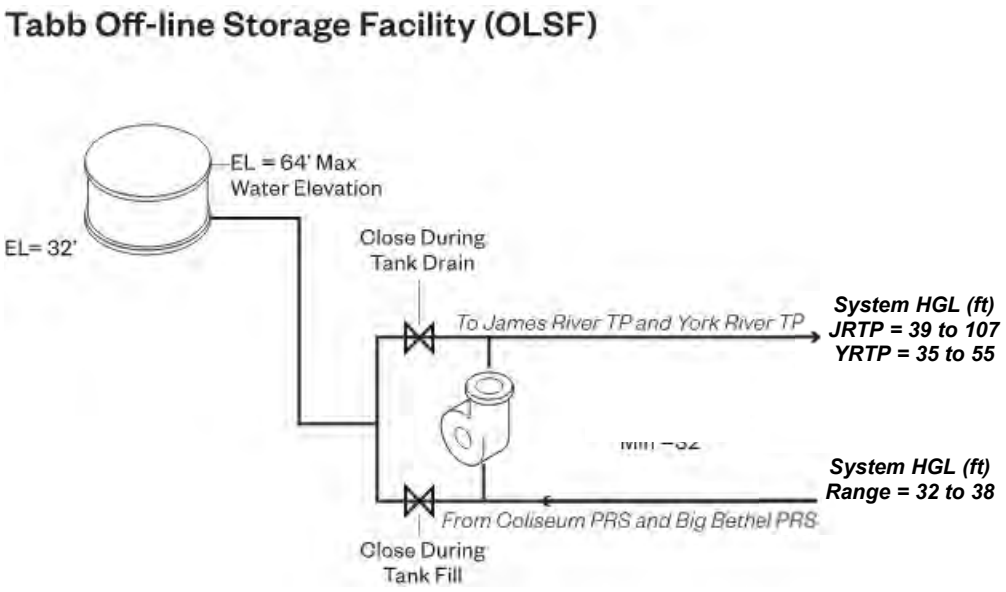


Figure 5-3: OLSF Pump Diagram

5.1.3.2 *Hydraulic Grade Line Break Considerations*

A hydraulic grade line break was considered for the OLSF. This approach would allow the interceptor system to float at the OLSF and create and "open to atmosphere" condition that could reduce impacts of NPHSA related to typical closed system operations. The following are considerations related to this type of operation:

- Tank fill operations would be limited to system HGL – See Section 5.1.2.1.1-System Pressure Fill / Tank Pressure Discharge for description.
- Lowering of the OLSF could improve tank fill operations however the associated costs are significantly higher than a tank at grade.

- Higher operational risk of SSOs due to reliance on mechanical means to limit tank overflow
- Additional risk offsite odors could occur due to required “open to atmosphere” condition

Based on the considerations noted above this option was excluded from further consideration.

6. Offline Storage Facility Tank Design

The offline storage facility (OLSF) design consists of water retaining structure(s), piping and accessories. Wastewater is pumped from the PRS to the OLSF and then pumped out of the OLSF into the forcemain network. Design considerations are discussed below.

6.1 Construction Alternatives

6.1.1 Cast in Place (CIP)

Cast-in-place (CIP) concrete tank design in accordance with ACI 350-Code Requirements for Environmental Engineering Concrete Structures, is the most commonly employed method for constructing water retaining structures in wastewater applications as the tank geometry options are virtually unlimited. The tank would consist of cast in place concrete slab and walls with a precast concrete plank roof to reduce overall cost.

6.1.2 Prestressed Concrete

Pre-stressed concrete tanks as manufactured by the Crom Corporation and Precon Corporation are constructed in accordance with ACI 350 and AWWA D110 - Wire-and-Strand-Wound Pre-stressed Concrete Water Tanks. They are limited in their geometry to round or semi round designs, however, due to their method of construction wall and roof thicknesses are significantly less than that of Cast-in-Place concrete tanks. They can be constructed in less time and can offer substantial cost savings without compromising service or longevity.

6.1.3 Cost Comparison

As indicated above, prestressed concrete tanks provide a substantial cost savings over CIP construction. **Table 6-1** below presents a cost comparison for various tank sizes considered for this project.

Table 6-1: CIP vs Prestressed Concrete Tank Cost Comparison

Capacity (MG)	CIP Tank Cost	CIP Cost/Gallon	Prestressed Tank Cost	Prestressed Tank Cost/Gallon
2.5	$3.1M	$1.24	$1.7M	$0.68
3	$3.5M	$1.17	$1.9M	$0.63
4	$4.2M	$1.05	$2.2M	$0.55
5	$4.8M	$0.96	$2.7M	$0.54

Pre-stressed Concrete tank manufacturers can construct tanks to almost any specified dimensions, however there are standard height to diameter ratios that provide for the most economical design for dome covered tanks. The costs presented in **Table 6-2** below demonstrate the importance of considering standard height to diameter tank ratios in the design process.

Table 6-2: Pre-stressed Concrete Tank Cost Comparison

Capacity (MG)	Tank Diameter (FT)	Tank Height (FT)	Prestressed Tank Cost	Prestressed Tank Cost/Gallon
2.5	100	42.6	$1.7M	$0.68
2.5	130	25	$1.9M	$0.74
3	120	35.5	$1.9M	$0.63
3	143	25	$2.2M	$0.74
4	125	43.6	$2.2M	$0.55
4	165	25	$2.7M	$0.67
5	135	46.8	$2.7M	$0.54
5	185	25	$3.1M	$0.64

6.1.4 Recommendations

Based on cost, available footprint, reliability, and construction duration we recommend proceeding with a round pre-stressed concrete tank that is designed using standard height to diameter tank ratios. The current preliminary site plan incorporates two 2.5 MG / 155 ft. diameter prestressed concrete tanks with a 32 foot operating range. A 155-foot diameter was used to determine the largest footprint the site can accommodate however a 100-foot diameter tank would represent the most economical tank design.

6.1.5 Offline Storage Facility Tank Design Elements

The offline storage facility is proposed to be a pre-stressed concrete tank design constructed in accordance with AWWA D110 with a pile supported reinforced concrete floor slab and free-span concrete dome. The floor will be constructed with a slope between 3% and 6% to a center outlet pipe to facilitate cleaning. the dome will have a rise of 1:10 to 1:12 to allow for access and maintenance. Odor control ductwork will be provided as well as washdown system and tank mixers in accordance with VA SCAT regulations. Tank access will be provided via wall mounted man-ways and dome mounted access hatches. An example of a prestressed concrete tank under construction is shown in **Figure 6-1** below. See Appendix G for preliminary tank and facility drawings.



Figure 6-1: Pre-stressed Concrete Tank Example

6.1.5.1 *Tank Wall Design and Corrosion Protection Options*

There are four AWWA D110 wall designs, however Type II and Type III tanks are the designs most commonly used in the Mid-Atlantic and South-Eastern United States.

6.1.5.2 *Type II Composite Wall Design*

The Type II composite wall design is the most common type of round precast concrete tank design. The steel diaphragm provides the water retaining core and is supported by vertical steel reinforcement and circumferential prestressing wire with a shotcrete overcoat both inside and out as shown in **Figure 6-2** below. After the floor is cast, the steel diaphragm is erected to full height and circumference and all work is performed vertically.

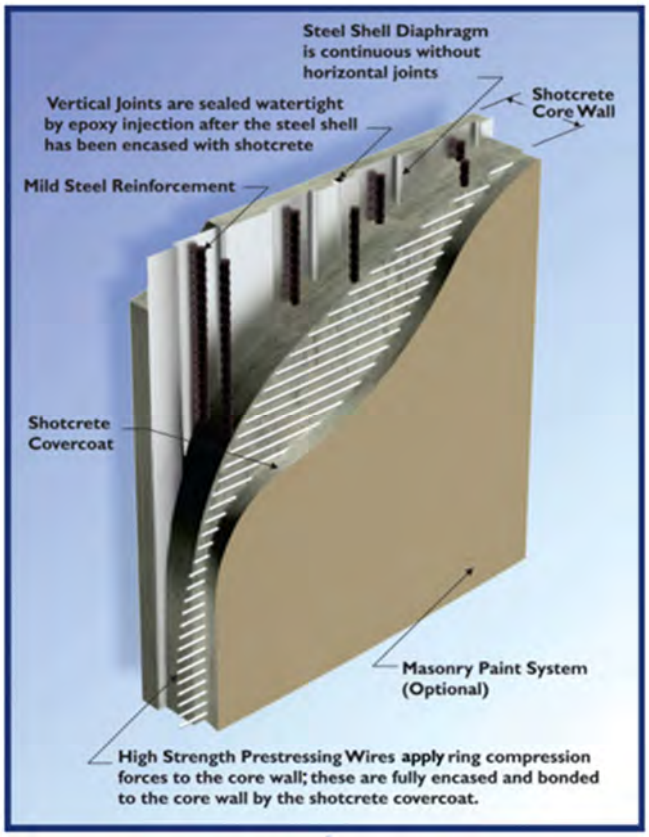


Figure 6-2: AWWA D110 Type II Composite Wall Design - Courtesy of Crom Corporation

6.1.5.3 *Modified Type III Wall Design*

For Type III wall tanks, the walls are cast in sections horizontally and then tilted up and vertical joints sealed as opposed to the Type II wall construction. One advantage to this design is the ability to cast a HDPE liner into the wall sections. The HDPE liner takes the place of the steel diaphragm as the primary water retaining component and provides the highest level of corrosion protection when coupled with a HDPE lined dome. The disadvantage to the Type III wall is that multiple wall sections provide multiple opportunities for leakage. Unfortunately, there are significant challenges in ensuring that the liner is completely sealed. Both Crom and Precon expressed that they are fully capable of building a HDPE lined tank, however neither recommended this option, as they have considerably more experience in successfully constructing leak free Type II wall tanks.

6.1.5.4 *Corrosion Protection*

As the tank will continuously be exposed to raw wastewater and consequently high levels of H2S, corrosion protection is a significant component of the tank design. Hazen discussed corrosion protection options with both Crom and Precon. The following options offer varying degrees of corrosion protection.

6.1.5.4.1 Calcium aluminate cement mortar lining on walls and HDPE lined dome

Calcium aluminate cement mortar is commonly used in the lining of manholes and wetwells to protect the concrete surfaces from moderate H2S corrosion. A disadvantage of calcium aluminate is that the substrate concrete must be properly prepared and dry, and the mortar applied prior to tank stressing to avoid failure upon tank filling. A properly applied calcium aluminate mortar lining should last the life of the tank but is not recommended for pre-stressed concrete tanks that have already been placed into service. A HDPE sheet liner can be cast into the dome to provide the highest level of protection against corrosion. Average cost for this option is approximately $12-$15/SF.

6.1.5.4.2 Epoxy coating walls and HDPE lined dome

An epoxy coating such as Tnemec Series 218 MortarClad can be applied to the walls, and a HDPE sheet liner can be cast into the dome. A properly applied epoxy coating provides a higher level of protection against H2S corrosion that calcium aluminate, however the life of the coating is limited to 10-15yrs at which time the tank would need to be removed from service, existing coating removed and a new coating applied. Average cost for this option is approximately $15-$20/SF.

6.1.5.4.3 HDPE lined walls and dome

Full lining with HDPE provides the highest level of corrosion protection for the entire tank, however it requires a Type III wall construction as discussed above. Average cost for this option is approximately $20-$30/SF.

6.1.5.4.4 Recommendations

Based on the challenges related to Type III wall tanks and reluctance by both tank manufacturers to recommend a Type III wall tank, we recommend proceeding with a Type II wall tank with a lined dome, calcium aluminate cement mortar lining on the walls, and waterproofing admixture in the floor concrete. However, further discussion/consideration of an epoxy coating system may be entertained during the detailed design phase of this project.

6.1.5.5 *Tank Mixing Options*

Several options are available to provide for tank mixing as it helps to keep solids in suspension reducing sedimentation buildup on the tank floor and reduces odor potential.

6.1.5.6 *Through-Wall Mixers*

Through-wall propeller mixers such as those such as those manufactured by Flygt, Landia and Sulzer can be installed through the side of the tank and are currently in service at the Coliseum OLSF. However, this style mixer requires holes constructed in the sides of the tank which is not preferable to the tank manufacturers as they provide additional areas for potential leakage. Additionally, removal of the mixers for maintenance and or de-ragging requires the tank be taken out of service. An example of a through wall mixer is shown in **Figure 6-3** below.



Figure 6-3: Through Wall Mixer - Courtesy of Landia Inc.

6.1.5.7 *Submersible Mixers*

Submersible Mixers such as those manufactured by Flygt, KSB, Landia and Sulzer can be installed inside the tank on a rail system that allows the mixer height to be adjusted and allows for removal without taking the tank out of service. Mixers would be installed in locations below access hatches for maintenance and removal and can be lowered from the top of the tank using a jib crane as described in Section 6.1.7. An example of a rail mounted submersible mixer is shown in **Figure 6-4** below.



Figure 6-4: Submersible Mixer - Courtesy of Flygt Corporation

6.1.5.8 *Directional Hydraulic Mixing*

Directional hydraulic mixing can be accomplished either by nozzles installed on the inlet standpipe, or by directing the inlet pipe discharge in a way that promotes circumferential water movement inside the tank as shown in **Figure 6-5** below. This type of mixing requires no additional power supply, however the mixing only occurs during the tank filling process.



Figure 6-5: Inlet Standpipe

6.1.5.9 *Recommendations*

Based on the above stated concerns we do not recommend through wall mixers and suggest further discussion/consideration of submersible and directional hydraulic mixing options during the detailed design phase of this project.

6.1.6 Tank Cleaning Options

Tank cleaning frequency typically depends on the overall operation of the facility. When storage facilities are used primarily for wet weather events, owners may clean tanks after each use, however tanks that are used daily may only be cleaned once or twice a year to limit down time. Several options are available for tank washdown are presented below.

6.1.6.1 *Water Cannons and Hose Stations*

Water Cannons and hose stations are commonly used for wastewater tank washdown and provide the lowest capital and O&M cost method of cleaning. They can be supplied by potable or alternate sources as available. The Coliseum OLSF tank was provided with multiple hose stations at ground level around the perimeter of the tank. Hazen staff observed cleaning operations at the Coliseum OLSF tank in July 2020 as shown in **Figure 6-6**. The location of the hose stations requires tank entry, which is advantageous for de-ragging the mixers as well as overall tank inspection, but it requires confined space entry procedures and full PPE.

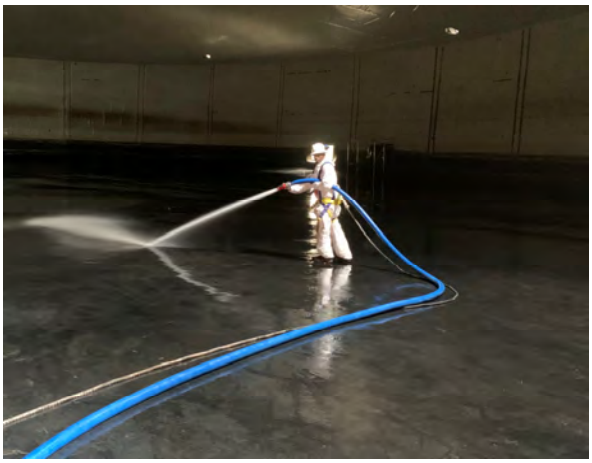


Figure 6-6: Coliseum OLSF Cleaning

Water cannons and hose stations can be provided on the dome of the tank at access hatch locations to allow washdown without requiring tank entry. An example of a water cannon is shown in **Figure 6-7** below.

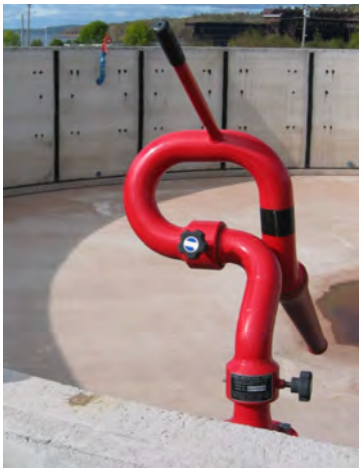


Figure 6-7: Water Cannon Example

6.1.6.2 *Deluge System*

An automated deluge washdown system similar to that currently being installed in the Providence Road OLSF could be provided consisting of a supply header and segmented deluge headers mounted around the inside perimeter of the tank as shown in **Figure 6-8** below. The deluge system could be supplied by potable or alternate sources as discussed in Section 6.1.6.2.1 below. Spray nozzles are mounted to the deluge header allowing the entire wall to be cleaned as well as the tank floor. Deluge header lengths are determined based on the available flowrate to achieve a minimum velocity of 2fps across the tank floor to

flush solids to the center outlet. Control valves mounted above the dome convey flow from the supply header to deluge header segments to provide full circumferential cleaning.



Figure 6-8: Deluge System Example

6.1.6.2.1 Water Supply

Water for tank washdown can be supplied from potable sources or by alternative sources. If potable sources are used, a 6-inch to 8-inch RPZ style backflow preventor located in an insulated and heated enclosure will be required on the supply piping.

A rainwater cistern sized for a complete tank washdown can also be provided. The cistern would collect rainwater piped from the tank domes and PRS roofs. An overflow would be provided to allow excess water to exit the cistern and convey it to the stormwater BMP. Submersible chopper style pumps would be designed to supply the target flow and head to the water cannons/hose stations or deluge system. **Figure 6-9** below depicts the cistern location in relation to the PRS and OLSF.



Figure 6-9: Deluge System Water Supply

6.1.6.3 *Recommendations*

Based on proposed the daily use of this tank we recommend water cannons and hose stations rather than a deluge system. We suggest further discussion/consideration of the water supply options during the detailed design phase of this project.

6.1.7 Tank Access and Accessories

We recommend the following tank access provisions and accessories:

- Two Standard tank manways located 180 degrees apart for ground level tank entry
- A Full height stairway to allow easy access to the tank dome for maintenance and inspection
- Circumferential concrete parapet wall to provide fall safety as well as means for capturing rainfall runoff to be diverted to the cistern for tank washdown
- Multiple dome mounted dual leaf access hatches to provide access to the mixers, allow for visual inspection and provide a light source
- One or more dome mounted jib crane(s) to raise and lower tools and equipment

An example of the various accessories is shown in **Figure 6-10** below.



Figure 6-10: Tank Access and Accessories

7. Pressure Reducing Station Facility Design

This section discusses primary features of the preliminary design for the PRS and tank pump facility. Appendix G contains preliminary concept plans indicating overall facility dimensions, interior components, and proposed equipment.

All components of the proposed facility were designed in accordance with HRSD Design and Construction Standards (revised January 2020), and the International Building Code standards.

7.1 Conceptual Floor Plan

The following section outlines approaches to the architectural design including code compliance issues related to occupancy, type of construction, fire resistance of materials, interior finishes, fire prevention and separation, fire protective systems, means of egress, accessibility, interior environment, exterior wall construction, roof construction, and exterior appearance.

7.1.1 General Overview of Governing Codes

Codes, standards, and references will provide the minimum standard for fire resistance, serviceability and quality of materials used for construction. The following codes will govern the design of the building: 2015 Virginia Uniform Statewide Building Code (VUSBC) incorporating 2015 International Building Code with Virginia amendments; 2015 Virginia Plumbing Code incorporating 2015 International Plumbing Code with Virginia amendments; 2015 Virginia Mechanical Code incorporating 2015 International Mechanical Code with Virginia amendments; 2015 Virginia Statewide Fire Prevention Code, incorporating 2015 International Fire Code with Virginia amendments; 2015 Virginia Energy Conservation Code incorporating 2015 International Energy Conservation Code; and the NFPA 70 – 2014 as referenced by Chapter 27 of the Virginia Construction Code.

Accessibility issues will be governed by Chapter 11 of the VUSBC incorporating ANSI/ICC A117.1. Additional federal, state, and local codes, standards and references will be coordinated and applied in accordance with the 2015 VUSBC.

A partial list of these codes and standards follows:

- ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry
- ACI 530.1/ASCE 6/TMS 602 – Specification for Masonry Structures
- American with Disabilities Act
- NFPA 10 – Portable Fire Extinguishers
- NFPA 13 – Installation of Sprinkler Systems
- NFPA 30 – Flammable and Combustible Liquids Code
- NFPA 80 – Fire Doors and Fire Windows
- NFPA 704 – Identification of Fire Hazards of Materials
- UL Fire Resistance Directory

In addition to the state and federal codes, local regulations additionally impact the design of the buildings and include Zoning Regulations. The impacts of zoning regulations on buildings include, but is not limited to, building area, building height, parking, landscaping, signage, and noise.

7.1.2 Proposed Building

The pump station building will house pumping and related equipment and include a pump room, electrical/control room, generator room, restroom, and stairs. The following criteria have been considered in the preliminary facility layout:

- Occupancy
    - The building will not be continuously occupied.
    - The building will be entered for monitoring, maintenance, and repair.
    - The primary occupancy and use of the pump station building will be Low Hazard Factory/Industrial (F-2).
    - The building will be entered by employees and escorted visitors.
    - The building will not be designed for accessibility as the building meets the requirements for exception 1103.2.9 equipment spaces within the VUSBC.
    - The number of occupants according to the code in these areas is 1 person for each 300 square feet.
- Exit Requirements
    - The occupancy number is used to determine size and number of exit components required, number of toilets, and parking spaces required.
    - Exit requirements may not be changed; however, number of toilets and parking spaces may be reviewed with the local authority to determine right sizing based on actual employee count.
- Egress
    - The building will be designed to provide adequate egress from the building and each room.
    - The lower pump room will require two means of egress.
    - One exit will be an enclosed fire rated stair and the second an open stair with an overall travel distance less than 300 feet and common paths of travel less than 75 feet.
    - Exits will open directly to the exterior, or stairwell and be located as remotely from each other as possible.
    - Panic hardware will be provided from electrical rooms.
    - Illuminated exit signage and emergency lighting will be placed throughout the building.
    - The common path of travel distance within a room or space with one exit will not exceed 75 feet.
    - Travel distance to the nearest exit from any point in the building will not exceed 300 feet.
    - Travel distance will be measured to include travel around fixed pieces of equipment.
    - Equipment and rooms will not create common path of travel that exceeds 75 feet.
    - Paths of travel will not proceed from a room of low hazard to a room of higher hazard
- Fire Suppression

- The building is not required to be provided with a fire alarm system or a fire suppression system in accordance with the building code. HRSD may install a fire alarm system or fire suppression system. Fire extinguishers will be located throughout the building and will be compatible with the contents of the room.

7.1.2.1 *Materials of Construction*

The building will be constructed of non-combustible materials primarily consisting of concrete, masonry and steel. The building will have a braced structural steel frame, insulated masonry cavity walls and a gable roof with a standing seam roofing system. Interior walls will be non-loadbearing and consist of painted or glazed concrete masonry. The building code recognizes this type of construction as 2B. Buildings constructed of 2B construction are limited to an area of 23,000 square feet plus allowed increases, with a maximum height of 55 feet and three stories. The proposed building will be smaller than the 23,000 square feet allowed.

7.1.3 Interior Finishes

Interior finishes will meet the flammability requirements of the building code. Metal surfaces, including structural members, will be epoxy painted or factory finished. Interior walls will be concrete masonry units painted with a low VOC acrylic epoxy paint, or glazed masonry units will be utilized. Concrete walls will be painted only when incorporated into a concrete masonry wall or a finish is desired. Exterior walls will be loadbearing masonry and utilize an insulated cavity wall design. The cavity wall design will consist of an interior wythe of concrete masonry or concrete and an outer wythe of brick to match and complement existing building design. A continuous drainage cavity with insulation will be formed between the wythes of masonry to enhance energy performance. The cavity will include a dampproofing applied to the exterior face of the concrete masonry, 2 inches of rigid insulation, and a 1-inch airspace. The cavity will drain through a series of weep vents above the through-wall flashing. A cavity drainage mat will be used to ensure an open drainage plane. The walls will be reinforced to resist loads as required by the building code.

7.1.4 Facility Exterior Finishes

The Tabb PRS and OLSF is located in a moderately visible location. The existing site is wooded, allowing some level of visual buffer however clearing of the site will create an opportunity for additional visual impacts to the adjacent residential and school property. With that in mind, all vertical site structures will be in accordance follow the HRSD Pump Station Architectural Guidelines as well as the Architectural and Landscaping Design Review Process.

The preliminary design provides a gable roof and slope to gutters and downspouts. Gable roofs will be developed by steel trusses. The roof system will consist of a metal deck, rigid roof insulation, roof cover board, underlayment, and standing seam metal roof system. Roof penetrations will be limited, and no equipment will be provided on the roof.

The exterior appearance is proposed to resemble a small commercial or large residential building. Where appropriate, banding will be incorporated to break up the overall mass of the building. Openings will be provided and grouped to break up facades and provide a rhythm to the building. The openings will be slightly recessed to accentuate the change of materials.

Additional discussion regarding exterior finishes and treatment will be coordinated through HRSD's Architectural Review Committee (ARC) during the design process.

7.1.5 OLSF Exterior Finishes

7.1.5.1 *Brick Veneer*

One consideration for the OLSF tanks is to provide a brick veneer that matches the pump station. This aesthetic treatment could reduce the visual impact to the adjacent properties. Where a brick veneer is provided a cavity would be provided behind the brick veneer to allow drainage. Weeps would be placed at the bottom of walls and above grade. Expansion joints would be provided at regular intervals to minimize future cracking of the brick. The brick would be tied to the concrete tanks with brick ties at 16-inches on center.

7.1.5.2 *Blending*

The pre-stressed concrete tank will have a concrete exterior that will receive a coating system. This provides the opportunity to select colors or mural style treatments that create a blending effect. **Figure 7-1** demonstrates how color and design can significantly reduce the visual impact of the OLSF.



Figure 7-1: Storage Tank with Blending Treatment

7.2 Instrumentation and Control Considerations

The proposed pressure reducing station/offline storage facility will have the following controls and/or instruments:

7.2.1 Check Valve Limit Switches

A limit switch will be provided on each sewage pump discharge check valve with the switch energized/de-energized by a paddle mounted to the outside lever and weight system. The main purpose of the switch is to provide a pump failure alarm and can also assist in activating the anti-cavitation device.

7.2.2 Level Transmitters

Non-contact Radar level transmitters will be provided in the offline facility tanks for the start-stop control of the tank pumps and to provide all alarm functions within the tank. Hazen will coordinate with HRSD during design to confirm the specific level transmitter to be used.

7.2.3 Discharge Header Pressure Transmitter

A single digital transmitter is used on the discharge header pipe for pressure indication back to the control panel. This transmitter is for control purpose of the pressure reducing pumps start/stop functionality purposes only.

7.2.4 Suction Header Pressure Transmitter

A single digital transmitter is used on the suction header pipe for pressure indication back to the panel. This transmitter is for control purposes of the pressure reducing pumps setpoint functionality purposes as well as low suction pressure cutoff for all pumps.

7.2.5 Flow Meters

Ultrasonic flow meters will be installed on the suction and discharge force main to meter the pump flow. There will be 3-ultrasonic flow meters (FIT-4. FIT-5, and FIT-6) incorporated on the tank fill/drain lines for control signals to the control panel for controlling the setpoint of the control valves in the lines. There will be 1-Ultrasonic flow meter (FIT-3) on the suction line from Big Bethel PRS, Coliseum PRS, and city of Poquoson. There will be 2-Ultrasonic flowmeters (FIT-1 and FIT-2) incorporated on the discharge lines in the control vaults for input monitoring of the flows being sent to James River and York River treatment plants.

7.2.6 Remote Flow Meter Analog Signals

The pressure reducing facility will have remote analog inputs into the local control panel from James River and York River Treatment plants for controlling pump discharge flow rates via VFDs and control valves on the respective discharge lines to the plants when deemed necessary.

7.2.7 Pressure Gauges

4.5-inch diameter pressure gauges shall be installed on the upstream and downstream side of the pumps.

7.2.8 Float Level Switches

Intrinsically safe float switches will be installed in the tanks for high level and low-level control/alarms for failsafe operation to the control panel and incorporated into the Control Panel/SCADA.

7.2.9 Control Panel

A single control panel and PLC will be provided by the contractor to monitor and control the proposed pressure reducing/offline storage facility. An operator interface will be provided in the control panel to provide graphic displays representing major equipment and systems in the station. Additionally, a remote operator interface will be provided in the lower level pump room to provide the operator visual awareness of the pump room components. This interface will allow the operators to see the status of major systems, execute control functions, and view alarms. Status, control, and alarms monitored by the local PLC will be transmitted to the PLC/SCADA RTU panel in accordance with HRSD Standards.

7.2.10 Tank Level Controls

The level transmitter in each tank will be used to maintain level control of the tank and pumps as listed below and alarms. The high-high level and low-low float switches will be utilized as alarms back into the PLC/SCADA RTU.

1. Low Water Level/Pump Shutdown
2. Low-low Water Level Alarm
3. Tank Pump Off
4. Tank Pump On
5. High Level
6. High-High Level Alarm
7. High Level Reset

7.2.11 Station Wireless Communication

The design will include all necessary peripheral equipment for the RTU/SCADA system for wireless 4G cellular communications by Verizon, back to HRSD's main server SCADA systems. A backup cellular modem capable of 3G/2G service in case of 4G interruption. All equipment will coordinate with HRSD during the design and will be in accordance with HRSD's Design and Construction Standards.

7.2.12 Proposed flow scenarios

Proposed flow scenarios and planning level functional descriptions were developed to demonstrate the PRS and OLSF functionality and ensure the necessary control elements are included in the design. See Appendix H for a visual representation of the below flow scenarios:

- **Scenario 1** – PRS (OFF) / Equalization (OFF)

  Flow from NF-024 (to the YRTP) continues through the station with no additional pumping or storage and discharges to NF-011 (to the YRTP).

- **Scenario 2** – PRS (OFF) / Equalization (FILL)

  Operator adjustable time setpoints (normally between 8am and midnight)

  Flow from NF-024 (to the YRTP) enters the site and a portion is stored in the OLSF. The remaining flow discharges to NF-011 (to the YRTP)

- **Scenario 3** – PRS (OFF) / Equalization (DISCHARGE)

  Operator adjustable time setpoints (normally between midnight and 8AM)

  - **Scenario 3A** – PRS (OFF) / Equalization (DISCHARGE to JR)

    In addition to baseline flow from NF-024 (to the YRTP), OLSF tanks are discharging to NF-207 (to the JRTP).

  - **Scenario 3B** – PRS (OFF) / Equalization (DISCHARGE TO YR)

    In addition to baseline flow from NF-024 (to the YRTP), OLSF tanks are discharging to NF-011 (to the YRTP).

- **Scenario 4** – PRS (ON) / Equalization (OFF)

  Assuming no tank drain operations during PRS operation.

  Flow from NF-024 (to the YRTP) enters the site and pressure reducing pumps are activated, reducing upstream pressure in the NF-024 service area.

- **Scenario 5** – PRS (ON) / Equalization (FILL)

  Flow from NF-024 (to the YRTP) enters the site and pressure reducing pumps are activated, reducing upstream pressure in the NF-024 system. A portion of the flow is stored in the OLSF.

  - **Scenario 5A** – PRS (ON) / Equalization (Discharge) – NOT A SCENARIO

- **Scenario 6** – PRS (ON) – (REVERSE FLOW-YRTP to JRTP) /Equalization (OFF)

  In the event there is a downstream failure in NF-011 (to YRTP), flow enters the site and pressure reducing pumps are activated. Flow discharges to NF-207 (to JRTP).

- **Scenario 7** – PRS (ON) – (REVERSE FLOW-JRTP to YRTP) / Equalization (FILL)

  In the event there is a downstream failure in NF-207 (to JRTP), flow enters the site and pressure reducing pumps are activated. Flow discharges to NF-011 (to the YRTP).

7.3 Electrical Considerations

The electrical design will be in accordance with the National Electric Code (NFPA 70), NFPA 820-2020, and the 2020 HRSD Design and Construction Standards. A new 480V underground three-phase service from Dominion Energy will be brought to the station, with the service transformer located on the station site. All major electrical equipment (switchboard, MCC, VFDs, PLCs, etc.) will be housed in a dedicated, climate-controlled electrical room.

The design will have the following major components:

- Consolidated service entrance and distribution switchboard consisting of Dominion metering section, main breaker, ATS, and distribution sections. Main breaker will be drawout power circuit breaker type, with a permanent remote control station installed outside of the arc flash boundary.
- Standby diesel generator housed in a generator room. Bulk fuel storage will be an aboveground concrete-encased tank ("Convault") with a day tank and fuel polisher in the generator room. Load bank and portable generator connections will be accomplished with a three-way manual transfer switch with Leviton 18 Series camlock receptacles.
- Yaskawa U1000 VFDs for all process equipment requiring VFDs. The pressure reducing pumps will additionally have RVSS bypasses.
- Motor control center(s) for non-VFD process equipment and HVAC loads.
- 120/208V transformer and panelboard for lighting/receptacle and miscellaneous circuits.
- Cable trays in the electrical room for power and control circuits.
- Cable trays and submersible junction boxes in the pump room to facilitate easier access to and disconnection of pump cables when removing/installing pumps.
- All-LED lighting:
    - Interior lighting will be 4000K.
    - Exterior and site lighting will be 3000K and full-cutoff to minimize light pollution. Lights will be controlled via individual integral photocells or a single photocell paired with a lighting contactor.
    - Emergency lighting will be based on individual unit backups, but emergency lighting inverter(s) are a possible alternative to simplify the lighting installation and reduce maintenance.

7.4 HVAC Considerations

The HVAC designs will be based on the 2015 Virginia Building Codes, designed to meet the minimum requirements of the 2015 International Energy Conservation Code and NFPA 820. Weather data and

design conditions will be based upon ASHRAE 99% winter and 1.0% summer conditions for Norfolk, Virginia. Weather design criteria are summarized in **Table 7-1**.

Table 7-1: Weather Design Criteria

Item	Design Criteria
Outside Winter Design Temperature	20 °F DB
Outside Summer Design Temperature	93 °F DB/ 77 °F WB

7.4.1 Pump Building - HVAC

7.4.1.1 *Electrical Room*

Heating, ventilation and air conditioning will be provided to the Electrical Room to maintain temperatures above 50-degree F when heating and below 85 degrees F during cooling seasons. Space conditioning will be provided by an electric split system heat pump unit with outside air and economizer capabilities. The unit will come complete with backup electric resistance heat. The manufacturers standard thermostat will be installed to control the units to meet setpoint temperatures. The electrical room will be designed in accordance with **Table 7-2**.

Table 7-2: HVAC Design Criteria for Electrical Room

Item	Design Criteria
Heating Design Temperature	Above 50 °F
Cooling Design Temperature	Below 85 °F
Controls	Space Thermostat

7.4.1.2 *Pump Room*

The pump room will be ventilated to comply with NFPA 820, table 4.2.2(a) – line 15a. Inline supply air fans will introduce outside air at the rate of 6 continuous air changes. Exhaust fans will exhaust air to the outside at a rate of 6 continuous air changes. The fans will be monitored for failure. Failure of the system to provide 6 continuous air changes will be indicated by a horn/strobe assembly mounted inside the space and at the entrance doors to the space.

Heat will be provided to the space by the electric unit heaters. The unit heaters will be controlled by unit mounted thermostats.

The pump room will be designed in accordance with **Table 7-3**.

Table 7-3: HVAC Design Criteria for Pump Room

Item	Design Criteria
Heating Design Temperature	Above 50 °F
Continuous OA Requirements	6 air changes - continuous
Controls	Airflow/motor monitoring, unit mounted thermostat

7.4.1.3 *Restroom*

The restroom will be exhausted per the Virginia Mechanical Code and will be heated by a wall mounted electric unit heater.

The restroom will be designed in accordance with **Table 7-4**.

Table 7-4: HVAC Design Criteria for Restroom

Item	Design Criteria
Heating Design Temperature	68 °F
Controls	Unit mounted Thermostat
Exhaust Fan	Wall switch

7.4.1.4 *Generator Room*

Heating and ventilation will be provided to the Generator Room to maintain temperatures above 50-degree F when heating and below 105 degrees F during cooling seasons. Heating will be provided by electric unit heater(s). Ventilation will be provided wall roof mounted exhaust fan and intake louvers. Ventilation during generator operation will be by intake louver and generator radiator exhaust through an exhaust louver. The generator room will be designed in accordance with **Table 7-5.**

Table 7-5: HVAC Design Criteria for Generator Room

Item	Design Criteria
Heating Design Temperature	Above 50 °F
Cooling Design Temperature	Below 105 °F
Controls	Space Thermostat

7.4.1.5 *Enclosed Stairs*

The enclosed stairs will be pressurized with outside air to maintain a positive pressure relative to the pump room.

7.5 Plumbing and Water Service Considerations

7.5.1 Building Plumbing

Potable water will be routed to the restroom area. A main shutoff valve and backflow preventer will be installed in the main service line. Cold potable water piping will be extended to an instantaneous domestic water heater, plumbing fixtures and other fixtures/potable water devices. Hot potable water piping will be extended from the water heater to the plumbing fixtures.

Waste piping will be routed to a pre-engineered packaged pumping station that will discharge to the PRS header system.

7.5.2 Fire Suppression Requirements

There is no fire suppression system proposed for the new pump building.

7.6 Structural Considerations

This section summarizes the basis of structural design and provides guidelines for use during final design for the Tabb PRS and OLSF. Among the information included herein are the codes and standards required for use in the structural design and the basic design loads to be utilized. Also included are the specific design requirements of likely construction materials and components that are being considered for the final design and incorporation into the proposed structures.

Preliminary geotechnical input is provided based on an investigation conducted by GET Solutions, Inc. and summarized in a report dated September 18, 2020 and included in Appendix B. This report is based on borings taken adjacent to the area where the proposed structures will be constructed. Land acquisition and necessary clearing would not allow an investigation to include borings within the footprint of the proposed structures and utilities. Therefore, additional geotechnical investigation work including additional borings will be required prior to proceeding with comprehensive design. However, the findings of the preliminary investigation will be used as assumptions for the design parameters and construction issues likely to be encountered including means of subgrade support of the structures, settlement potentials, lateral earth pressures, seismic parameters including site classification, excavation support and grading requirements, and groundwater concerns for design and construction, etc. These preliminary recommendations will be used for describing the likely approach to constructing the proposed facilities.

7.6.1 Codes, Standards, References

7.6.1.1 *Governing Code*

In no case shall the strength, serviceability, or quality standards be less than that required by the Governing Building Code. The Governing Building Code for the Tabb Reducing Station and Offline Storage Facility shall be the Virginia Uniform Statewide Building Code (USBC) – 2015 Edition which includes the Virginia Construction Code, and the Virginia Maintenance Code. The USBC is based on the 2015 Edition of the International Building Code.

7.6.1.2 *Supplemental Codes*

Selected provisions from the following codes will also be used for structural design work, as applicable.

- American Society of Civil Engineers — ASCE 7 Minimum Design Loads for Buildings and Other Structures
- American Society of Civil Engineers — ASCE 24 Flood Resistant Design and Construction

7.6.1.3 *Codes and Standards for Specific Materials*

Design of specific materials will be performed in accordance with the standards, codes, and specifications adopted by the USBC as listed below.

7.6.1.4 *All Materials*

The American Society for Testing and Materials (ASTM) standards, as referenced by the USBC or the other codes, standards, or specifications listed herein.

7.6.1.5 *Concrete*

- ACI 318, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute.
- ACI 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary, American Concrete Institute.
- ACI 350.3, Seismic Design of Liquid-Containing Concrete Structures, American Concrete Institute
- ACI 301, Specifications for Structural Concrete, American Concrete Institute.

7.6.1.6 *Masonry*

- ACI 530, Building Code Requirements for Masonry Structures and Commentary, American Concrete Institute.
- ACI 530.1, Specifications for Masonry Structures and Commentary, American Concrete Institute.

7.6.1.7 *Steel*

- AISC 360, Specification for Structural Steel Buildings, American Institute of Steel Construction.
- AISC 341, Seismic Provisions for Structural Steel Buildings, including Supplement No. 1, American Institute of Steel Construction.
- AISC 303, Code of Standard Practice for Structural Steel Buildings and Bridges, American Institute of Steel Construction.
- RCSC, Specification for Structural Joints Using High-Strength Bolts, Research Council on Structural Connections.
- AWS D1.1, Structural Welding Code – Steel, American Welding Society.
- AWS D1.3, Structural Welding Code – Sheet Steel, American Welding Society.

- S100 North American Specification for the Design of Cold-Formed Steel Structural Members, American Iron and Steel Institute.

7.6.1.8 *Stainless Steel*

- ASCE 8, Standard Specification for the Design of Cold-formed Stainless-Steel Structural Members, American Society of Civil Engineers.
- AISC Design Guide 27, Structural Stainless Steel, American Institute of Steel Construction.

7.6.1.9 *Aluminum*

- Aluminum Design Manual (ADM) Specifications & Guidelines for Aluminum Structures, Aluminum Association.
- AWS D1.2, Structural Welding Code – Aluminum, American Welding Society.

7.6.1.10 *Fiberglass Reinforced Plastic (FRP)*

No nationally recognized codes, standards, or specifications for the design of FRP are available. Proprietary design manuals that have been referenced are listed in Section 6.7.1.11 References below.

7.6.1.11 *References*

Engineering manuals, handbooks, textbooks, articles, and technical publications that may be used for structural design include the following:

- Reinforced Concrete Design Handbook, Publications SP-17, American Concrete Institute.
- Detailing Manual, Publication SP-66, American Concrete Institute.
- Manual of Standard Practice, Concrete Reinforcing Steel Institute.
- PCI Design Handbook, Precast/Prestressed Concrete Institute.
- Masonry Designer's Guide, American Concrete Institute/Masonry Society.
- Reinforced Masonry Engineering Handbook, James E. Amrhein, Masonry Institute of America.
- Steel Construction Manual, American Institute of Steel Construction (AISC)
- Structural Steel Detailing Manual, American Institute of Steel Construction.
- Design Manual for Structural Stainless Steel, Nickel Development Institute.
- Guidelines for the Use of Stainless Steel in Municipal Wastewater Treatment Plants, Arthur H. Tuthill, Nickel Development Institute.
- Extren Fiberglass Structural Shapes – Design Manual, Strongwell Corporation.

- Dynaform FRP Structural Shapes Design Guide, Fibergrate Composite Structures.

7.6.2 Design Loads

7.6.2.1 *Dead Loads*

Dead loads are those resulting from the weight of all permanent non-removable stationary construction, such as walls, floors, roofs, permanent partitions, framing, ceilings, cladding, and permanent fixed equipment and piping. Loads from process liquids within the structure and from soil and groundwater outside the structure will not be considered as dead loads. These loads will be discussed separately in Sections 6.7.2.6 and 6.7.2.7, respectively. Unless deemed otherwise by the USBC, Dead Loads will be as follows:

Table 7-6: Dead Load

Material	Dead Loads
Concrete	150 pcf
Steel and Stainless Steel	490 pcf
Aluminum	169 pcf
Fiberglass Reinforced Plastic (FRP)	120 pcf
Concrete Masonry, CMU, 8" Lightweight (Measured over the vertical surface of the wall)	77 psf (grouted solid) 50 psf (grouted at 32" oc) 38 psf (hollow)
Concrete Masonry, CMU, 12" Lightweight (Measured over the vertical surface of the wall)	118 psf (grouted solid) 73 psf (grouted @32" oc) 55 psf (hollow)
Wood	30 to 40 pcf
Equipment Loads	See Section 6.7.2.3
Pipe Loads	See Section 6.7.2.4

7.6.2.2 *Live Loads*

Live loads technically include all nonpermanent loadings that can occur, in addition to the dead loads. Live loads are those resulting from occupancy, furnishings, and equipment. Except in administrative areas, live load reductions stated in the USBC will not be used due to the relatively high probability of simultaneous live loads in all areas. Unless deemed otherwise by the USBC, Live Loads will be as follows:

Table 7-7: Live Loads

Area	Live Loads
Working Roofs	100 psf
Non-working Roof Loads	As per USBC, including wind
Office Floors	80 psf
Process Area Floors	See Section 6.7.2.3, Equipment Loads
Corridors and Stairways	100 psf
Electrical Control Rooms	250 psf
Light Storage	150 psf
Heavy Storage	300 psf
Grated Access Platforms and Walkways	150 psf
Equipment Loads	See Section 6.7.2.3
Pipe Loads	See Section 6.7.2.4
Truck Accessible Areas	HS-20 loading
Lifting Points	Vertical Load = 2 * (Heaviest Piece of Equipment Lifted) Horizontal Load = 0.20 * (Vertical Load)
Monorail and Bridge Crane Loads	Vertical Load = Hoist System DL + (1.25*Hoist Rated Capacity) Horizontal Lateral Load = 0.20 * (Hoist Trolley DL + Hoist Rated Capacity) Horizontal Longitudinal load = 0.10 * (Hoist Trolley DL + Hoist Rated Capacity)

7.6.2.3 *Equipment Loads*

Process area operating floors are designed for the load case resulting in the maximum stresses from the following live load conditions:

- 300 psf on the entire floor area, with no additional load from equipment included.
- 150 psf on the areas not directly under equipment, plus actual equipment loads.

Equipment loads obtained from manufacturers will be used. In addition to the equipment's operating weight (including any fluids contained), other loads due to moving parts, malfunction, and maintenance will be considered. Examples of these other loads include but are not limited to the following:

- Loads from rotating equipment will include moment, torque, and lateral thrust.
- Loads from vertical turbine pumps will include dynamic suction loads and weight of water contained in the riser column.
- Loads from all equipment will include those loads induced for required maintenance, such as the removal of large components that may be temporarily placed on the adjacent floor.

- Loads from hoisting equipment such as monorails and bridge cranes will be as shown in Section 6.7.2.2.

The load option which creates the highest stress conditions shall control the design. The weight of equipment components, which could be placed on or transported across the floor, shall be located to create maximum stress conditions.

7.6.2.4 *Piping Loads*

The live loads listed above for equipment loads will be considered to include the loads from process piping that are supported by the floor below the piping. On floors and roofs that will support process piping suspended below, an additional live load allowance will be included. This allowance ranges from 25 psf to 100 psf, depending on the size and quantity of piping, anticipated to be suspended below the floor or roof.

Upon completion of the piping layout, these allowances will be reviewed for accuracy with the actual pipe configurations for pipes less than 18 inches in diameter, and the actual concentrated loads from pipes 18 inches and larger will be considered.

7.6.2.5 *HVAC, Ducts, Plumbing, and Electrical Raceway Loads*

Loads from HVAC ducts, plumbing, and electrical raceways that are suspended from floors and roofs above are typically relatively light and included within the live loads listed above. However, if these loads do get significant at selected locations, the actual loads will be considered.

7.6.2.6 *Process Liquid Loads*

Process liquid loads are based on a density of 63 and 70 pcf for water and sludge, respectively. For liquids in chemical storage tanks the actual density of the stored chemical will be used.

Static loads from process liquids and from chemicals are determined for the worst case of the following two conditions:

- Liquid surface at normal maximum operating level, or, where applicable, at the design overflow level where overflow is controlled (such as at overflow pipes or weirs). For this condition, normal allowable stresses are used when design is done by the working stress method, or the load factor for dead loads (including the environmental durability factor of ACI 350 for concrete structures) is used if design is done by the ultimate strength method.
- Liquid surface at the maximum level possible before liquid spills out of the structure (uncontrolled overflow conditions). For this condition, a 33 percent increase in allowable stresses is used, or the load factor for dead loads (excluding the environmental durability factor of ACI 350 for concrete structures) is used if design is done by the ultimate strength method.

Seismic loads from process liquids are determined as stated in Section 6.7.2.10, using a liquid surface at normal operating level. Seismic loads for liquid surface at maximum levels possible (uncontrolled overflow) are not considered.

7.6.2.7 *External Soil and Groundwater Loads*

External soil and groundwater loads shall be based on data and recommendations to be furnished by the geotechnical engineer. For preliminary designs where geotechnical information is not yet available, density of soils may be assumed to be 130 pcf and density of aggregate fills may be assumed to be 135 pcf.

Static Loads from external soil and groundwater include the following:

- Soil Pressure "At-Rest" - The Soil Pressure "At-Rest" on the external walls is the static distribution of the soil based on the soil parameters and ground water levels.
- Surcharge Pressure Live Load - The Surcharge Pressure is based upon 300 psf live load on top of final grade.
- Surcharge Pressure of Soil/Foundations - The surcharge pressure of soil/foundations is based upon soil cover over tanks and spread footings of adjacent structures, where applicable.
- Hydrostatic Pressure - The Hydrostatic Pressure on external walls is the static pressure distribution that the ground water level produces.

Seismic loads from external soil and groundwater are determined as stated in Section 6.7.2.10.

7.6.2.8 *Wind Loads*

Wind loads on any above grade structures will be in accordance with the USBC and ASCE 7.

7.6.2.9 *Snow Loads*

Snow loads will be in accordance with the Governing Code and ASCE 7.

7.6.2.10 *Seismic Loads*

Seismic loads resulting from seismic acceleration of the structure dead and live loads, including permanent fixed equipment and piping, will be determined in accordance with the USBC and ASCE 7.

The structure shall also be analyzed and designed to resist seismic loads from internal liquid and exterior soil. The procedures used for the analysis of these conditions are summarized below.

7.6.2.10.1 Internal Liquid Loads

Walls subject to internal liquid loads shall be analyzed and designed to resist seismic loads in accordance with ACI 350.3, "Seismic Design of Liquid-Containing Concrete Structures", in addition to the static loads indicated in Section 6.7.2.6. The seismic design loads are:

- Wall Inertia - The Wall Inertia - Seismic pressure is the lateral inertia force due to the weight of the tank wall per unit height of the tank wall, acting at any given height, y, above the base of the wall.

- Impulsive Forces - The Impulsive Force - Seismic load is the force of the effective mass of liquid that moves rigidly with the tank.
- Convective Forces - The Convective Force - Seismic load is the force of the effective mass of the sloshing liquid that is in motion during an earthquake.

7.6.2.10.2 External Soil Loads

Walls subject to external soil loads shall be analyzed and designed to resist seismic loads in accordance with ACI 350.3, "Seismic Design of Liquid-Containing Structures" and data to be furnished by the Geotechnical Engineer, in addition to the static loads indicated in Section 6.7.2.7. The seismic design loads include:

- Seismic Pressure of soil (including the effects of the soil, surcharge, and ground water level) - Seismic loads resulting from seismic acceleration of soil and groundwater will be in accordance with recommendations established in the geotechnical report. If groundwater will be drained with a permanent free draining or pumped underdrain system, then groundwater loads will not be applicable.
- Wall Inertia - The Wall Inertia - Seismic force is the lateral inertia force due to the weight of the tank wall per unit height of the tank wall, acting at any given height, y, above the base of the wall.

7.6.3 General Basis for Design

7.6.3.1 *Introduction*

The following load combinations shall be used in the design of structures. Additional load combinations, which may produce a maximum stress condition, are also to be considered, as appropriate. Note that combinations, which clearly do not govern, will not need to be fully analyzed.

Table 7-8: Load Combinations

Load Combinations
Dead Load + Construction (if unusual construction loads occur)
Dead Load + Live Load + Permanent Equipment Load
Dead Load + Normal Operating Equipment Load + Seismic
Dead Load + Normal Operating Equipment Load + Flood
Dead Load + Normal Operating Equipment Load + Wind

In addition to the load combinations above, exterior tank walls shall be designed with tanks full and without any beneficial soil pressure on the exterior face of the tank. Interior tank walls shall be designed for all possible combinations of full and empty tanks. Walls that separate cells within a tank but do not hydraulically isolate the cells from each other shall not be designed for liquid on one side only. To account for flow lag and minor dynamic effects, however, these walls shall be designed for a 12-inch maximum water level differential on either side of the wall, unless hydraulic analyses determine a greater

differential is possible. Internal tank walls, which do not hydraulically isolate cells from each other, shall be designed to resist hydrodynamic loads produced by seismic events. All structure walls retaining water or soil will consist of reinforced concrete using both vertical expansion joints and vertical contraction joints spaced as necessary to assist in control of shrinkage crack formation.

Closed liquid containing structures which have the possibility of becoming pressurized or depressurized due to mechanical or process systems shall be designed for the maximum and minimum pressures as determined by the process engineer.

Lateral loads from soil, rock and groundwater shall be in accordance with the recommendations provided in the geotechnical report. Structures shall be designed for these loads with no benefit from internal liquid loads or live loads.

7.6.3.2 *Safety Factors*

Structures are designed based on determining the service loads and obtaining a suitable ratio of material or soil strength to these loads termed a safety factor. Either the service loads are multiplied by a suitable set of load factors and compared with the ultimate strength or the structural material or yield strength is divided by a suitable safety factor.

Table 7-9: Safety Factors

Safety Factors	
Overturning	1.5 1.10 (if Seismic Loads included)
Sliding	1.5 1.10 (if Seismic Loads included)
Buoyancy for Groundwater, Design Elevation	1.25
Buoyancy for Groundwater, 100-yr Flood Elev.	1.20
Buoyancy for Groundwater, 500-yr Flood Elev.	1.10
Buoyancy for Flood for structures in Flood Hazard Areas	1.50

Forces resisting buoyancy shall be a combination of structure dead load (not including partitions and equipment), weight of soil directly over footings (considering buoyant soil weight), and the tensile resistance of anchors and/or tension piles (based on allowable load values provided by the geotechnical report), if applicable. Where there are superstructures above grade, the drawings shall clearly indicate at what level of completion dewatering operations can be terminated.

7.6.4 Serviceability Considerations

7.6.4.1 *Introduction*

In addition to the design requirements in the USBC and specific material codes, additional design requirements to ensure serviceability of the structures will be considered. Serviceability of a structure is defined as its ability to behave under load in a manner which does not adversely affect the intended use of the structure or provide discomfort to its occupants. Harsh chemical environments may require a special

coating to protect the concrete. Some processes may also require more concrete cover over the reinforcement than typically provided for the structure to limit possible structural deterioration. Deflections and vibrations are behaviors of a structure that do not necessarily cause damage to the structure itself, but if excessive can cause minor damage or wear to equipment or discomfort and annoyance to occupants. Structures shall be designed to limit deflections and vibrations as stated below such that the intended use and performance of the structures are not adversely affected.

7.6.4.2 *Deflection*

Maximum allowable deflections used for design are shown below. An asterisk (*) indicates the deflection limit applies to live loads only.

Table 7-10: Maximum Allowable Deflection

Structures	Deflections
Floors, Concrete	Per ACI 318
Grated Access Platforms *	L/240
Roofs *	L/240
Beams, Lintels, or Slabs Supporting Masonry	L/600

7.6.4.3 *Vibration*

The design should provide appropriate protection against structural or mechanical deterioration and occupant discomfort from the effects of vibrations. The guidelines stated below will be used to mitigate the effects of vibration.

- The operating frequencies, unbalanced loads, and specific design recommendations from equipment manufacturers will be considered in the design.
- To minimize resonant vibrations, the structure supporting the equipment shall be designed such that the ratio of its natural frequency to the operating frequency of the equipment is less than 0.50 or more than 1.50.
- Equipment shall be mounted on concrete foundations rather than metal support systems whenever possible and appropriate.
- Concrete pads or foundations shall be provided with a mass equal to ten times the rotating mass of the equipment or three times the gross mass of the equipment, whichever is greater.
- Vibration isolators or dampeners shall be used on equipment foundations where appropriate.

7.6.4.4 *Joints*

Expansion and contraction joints will be used in accordance with the requirements of ACI 318 and ACI 350 to minimize stresses from concrete drying shrinkage and thermal loads. Construction joints will be provided as required for constructability. Waterstops will be provided in all joints which are in contact

with soil, rock, process liquid or chemicals. All waterstops in construction and contraction joints will be polyvinyl chloride (PVC) flat-ribbed type, 3/8-inch thick by 6-inch wide. PVC waterstops in expansion joints will be flat–ribbed type, 3/8-inch thick by 9-inch wide, with a center bulb. Waterstops in chemical and fuel storage containment areas will be a thermoplastic elastomeric rubber material verified for compatibility with the contained liquid.

7.6.5 Seismic Design

The basis for determining acceleration values and corresponding factors for design are given in the section presenting load criteria. Structures shall be designed according to the USBC and ASCE 7 requirements using the values given in the appropriate code formulas.

Seismic forces due to vertical acceleration result from all dead loads, including the total mass of water above slabs (especially suspended slabs). The direction of force (up or down) shall be selected to create maximum stresses when combined with horizontal seismic forces. The design of foundations resisting overturning must assume that balancing dead loads are reduced by vertical accelerations.

Transitory live loads are not to be used to produce seismic loading with the following exceptions. In storage areas, the loading which is anticipated to be in place most of the time shall be used but not less than 25% of the total live load. Where flat roof snow loads exceed 30 psf, 20% of the uniform design snow load shall be included in the weight used to calculate seismic load. Equipment, partition walls, and other fixed items shall be considered as dead loads for determining seismic forces.

Because the performance of non-structural components (e.g. equipment, pipe supports, etc.) and non-building structures (vessels, tanks, etc.) can adversely impact the cost & recovery time associated with seismic events, non-building structures and non-structural components will be restrained and braced for seismic forces such that displacements shall not impede component functionally or containment immediately following a seismic event where required by the USBC. Seismic resistant elements and supports will be designed to minimize damage to building contents during a seismic event, thereby limiting disruption of service.

7.6.6 Concrete Design

All portions of the structure in contact with soil or containing process liquids (including slabs over process liquids) will be designed in accordance with ACI 350 by one of the following two design methods:

- Working Stress Design, per the Alternate Design Method in Appendix I of ACI 350.
- Ultimate Strength Design, with load factors and durability coefficients required by ACI 350.

Portions of the structure not included above may be designed per ACI 318 in lieu of ACI 350.

Materials for use in concrete design will be specified to have the following minimum properties:

Table 7-11: Concrete Design

Concrete Class A1 – Structural: (Environmental Concrete Structures-ACI 350)	
28-day compressive strength (f'c)	4500 psi
Cementitious Materials	ASTM C150 Type II plus mandatory addition of pozzolan such as Class F fly ash or Slag Cement
Maximum water/cementitious materials ratio	0.42
Air content	4.5% to 7.0%
Concrete Class A2 – Structural: (All other structures, sidewalks, pavement)	
28-day compressive strength (f'c)	4000 psi
Cementitious Materials	ASTM C150 Type II. Addition of pozzolan such as Class F fly ash or Slag Cement is optional unless required to meet other durability requirements for concrete mix.
Maximum water/cementitious materials ratio	0.45
Air content	4.5% to 7.5%
Concrete Class B – Structural: (encasements, catch basins, concrete fill)	
28-day compressive strength (f'c)	3000 psi
Cementitious Materials	ASTM C150 Type II. Addition of pozzolan such as Class F fly ash or Slag Cement is optional unless required to meet other durability requirements for concrete mix.
Maximum water/cementitious materials ratio	0.50
Reinforcing Steel:	
Deformed reinforcing bars	ASTM A615 Grade 60

Minimum required amounts of reinforcing shall be determined per ACI 318 and ACI 350 recommendations depending on the spacing of joints. Amounts of reinforcing used will be as required for structural strength, but not less than these minimum amounts. Maximum spacing of reinforcing bars will be 12 inches on center for environmental concrete structures designed per ACI 350.

Finishes on concrete surfaces will be provided in accordance with ACI 301, and as appropriate for their use and exposure. Interior exposed walls, columns, ceilings, and beams in habitable spaces will receive a smooth rubbed finish. Interior walls above the water surface of open tanks and any exterior exposed walls above grade will receive a grout-cleaned finish. Floors of tanks and floors in areas likely to be intermittently wet due to washdown or maintenance of equipment will receive a floated finish. Floors in habitable areas intended to be dry always will receive a steel troweled finish.

Waterproof coatings will be provided on all walls and slabs in contact with liquid on one side and dry habitable or exposed spaces on the other. Concrete sealers will be provided on all floors that are exposed, not intended to be immersed, and not scheduled to receive any other type of coating.

7.6.7 Masonry Design

Masonry will be designed in accordance with ACI 530 and ACI 530.1. Materials for use in masonry design will be specified to have the following minimum properties:

Table 7-12: Minimum Properties for Masonry Design

Material	Standard
Compressive strength of masonry (f'm)	2000 psi
Concrete masonry units	ASTM C90 Type I
Compressive strength of masonry units	2000 psi
Mortar	ASTM C270 Type S
Grout	ASTM C476
Compressive strength of grout	2000 psi
Deformed reinforcing bars	ASTM A615, Grade 60
Horizontal joint reinforcing	ASTM A82

Minimum required amounts of reinforcing for seismic loads shall be provided in accordance with ACI 530 and ACI 530.1. Amounts of reinforcing used will be as required for structural strength, but not less than these minimum amounts. All cells containing reinforcing will be grouted. Maximum spacing of horizontal joint reinforcing will be 16 inches on-center vertically.

7.6.8 Structural Metals Design

Structural steel will be designed in accordance with AISC 360 Specification for Structural Steel Buildings – Allowable Strength Design or Load and Resistance Factor Design, with modifications as stated in the Governing Code.

Steel joists will be designed in accordance with the Steel Joist Institute (SJI) Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders with the modifications as stated in the Governing Code.

Steel decking will be designed in accordance with the Steel Deck Institute (SDI) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Deck Floor Systems with Electrical Distribution. Diaphragm action of steel decks will be designed in accordance with the SDI Diaphragm Design Manual.

Cold-formed steel structural members will be designed in accordance with the American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members, with modifications as stated in the governing code.

Cold-formed stainless-steel structural members will be designed in accordance with ASCE 8 - Specification for the Design of Cold-Formed Stainless-Steel Structural Members.

Aluminum members will be designed in accordance with the Aluminum Association's Specifications for Aluminum Structures.

Materials for use as structural metals will be specified to have the following minimum properties:

Table 7-13: Minimum Properties for Structural Metals

Material	Standard
Structural steel W shapes	ASTM A992
Structural steel HP shapes	ASTM A572, Grade 50
Structural steel M, S, C and MC shapes, angles, plates, and bars	ASTM A36
Hollow Structural Steel (HSS)	ASTM A500, Grade C
Structural steel pipe	ASTM A53, Type E or S, Grade B
High strength steel bolts	ASTM F3125, Grade 120 or 150
Steel anchor bolts and threaded rods	ASTM F1554 Grade 36
Stainless steel shapes	ASTM A276, Type 304L or 316L
Stainless steel plates and sheet	ASTM A167 or A666 Grade A, Type 304L or 316L
Stainless steel bolts	ASTM F593, Type 304 or 316
Aluminum structural shapes	ASTM B308, 6061-T6
Aluminum extruded rods, shapes, and tubes	ASTM B221, 6063-T6
Aluminum plates	ASTM B209, 6061-T6
Aluminum sheet	ASTM B221, 3003

7.6.9 General Structural Descriptions

7.6.9.1 *Introduction*

The Tabb Pressure Reducing Station and Offline Storage Facility will consist of three structures: The Pressure Reducing Pump Station, the Offline Storage Facility, and the Odor Control Facility. This section describes the preliminary concepts for the construction of each feature including associated structural systems being considered and construction issues that will need to be addressed.

7.6.9.2 *Pressure Reducing Station*

The Pressure Station will be located on the east side of the proposed site. This structure will consist of a two-level pump station. Influent and effluent piping with enter and exist the facility below grade. The

invert of the pump station will be approximately 35 feet below existing and final grade. The structure will measure approximately 85 feet by 45 feet in plan. The substructure will be an entirely dry area housing the piping and pumps associated Pressure Reducing and filling and discharging the OLSF. The substructure will consist of reinforced concrete walls supported on a reinforced concrete mat foundation. Due to the depth of the structure and the high elevation of groundwater, extensive dewatering measures will be required to construct the facility including the construction of a totally enclosed coffer cell to isolate the extent of dewatering and allow construction of the substructure. The recommended type of coffer cell will be evaluated further during detailed design. If the system chosen is a totally independent system used exclusively for construction purposes only, the coffer cell design will be delegated to the responsibility of the contractor as part of their means and methods. Performance specifications will be included to require submission of drawings and calculations of the system, both sealed by a currently registered Professional Engineer in the Commonwealth of Virginia.

Due to the depth of the structure and the presence of high static groundwater, the structure will require assistance in resisting the uplift forces induced upon it by the high level of groundwater and flood conditions. Unless the design allows the substructure to be significantly elevated from its current location, the dead weight of the structure will not be able to practically resist these uplift forces. Therefore, some type of anchorage system or uplift piles will be needed to resist the buoyant forces. While the structure will not need vertical support via a deep foundation system, the use of prestressed concrete piles may still be used to resist the uplift forces, as these type piles are already required for the Offline Storage Tank. The selection of the appropriate means to resist the uplift forces will be evaluated further during detailed design upon completion of the additional geotechnical investigation.

The ground floor level of the structure will consist of a partial accessible area around the perimeter of the building. This area will consist of a reinforced concrete slab supported by reinforced beams spanning between concrete columns extending to the bottom mat below. Most of the grade level area will be open to allow bridge crane access to the pumps and piping in the lower area. A metal stair system will provide access from the ground floor level to the below grade level of the facility.

The superstructure above the grade level floor will consist of a reinforced concrete frame and beams at the roof level. The columns will support a roof consisting of structural steel trusses spanning the entire width of the station. The steel trusses will support a roof consisting of secondary framing members and metal decking. The concrete columns will also support a bridge crane over the width to allow means of removing pumps and piping as necessary for maintenance of the pumps and piping in the dry well area of the structure. The walls of the superstructure will consist of a double wythe masonry wall system consisting of an inner wythe of concrete masonry units (CMU) and an exterior brick veneer. If the superstructure area must extend beyond the boundaries of the substructure, these areas will likely require deep foundation support via prestressed concrete piles to avoid potential differential settlement between the superstructure supported on the deep substructure and the superstructure supported at grade. This issue will be further evaluated during detailed design upon completion of the additional geotechnical investigation.

7.6.9.3 *Offline Storage Tank*

The Offline Storage Tank will be located west of the Pressure Reducing Station. This tank will have an inner diameter of approximately 100 feet and a side water depth of approximately 32 feet. The tank will

consist of a Type II Prestressed Concrete Tank in accordance with AWWA D-110. The tank will be covered by a cast-in-place reinforced concrete dome. The tank will be totally above grade bearing roughly at existing grade. Based on the preliminary geotechnical investigation, the load of the filled tank will likely require support via either 12-inch or 14-inch square prestressed concrete piles embedded between 65 and 75 feet below grade. These piles should develop an allowable capacity of 120 tons in compression and 60 tons in tension. Additional geotechnical investigation work will be required within the actual footprint of the proposed tank to verify these parameters. If subgrade conditions are shown to be more consistent, use of a subgrade enhancement system such as rammed aggregate piers may be considered to limit the projected settlement. Until this additional work is completed, the prestressed concrete piles will remain the conservative assumption for the foundation support.

7.6.9.4 *Odor Control Facility*

An Odor Control facility will be constructed adjacent to the Offline Storage Tank to draw and treat foul air from the storage tank. This facility will also be supported at grade and may require prestressed concrete piles for support, similarly to the tank. The piles will support a reinforced concrete mat that supports two odor control vessels and associated foul air piping. The foul air piping will extend from the odor control vessels over the top of the tank to draw off the foul air for treatment.

8. Site Plan Considerations

8.1 Site Plan Layout

The project's site features generally consist of the following items:

- Two 2.5 MG round pre-stressed concrete tanks approximately 155 feet in diameter, also referred to as the offline storage facilities (OLSFs) will be located on the Tabb PRS & OLSF Property. The western OLSF may not be installed initially, but the site will be cleared and graded to support its future installation.
- 8,950 sq ft pressure reducing station (PRS) will be located on the Tabb PRS & OLSF Property.
- 100,000-gallon cistern to be used for OLSF washdown operations. The cistern will be located southeast of the eastern OLSF on the Tabb PRS & OLSF Property.
- An 8-foot perimeter chain link fence with a swing gate at the access road connection on the Tabb PRS & OLSF Property.
- Two odor control units will be installed on concrete pads between the two OLSFs on the Tabb PRS & OLSF Property.
- Extensions of sanitary sewer force mains related to the interception of the existing 24-inch and 30-inch force mains by the PRS.
- A 16-inch force main extending from the PRS to the OLSFs will be installed on the Tabb PRS & OLSF Property.
- A 12-inch water line will be installed along the north side of Victory Blvd within the right-of-way. The line will span approximately 2,200 feet between Big Bethel Road and N. Bowman Terrace to tie into a 12-inch water main and 8-inch water main, respectively.
- Water improvements on the Tabb PRS & OLSF Property will consist of the following:
    - An 8-inch service line will be extended off the new 12-inch water main on Victory Blvd to serve the Tabb PRS & OLSF property. The line will be extended to the site at the southwestern corner of the property.
    - The 8-inch service line will support connections to an onsite fire hydrant and to provide backup flow to the onsite cistern.
    - A 1-inch domestic line will extend from the 8-inch service connection to provide domestic service to the PRS.
    - After the split for the 1-inch domestic service line, a Newport News Waterworks (NNWW) single check detector assembly for fire suppression systems will be installed on the 8-inch line. A backflow preventer will also be installed on the downstream side of the detector check valve and will be required to be in a hotbox.

- Stormwater improvements will consist of the following:
    - Various stormwater inlets and piping will provide drainage on the site. Note that these are not shown on the concept drawings that have been prepared and will be designed during the detailed design.
    - Four Best Management Practices (BMPs) are proposed to manage stormwater runoff. These include a conserved open space BMP on the north end of the Tabb PRS & OLSF Property, constructed wetlands BMP at the southwestern and southeastern corners of the Tabb PRS & OLSF Property, and a manufactured treatment device (MTD) in the form of a hydrodynamic separator BMP located on the Access Road Property on the far east end.
- The proposed paving improvements will replace the existing gravel road providing access to the site with asphalt pavement and curb and gutter which will extend to the Tabb PRS & OLSF Property. Curb and gutter on the access road will direct runoff to the proposed stormwater management features. Paving on the Tabb PRS & OLSF Property will provide access to the PRS and to the two OLSFs and extend between the two OLSFs to provide access to the two odor control units.

All of the subject improvements will be designed to the following standards:

- *HRSD Design and Construction Standards*
- York County Code of Ordinances
- *Newport News Waterworks Distribution Standard for Materials & Construction*
- 2016 Virginia Department of Transportation (VDOT) Road and Bridge Standards
- 2016 Virginia Department of Transportation (VDOT) Road and Bridge Specifications

8.2 Required Finished Floor Elevation

The site is not located within a flood hazard area therefore the finish floor requirements established in Section 10 of the HRSD Design and Construction Standards do not apply. The finish floor elevations will be driven by providing positive drainage on the site and have been approximated to be elevation 32.5 for the OLSFs and PRS building.

8.3 Construction Considerations

8.3.1 Suggested Sequence of Construction and Related Impacts

For the evaluation of construction and related impacts, the sequence of construction can be defined by 6 stages of work: Clearing and Grubbing, Excavation and Sedimentation Control, Dewatering Operations, Pile Driving, Tank and PRS Construction, and Backfill and Grading. Each phase of work has been evaluated for potential noise, vibration, and dewatering impacts to the project site and surrounding

stakeholders. A detailed list of anticipated impacts and associated strategies to mitigate impacts from noise and vibration throughout all stages of the project have been detailed in Appendix L.

8.3.2 Construction Staging and Laydown

If the western OLSF is not installed, this area would be a convenient location for construction staging and laydown. If this OLSF is installed, the open space area south of the access road to the OLSFs could be used for construction staging and laydown.

8.4 Stormwater Considerations

8.4.1 Existing Drainage

A topographic survey was obtained to support the site design efforts and was used as the basis for the development of the conceptual drawings. The vertical datum for the survey was North American Vertical Datum of 1988 (NAVD88).

The existing topography is fairly level throughout with elevations ranging between 30 to 33 feet between the three properties. The three properties impacted by the proposed project have been divided into six drainage areas within the proposed limits of disturbance as shown in the Pre-development Drainage Map included in **Appendix I**. These drainage areas are referred to as PRE DA-1, PRE DA-2, PRE DA-3, PRE DA-4, PRE DA-5, and PRE DA-6 and are described in detail below.

- PRE DA-1 largely encompasses the north side of the Tabb PRS & OLSF Property and comprises 1.75 acres. It is completely forested and drains to the north and northeast, towards an existing wetland located at the northeastern corner of the site.
- PRE DA-2 is the largest drainage area comprising 2.82 acres, and generally consists of the southern half of the Tabb PRS & OLSF Property and a portion of the Access Road Property to the east. It currently drains south to the existing channel that runs along Victory Boulevard and flows from west to east.
- PRE DA-3 is the smallest drainage area at 0.01 acres and consists of an area within a channel located south of the existing gravel road within the Dominion Virginia Energy Easement on the Access Road Property. This area is being impacted by the project to support the new paved road and will require this culvert to be extended. The channel traverses to the south and connects to the Victory Blvd ditch system.
- PRE DA-4 is approximately 0.17 acres and encompasses the southern portion of the gravel road on the Access Road Property. This area generally sheet flows towards Victory Blvd into the wooded area south of the gravel road.
- PRE DA-5 is largely located on the Access Road Property and a small section of the Tabb High School Property. It is approximately 0.18 acres and encompasses the northern portion of the gravel road. Drainage in this area is captured by a ditch on the Tabb High School Property

that drains west to east. This ditch connects into the same ditch mentioned in the description for PRE DA-3, ultimately connecting into the Victory Blvd drainage system.

- PRE DA-6 is 0.04 acres drainage area located on eastern portion of the gravel road on the Access Road Property. This area was broken out separately since it drains to a ditch that is located within the wooded area south of the gravel road. The ditch drains north to south, heading towards Victory Blvd.

The total area of the project site which will be disturbed measures 4.97 acres.

8.4.2 Proposed Drainage

- The post-development condition of the proposed project has been divided into seven drainage areas within the proposed limits of disturbance as shown in the Post-development Drainage Map included in **Appendix I**. These drainage areas are referred to as POST DA-1, POST DA-2, POST DA-3, POST DA-4, POST DA-5, POST DA-6, and POST DA-7 and are described in detail below.

- POST DA-1 is the drainage area on the northwestern corner of the Tabb PRS & OLSF property and measures approximately 0.93 acres in area. This drainage area collects runoff extending from the exterior of the northern half of the two OLSFs and into the proposed conserved open space BMP area. This area includes capturing runoff from a portion of the odor control unit pads and the northern half of the access road between the two OLSFs. Accordingly, this drainage area will be a mixture of managed turf, forested open space, and impervious area.

- POST DA-2 comprises approximately 0.05 acres and consists of the area being disturbed between the Tabb PRS & OLSF Property and Victory Blvd to support the installation of an outlet pipe for the constructed wetlands BMP proposed at the southwestern corner of the site and the 8” water line service to the site. Runoff in this area drains to a ditch running east to west that parallels Victory Blvd. This drainage area will consist entirely of managed turf.

- POST DA-3 is the drainage area being directed to the two constructed wetlands BMPs, referred to as BMP 2A and BMP 2B. The drainage area will capture runoff from the roofs of the two OLSFs, drainage from the exterior of the southern half of the OLSFs, the PRS, and drainage from the access roads and managed turf areas surrounding these facilities. It measures approximately 3.37 acres.

- POST DA-4 is approximately 0.20 acres and consists of runoff sheet-flowing away from the northeastern corner of the eastern OLSF and the northwestern corner of the PRS. This drainage area is largely managed turf with the only impervious area being the 4-foot section of concrete extending from the base of the OLSF. This drainage discharges to the wetland area located at the northeastern corner of the site.

- POST DA-5 is approximately 0.03 acres and consists of the managed turf disturbed area impacted by the outlet pipe for BMP 2B. This area generally sheet flows to the south and is ultimately intercepted by the Victory Blvd roadside ditch.

- POST DA-6 consists of the approximate 0.01 acres of disturbed area associated with the extending the culvert that traverses under the access road in the center of Virginia Dominion Energy easement. This drainage area features managed turf since it is within the existing grass channel.
- POST DA-7 generally consists of the access road drainage area east of the culvert referenced in the POST DA-6 description, and totals approximately 0.38 acres. This drainage area is conveyed to a MTD hydrodynamic separator BMP that will be placed at the approximate low point in the drainage area. The outlet for this BMP is into the drainage ditch on the Tabb High School Property since most of the drainage on this section of the road drains to this ditch in the existing condition. Managed turf will be installed north and south of the access road within the drainage area thus the drainage area will be a mixture of managed turf and impervious area.

As stated previously, fours BMPs are proposed to meet stormwater quantity and quality requirements. These BMPs include the following:

- BMP 1 – Sheet Flow to Conserved Open Space (northern portion of the Tabb PRS & OLSF Property), DEQ Stormwater Design Specification No. 2
- BMP 2A – Level 2 Constructed Wetlands (southwestern corner of the Tabb PRS & OLSF Property), DEQ Stormwater Design Specification No. 13
- BMP 2B – Level 2 Constructed Wetlands (southeastern corner of the Tabb PRS & OLSF Property), DEQ Stormwater Design Specification No. 13
- BMP 3 – MTD, Hydrodynamic Device (on access road on the Access Road Property), DEQ Stormwater Design Specification No. 16

These BMPs were selected based on information provided by the geotechnical engineer that the seasonal high groundwater depth was 2.5 feet below grade. Since many of the BMPs require a minimum separation from the seasonal high groundwater from the bottom of the facility, this led to the specifying of the BMPs listed above which are either not impacted by this condition or are supported favorably by this condition.

Based on preliminary understandings of the required mitigation for the wetland impact permitting, the proposed constructed wetlands BMPs will not be able to be considered as wetland mitigation credits. This is because the State Water Control Board assumes that the purchase of mitigation bank credits or in-lieu fee program credits is ecologically preferable to practicable onsite or other off-site compensation options.

The Virginia Department of Conservation and Recreation's (DCR's) online Hydrologic Unit Explorer suggests the site straddles two different Hydrologic Units. Per discussions with the York County Public Works Department, it was agreed that because the obtained survey confirmed all the impacted properties are within the same Hydrologic Unit, it was acceptable to move forward with that determination for the stormwater calculations. This determination was critical since the Virginia stormwater regulations would have required that stormwater quality compliance be established within each Hydrologic Unit, making the stormwater design more challenging.

The proposed drainage will be designed to comply with the following standards:

- *Virginia Stormwater Management Handbook*

- Virginia Administrative Code, 9VAC25-870-62 through 9VAC25-870-92
- York County Code of Ordinances, Chapter 23.3 Stormwater Management
- *HRSD Design and Construction Standards*
- 2016 VDOT Road and Bridge Standards

8.4.2.1 *Stormwater Quality*

Water quality treatment requirements for the project will adhere to 9VAC25-870-63, Water Quality Design Criteria Requirements. Per the completed Virginia Department of Environmental Quality (DEQ) Virginia Runoff Reduction Method (VRRM) Re-Development Compliance Spreadsheet for the subject provided in **Appendix I**, the required amount of total phosphorus to be removed is 3.68 lbs/yr. As shown in the results included in **Appendix I**, the four proposed BMPs achieve the required pollutant removal indicating water quality compliance is achieved.

The proposed cistern was not considered a rainwater harvesting BMP in the VRRM water quality calculations since the cistern-stored runoff would be used for OLSF tank washdown operations on an annual basis thus suggesting a minimal level of reuse. Based on preliminary rainwater harvesting calculations, no runoff reduction could be assigned to the cistern usage thus negating its need to be inputted into the VRRM water quality calculations.

8.4.2.2 *Stormwater Quantity*

Per 9VAC25-870-66, stormwater quantity requirements for a new development must meet compliance with channel protection and flood protection regulations as stated below. Water quantity calculations have not been performed as part of the preliminary engineering report efforts, but commentary is provided on how it is anticipated compliance will be confirmed during the detailed design process.

8.4.2.2.1 Channel Protection

It is anticipated that channel protection compliance will be accomplished via the usage of the Energy Balance equation for each of the various stormwater outfalls. The Energy Balance equation utilizes the 1-year 24-hour peak flow and runoff volumes in the pre- and post-development conditions to determine water quantity channel protection compliance. The energy balance equation consists of the following:

$$Q_{Developed} \leq I.F.*(Q_{Pre\text{-}developed} * RV_{Pre\text{-}Developed})/RV_{Developed}$$

The stormwater regulations state that under no condition shall $Q_{Developed}$ be greater than $Q_{Pre\text{-}Developed}$ nor shall $Q_{Developed}$ be required to be less than that calculated in the equation $(Q_{Forest} * RV_{Forest})/RV_{Developed}$; where

I.F. (Improvement Factor) equals 0.8 for sites > 1 acre or 0.9 for sites ≤ 1 acre. Accordingly, for the Tabb PRS & OLSF project, the I.F. will be 0.9 ac.

$Q_{Developed}$ = The allowable peak flow rate of runoff from the developed site.
$RV_{Developed}$ = The volume of runoff from the site in the developed condition.
$Q_{Pre\text{-}Developed}$ = The peak flow rate of runoff from the site in the pre-developed condition.
$RV_{Pre\text{-}Developed}$ = The volume of runoff from the site in pre-developed condition.
Q_{Forest} = The peak flow rate of runoff from the site in a forested condition.
RV_{Forest} = The volume of runoff from the site in a forested condition; or

This approach allows the project to comply with channel protection requirements without having to perform extensive downstream analyses which would be required if energy balance compliance is not pursued.

Given that the conserved open space BMP, BMP 1, provides runoff reduction per the DEQ specifications, channel protection compliance will attempt to be achieved by taking advantage of this runoff reduction feature.

For BMPs 2A and 2B, it is anticipated that the BMPs will be designed with outlet control devices to provide the necessary water quantity controls to achieve compliance with the energy balance equation.

Finally, it is likely that a check dam may need to be installed downstream of the hydrodynamic separator (BMP 3, which will not control water quantity) outlet to provide the necessary stormwater quantity attenuation needed to achieve water quantity compliance.

For the proposed drainage areas not routed to BMPs, the channel protection water quantity calculations will need to compensate for these areas direct discharging into the adjacent channels and properties.

8.4.2.2.2 Flood Protection

To illustrate compliance with flood protection , it is anticipated that compliance will be shown by ensuring the 10-year, 24-hour peak flow rates are not greater than the existing development 10-year, 24-hour peak flow rate at each of the discharge locations. This analysis may be able to be limited to areas on the impacted properties if it can be confirmed these receiving areas are considered a flood-prone area. If the receiving channels and other areas receiving runoff from the site are determined to be non-flood-prone

areas, additional downstream analyses may be required to confirm compliance with flood protection requirements.

8.4.3 Stormwater Alternatives

Given that the geotechnical efforts determined the seasonal high groundwater elevations are approximately 2.5-feet below existing grade, this eliminates a large portion of alternative BMP types that can be installed. If additional water quality credit is desired by HRSD to develop a water quality surplus, this may be able to be achieved by adding upstream manufactured treatment devices (MTDs) to the drainage being directed to the constructed wetlands, BMP 2A and BMP 2B. Additionally, it is likely additional water quality may be achieved by replacing a portion of the conserved open space at the northwestern corner of the site with constructed wetlands.

8.4.4 Erosion and Sediment Control

It is anticipated that the erosion and sediment control measures along the access road and water main extension on Victory Blvd will largely consist of silt fence, inlet protection, culvert protection, and combination fencing which is combined silt fence and tree protection. For the improvements on the Tabb PRS & OLSF Property, it is anticipated that the perimeter of the site will be protected by silt fence and combination fence. It is anticipated that interior portions of the Tabb PRS & OLSF Property will require the installation of temporary sediment traps to treat the denuded runoff given the size of the property since silt fence can only treat a 100 foot area behind the fencing.

The erosion and sediment control will be designed to comply with the following standards:

- *Virginia Erosion and Sediment Control Handbook* (VESCH)
- York County Code of Ordinances, Chapter 10, Erosion and Sediment Control
- Virginia Administrative Code, 9VAC25-840

In effort to expedite land clearing operations and geotechnical efforts for the subject improvements, it may be beneficial to prepare and submit a separate Erosion and Sediment Control Plan to York County for approval. This approach would be beneficial since these plans can typically be reviewed and approved more quickly when compared to the normal site plan approval process thus allowing an earlier mobilization of the contractor. According to the York County *Development Guide*, the procedure for the Erosion and Sediment Control Plan submission is the following:

1) Schedule a meeting with a Stormwater Engineer in the Department of Public Works.
2) Prepare plans in accordance with the Ordinances.
3) Amend plan as required by staff.
4) Submit Erosion and sediment control agreement, stormwater agreements, sureties, and permit fees as necessary.
5) Attend pre-construction meeting.
6) Install all temporary and permanent E&S control practices.

7) After land disturbing activities are completed and final as-builts have been submitted, call for a final inspection.

The *Development Guide* indicates the review period to be 45 days for the submission of the erosion and sediment control plan.

8.4.5 York County Stormwater Design and Permitting Requirements

Per Chapter 23.3 of the York County Code, the following design and permitting requirements apply:

- All stormwater systems in land disturbing projects must be constructed prior to the construction of any required sanitary sewer system.
- Record drawings are required for all components of a stormwater system and must be signed and sealed by a licensed professional. Typically, these drawings ensure that all minimum standards put forth by York County have been met and that the stormwater system has been constructed correctly.
- A BMP Maintenance Agreement must be executed prior to the issuance of the land disturbing activity/stormwater VSMP permit.
- The maximum depth of open channels should not exceed three feet measured from the invert of the ditch to the adjacent proposed ground elevation.
- The minimum longitudinal slope for open channels shall be 0.0050 foot per foot for channels with unpaved bottoms and 0.0025 foot per foot for channels with paved bottoms.
- The minimum longitudinal slope for curb and gutter shall be 0.0030 foot per foot.
- Permanent impoundment easements are to be provided where the stormwater system is expected to impound waters during a 100-year storm on private property.
- All stormwater runoff shall be conveyed to a stormwater system and shall not be permitted to sheet flow offsite unless otherwise approved. (This will require coordination of the conserved open space BMP approach.)
- The maintenance requirements for all BMPs proposed on the plans shall be identified on the plans in the form of a maintenance plan.
- Prior to the issuance of any building permit for above ground structures, preliminary record drawings of the stormwater system must be submitted for approval.
- Prior to the completion of the project and the issuance of a Certificate of Occupancy, final record drawings must be submitted to York County for review and approval.

8.4.6 York County Post-Construction Stormwater Requirements

York County post-construction stormwater requirements involve the preparation of record drawings, maintenance, and inspections.

8.4.6.1 *Record Drawings*

Record drawings are used to determine how a site was constructed and document what changes were made from the design plans. It must be certified by a professional engineer or land surveyor and verified that all drainage facilities comply with York County standards and are operating as intended. As part of the record drawing package the following must be checked:

- Pipe inverts
- Pipe depths
- Stormwater structure locations and rim elevations
- Associated details with BMP facilities such as size and layout
- Channel dimensions

Any changes from the design plans should be notated clearly for a reviewer to understand.

8.4.6.2 *Maintenance*

The following defines the anticipated maintenance associated with each of the BMPs proposed. HRSD will be required to maintain the BMPs to ensure compliance with the BMP Maintenance Agreement and to avoid issues noted by York County during periodic inspections which will occur at least once every five years.

8.4.6.2.1 Constructed Wetlands

Per the DEQ Stormwater Design Specification No. 13 for constructed wetlands, the following maintenance tasks must be completed in the first two years:

- Initial Inspections. During the first 6 months following construction, the site should be inspected at least twice after storm events that exceed 1/2 inch of rainfall.
- Spot Reseeding. Inspectors should look for bare or eroding areas in the contributing drainage area or around the wetland buffer, and make sure they are immediately stabilized with grass cover.
- Watering. Trees planted in the buffer and on wetland islands and peninsulas need watering during the first growing season. In general, consider watering every three days for first month, and then weekly during the first growing season (April - October), depending on rainfall.
- Reinforcement Plantings. Regardless of the care taken during the initial planting of the wetland and buffer, it is probable that some areas will remain unvegetated and some species will not survive. Poor survival can result from many unforeseen factors, such as predation, poor quality plant stock, water level changes, drought. Thus, it is advisable to budget for an additional round of reinforcement planting after one or two growing seasons. Construction contracts should include a care and replacement warranty extending at least two growing seasons after initial planting, to selectively replant portions of the wetland that fail to fill in or survive.

The standard indicates that annual inspections should also be performed to assess sediment accumulation, monitor plant growth, and to inspect items such as the condition of embankments and other structural components.

8.4.6.2.2 Sheet Flow to Conserved Open Space

Per the DEQ Stormwater Design Specification No. 4 for sheet flow to conserved open space, maintenance for this feature is minimal since the goal is to protect an established vegetative area on a development that is contiguous to a receiving system such as a receiving stream or natural channel. A long-term vegetative management plan must be in place for areas to be marked as conserved open space. This ensures that the vegetative condition will not change and not be damaged by passive recreation, invasive species, or tree and understory maintenance.

In addition to the maintenance agreement drafted to utilize natural vegetative conditions as conserved open space as a BMP, this area must also be preserved through a perpetual easement or deed restriction that assigns the responsible party that no future development, disturbance, or clearing may occur within the area unless it pertains to the vegetative maintenance plan.

8.4.6.2.3 Hydrodynamic Separator

The following are the anticipated maintenance requirements for the hydrodynamic separator based on information provided by one of the approved hydrodynamic separator manufacturers identified on the Virginia Stormwater Best Management Practice Clearinghouse site:

1. Hydrodynamic separator (HDS) operations and maintenance procedures shall be per manufacturer recommendations.
2. During construction:
    a. HDS units shall be inspected every two weeks and after every storm over 0.5-inch during the construction period.
    b. HDS units shall be vacuumed out when sediment in unit reaches 30-inch depth, or if floatables other than oil cover over 50% of the open water surface on the inlet side of the outlet baffle wall.
    c. HDS units shall be vacuumed at the end of the construction period.
3. After construction:
    a. HDS units shall be inspected every six (6) months for the first year after installation. Afterwards, inspections and cleanouts should occur every year or more frequently. A report shall be compiled as a part of each inspection and kept on record. Specific information to be reported shall be per manufacturer specifications.
    b. HDS units shall be vacuumed out when sediment in unit reaches 75% of the maximum capacity or with appreciable level of trash accumulation.

c. HDS units shall be vacuumed and material disposed of at a permitted location.

8.4.7 State Permitting Requirements

Because the total land disturbance for this project will be greater than 1 acre, the project will be required to obtain a DEQ VSMP Construction General Permit.

8.5 Odor Control Considerations

HRSD has established itself as a good neighbor by mitigating the potential for off-site odor impacts to the surrounding community. This is important for every facility and is critical for the Tabb OLSF because its location has potential for relatively close neighbors. Selection of the proper technology and capacity is essential and details for the methodology for performing these tasks are outlined below.

8.5.1 System Sizing

Odor control systems for large storage tanks are typically sized in one of two ways:

- Select number of air changes per hour of the entire tank(s) volume
- Establishing foul air rates from expected wastewater flows

This section will review the odor control system capacity based upon these two sizing methods and provide a recommended air flow rate for the Tabb OLSF.

8.5.1.1 *Air changes per hour*

Foul air rates that are based air changes per hour tend to be one of the more conservative approaches for odor control of large storage tanks. These systems are typically designed for a range of two (2) to twelve (12) air changes per hour (ACH). As tank volumes are being finalized, the volume selected for this analysis will be three million gallons (MG). **Table 8-1** below provides summary of the foul air rates for a 3 MG tank with ACH ranging from 2 to 12 ACH.

Table 8-1: Foul Air Rates – Air Changes Per Hour (3 MG Tank)

Air Changes Per Hour (ACH)	Foul Air Rate (cfm)	Foul Air Rate (gpm)	Foul Air Rate (mgd)
2	13,400	100,200	144
3	20,050	150,000	216
4	26,800	200,400	288
6	40,100	300,000	432
9	60,150	450,000	648
12	80,200	600,000	864

As shown in the **Table 8-1**, all the flows using this method will be significantly greater than the inflows into the tanks. Deciding the most appropriate number of air changes to consider further requires additional considerations. Four (4) to six (6) ACH is recommended by WEF to prevent corrosion within an enclosed structure. The Tabb OLSF tanks will be used for daily equalization and will typically have a portion of the tank filled with wastewater. Therefore, it is reasonably conservative to use a smaller number of empty tank air changes because the air changes will be higher most of the time. Three (3) empty tank ACH is a conservative number because most of the time the tank will have a much higher number of headspace air changes.

8.5.1.2 *Systems sized for expected wastewater flows*

In many cases, foul air rates for equalization tanks are based upon the peak wastewater flow into the tank. These rates will prevent nuisance odors because the flow rate into the odor control system exceeds the flow into the tank and does not let any air leave the tank when the tank is filled. Inflow and outflow rates will be considered, and a summary of the required foul air rates based upon influent and outflow is provided in **Table 8-2**.

Table 8-2: Foul Air Rates – Air Changes Per Hour Based Upon Wastewater Flows

Flow Condition	Foul Air Rate (cfm)	Foul Air Rate (gpm)	Foul Air Rate (mgd)
Maximum Outflow	895	6,694	9.6
Minimum Outflow	153	1,144	1.6
Maximum Inflow	452	3,376	4.9
Minimum Inflow	157	1,171	1.7

As shown in the table, the foul air rates are significantly lower using this methodology. Even considering a factor of safety of two, the foul air rates would be less than 2,000 cfm. Comparing that to the foul air rate for 3 ACH of the empty tank volume, it is less than 10%.

8.5.1.3 *Recommended system size*

A system sized greater than the expected flows should keep nuisance odors from escaping the tank and moving off site, but these foul air rates are not as conservative as the ACH rates. Therefore, it is recommended that the system capacity be set achieve 3 ACH of the full tank volume or 20,050 cfm of a 3 MG tank.

8.5.2 Technology Evaluation

A variety of odor control system technologies are available, and all have advantages and disadvantages. This section will review these pros and cons and provide a recommended system that will provide effective treatment but require minimal operations and maintenance needs.

8.5.2.1 *Dry Media Adsorption*

Dry media adsorption can be effective for odor control, though it is usually designed for removal of specific compounds. The removal efficiencies for most odor-causing compounds found in wastewater are approximately 99%. Dry media systems are also relatively simple when compared to other types of odor control systems. The only moving part to these systems is the fan, which keeps maintenance low in dry media systems. However, dry media can have disadvantages as well. If the concentration of odor is high, the media will tend to be consumed quickly, thereby requiring regeneration or replacement. For example, a dry media vessel with an EBRT of 5 seconds would require media replacement every six months if the average hydrogen sulfide concentration is 20 ppm. The replacement time would decrease to 1 month if the average hydrogen sulfide concentration is 100 ppm. For the Tabb OLSF, the tanks will not have significant turbulence and therefore should keep odorous compounds from reaching extremely high levels. Also, hydrogen sulfide is expected to be the primary odorous compound in the headspace of the tanks. Frequent replacement can cause disposal problems and higher operating costs. **Figure 8-1** below shows a typical dry media system used at a pump station application.



Figure 8-1: Single Deep Bed Dry Media Scrubber

Dry media adsorbers come in three primary arrangements. The first is a single deep arrangement, which has a single dry media bed that is three (3) feet thick. Due to the maximum size the FRP vessels can be made and transported, this arrangement is limited to approximately 9,000 cfm of flow. The second most common arrangement is a dual deep bed, which has two exhaust stacks and splits the foul air flow between an upper and lower bed. The beds are also three (3) feet thick in the arrangement and the maximum foul air rate is approximately 18,000 per vessel. The final arrangement is a radial flow vessel that pushes from the outside through a three-foot bed that is vertically arranged to allow from greater

overall bed size. This type of system can be designed to allow for different dry media types for more effective treatment. It can also treat foul air rates greater than 30,000 cfm.

Based upon the foul air rate determined in **Table 8-1**, a single deep bed system would require three vessels to meet the required rate, while the dual deep bed system would require two vessels and the radial flow system could handle the rates with just one vessel. To provide continuous odor control while dry media in being replaced, two vessels are recommended. Therefore, the single deep bed system is not recommended, and the radial flow and dual deep bed system will be evaluated further during final design if this technology is accepted. For the purpose of comparing technologies, a dual deep bed system was selected. To meet the 20,000-cfm required, the system would consist of two ten (10) diameter dual bed dry media scrubbers. The footprint of this system would be approximately 35 feet by 30 feet.

8.5.2.2 *Biological Systems*

Biological odor control systems consist of two primary types: Biofilters and Bio-trickling filters. Biofilters tend to be large beds with inorganic media. To prevent short circuiting in the biofilter bed, the bed depth is limited to approximately 6-8 feet. Biofilters also require an EBRT of at least 30 seconds, which is significantly higher than other technologies. The 20,000-cfm system for Tabb OLSF would require a bed area of approximately 1,250 square feet. The total footprint of the system including fans and other appurtenances would be approximately 50 feet by 40 feet. Due to this system requirement, the biofilter is eliminated from consideration.

Bio-trickling filters are tower-based systems that use synthetic media, nutrients and recirculated water to create a biomass that treats the foul air. Bio-trickling filters have a fiberglass shell similar to dry media scrubbers, but these tend to be much taller. They typically have a EBRT of 12 to 15 seconds, which makes them significantly smaller than biofilters. **Figure 8-2** provides a schematic of a bio-trickling filter odor control system.

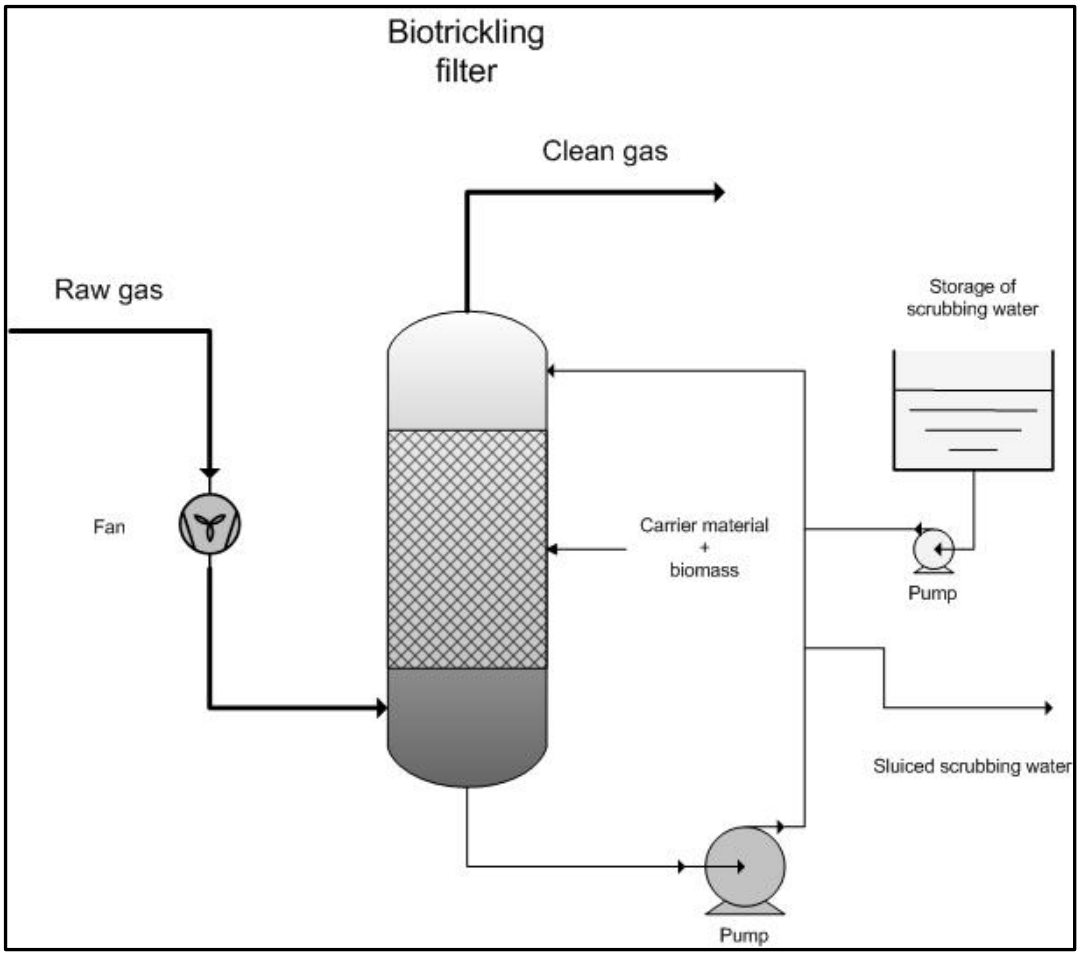


Figure 8-2: Bio-trickling Filter Schematic

Bio-trickling filters require more O&M time that dry media scrubbers because they have a recirculation pump, water cabinet and nutrient system in addition to the fans. They also need to be regularly monitored to ensure that the correct pH is being maintained, which confirms that adequate biomass is present.

The maximum flow for a single bio-trickling filter tower is approximately 14,000 cfm. Therefore, the Tabb OFSF will need to have two twelve (12) foot diameter 10,000 cfm towers. The footprint of this system would be approximately 40 feet by 35 feet.

8.6 Zoning Requirements

Given that the existing Tabb PRS & OLSF Property is zoned Rural Residential (RR), the development of a pressure reducing station and offline storage facilities appears to be allowed without having to rezone the property based on a review of the York County Code of Ordinances.

8.6.1 Site Zoning

The Tabb PRS & OLSF Property and Access Road Property are both zoned RR, Rural Residential District. The Tabb High School Property is zoned RC, Resource Conservation District. Because the Tabb PRS & OLSF Property is zoned RR, all setbacks for vertical construction were based off the requirements for this district. The following is a summary of the impacted properties' setback and building height requirements per the County of York Code of Ordinances, Section 24.1-321 and Section 24.1-322:

Table 8-3: Zoning Requirement Summary

Property	Zoning	Min. Lot Width	Min. Lot Area	Front Setback	Side Setback	Rear Setback	Max. Building Height
Tabb PRS & OLSF Property	RR	150 feet	1 acre	50 feet	20 feet	50 feet	35 feet
Access Road Property	RR	150 feet	1 acre	50 feet	20 feet	50 feet	35 feet
Tabb High School Property	RC	300 feet	5 acres	50 feet	50 feet	50 feet	35 feet

8.6.2 Special Use Permits

Currently, Hazen is awaiting a determination from the York County Director of Planning & Development Services on the County's interpretation of the use of the property. Per preliminary conversations with staff in the Planning & Development Services Department, it is believed the County will classify the use of the property as "utility transmission facilities other than normal distribution facilities" which allows for the project to be constructed on the RR-zoned property, but requires a Special Use Permit.

The County may reach this determination since the County requires special use permits when a project would have external impacts which may negatively affect neighboring properties. Per preliminary conversations with County staff, this determination would likely be reached since the Tabb PRS & OLSF Property abuts residential areas.

If required, a Special Use Permit Application is submitted to the York County Board of Supervisors and Planning Commission for review and approval. The Special Use Permit is first reviewed by the Planning Commission and then passed to the Board of Supervisors. Per conversations with County staff, the County may allow for site plans to be submitted once the Planning Commission has approved the application, but not any sooner.

The County's website suggests the Special Use Permit process takes approximately 90 days once submitted. Accordingly, this process will need to be factored into the project schedule if it is determined to be required.

Per Chapter 24.1, Article I, of the York County Code of Ordinances, the application shall consist of the following items:

- A narrative description of the property which shall include the assessor's parcel number or in the case of a recorded subdivision, the lot number and block description.
- A narrative description of the proposed uses of the property.
- A sketch plan of the site prepared at scale to show all existing and proposed physical improvements and such other information as is necessary to clearly indicate to the commission and the board that adequate provisions will be made for compliance with all standards for that particular use and the extent of property to be so used on a given parcel or parcels.
- Property owner's signature or written consent.
- A traffic statement specifying the expected trip generation, both twenty-four-hour and peak hour, and, if either exceed the trip generation limits established in Article II, Division 5, a traffic impact analysis prepared in accordance with that section.
- Such other attachments as may be necessary by virtue of being in an overlay district or the YVA District (does not apply to this project).

8.6.3 Site Plan Permitting

When submitting this project for site plan review, York County's site plan review procedures must be followed. The review period will last 60 calendar days for the first submittal of non-priority projects, which is assumed to the be designation for this project, and 45 calendar days for subsequent re-submittal of plans. A project can be considered a priority project which means that the review period will only last 15 business days, however a pre-application meeting must be held before the site plan submittal to be considered a "Priority Project". Again, it is believed this project will not be classified in this manner.

A pre-application meeting to review the project with County staff prior to site plan submission is recommended.

Requirements for the pre-application meetings include:

- Seven copies of 70%-80% engineering plans
- Brief Narrative about the project
- The plans and narratives should be submitted to Development Services
- The developer, property owner, and/or their agent must attend the pre-application meeting

Approval for site plan submittals expire in five years unless building permits have been issued. In this case, approval runs concurrently with the validity of the building permits. The site plan procedure follows the flowchart below:

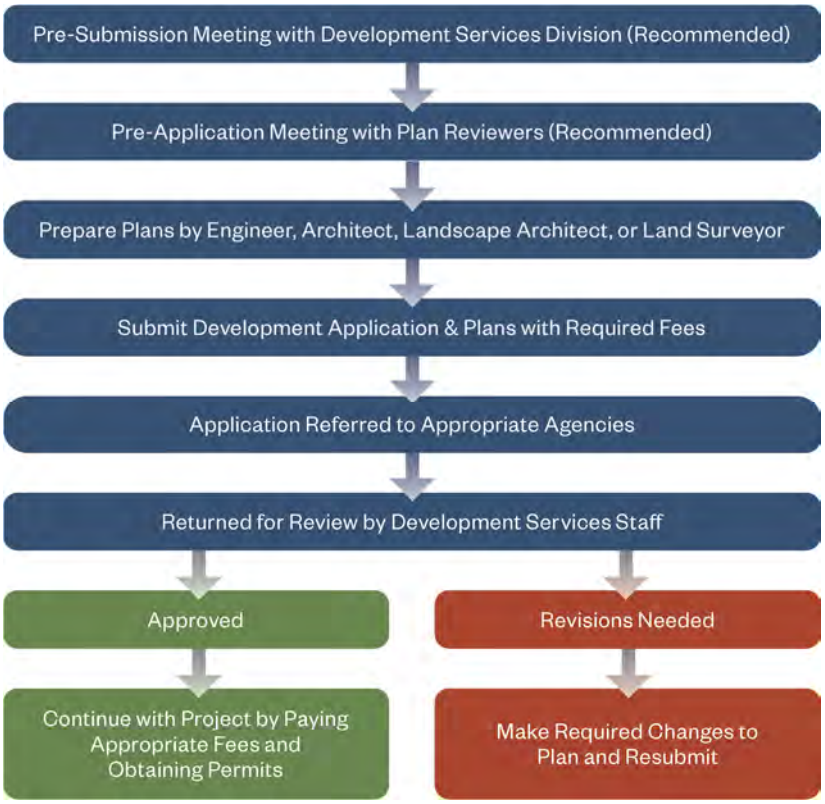


Figure 8-3: Site Plan Submittal Flow Chart

8.6.4 Greenbelts

A greenbelt is a policy and land use zone designation used to retain areas of undeveloped land surrounding or neighboring urban areas. A greenbelt is required along the southern side of the Tabb PRS & OLSF Property, as it is contiguous to Victory Boulevard (Route 171). The specified minimum width of the required greenbelt is 35 feet, per the County of York Code of Ordinances, Section 24.1-245. The greenbelt shall be left in an undisturbed natural state and landscaped in accordance with the County of York planting requirements, with 70 landscape credits per 100 linear feet.

8.6.5 Transitional Buffers

Per preliminary conversations with County staff, a 25-foot to 35-foot transitional buffer will likely be required along the western side of the Tabb PRS & OLSF Property to screen the site from the adjacent residential properties. The final width of the transitional buffer will be determined by the Special Use Permit process if it is required. A buffer as wide as 50 feet could be required, but County staff feels this may not be required given the tight footprint of fitting the improvements on the 5-acre property. The buffer may be reduced by 25% if there is a proposed landscaped berm with minimum height of 2 feet. The buffer must be landscaped with evergreen trees and shrubs, which will achieve a minimum of 0.75 landscape credits per linear foot measured along the outer edge of the transitional buffer. A maximum of 70% of the landscape credits can be earned from shrubs.

8.6.6 Landscaping

All landscaping and planting required shall be based on landscape credit units (L.C.U.) and shall follow all layout and design standards, per County of York Code of Ordinances, Section 24.1-242. Throughout construction, tree preservation practices shall be utilized, in accordance with Virginia Erosion and Sediment Control Handbook (VESCH), Third Edition, 1992. Significant tree preservation practices may be used to obtain landscaping credits. All landscape plantings to be installed shall be selected from the listing of recommended plant material in Tables II-1 through II-7 in Appendix A of the York County Code. Plantings shall be noninvasive species and shall not require exotic fertilizers, mulches, or similar items. A combination of tree types, shrubs, perennials and grasses installed must be integrated and dispersed throughout the required planting areas. Existing vegetation shall be preserved to the maximum extent practicable. Impervious surface shall be limited to the minimum amount necessary. The minimum required dimensions of landscape yards around the site perimeter are 20 feet for front yards and 10 feet for side and rear yards, per County of York Code of Ordinances, Section 24.1-244. A minimum width of 10 feet of a landscaped open space strip surrounding all buildings is required.

Landscaping shall be performed in accordance with HRSD Design and Construction Standards, VESCH, and County standards and regulations, per County of York Code of Ordinances, Section 24.1-242. A landscape plan must be submitted to provide the following:

- Existing and proposed site landscape features
- Location and identification of all disturbed heritage, memorial or specimen trees on site
- Existing vegetation to remain undisturbed
- Location, dimensions and area of all required buffer and landscape yards
- Proposed plant list or schedule
- Proposed plant locations and labels
- Planting, installation details and tree protection details and
- Schedules or lists showing required and proposed quantities for required landscape items

Throughout construction, no more land shall be disturbed than necessary. Existing indigenous vegetation must be preserved as much as possible, and clearcutting shall not be permitted. Best management practices shall be utilized for all land-disturbing activities.

Table 8-4: Planting Requirements

Location	Landscape Credit Unit (LCU) Requirement
Front Yard	40 credits per 100 feet
Side Yard(s)	10 credits per 100 feet
Building Perimeter	15 credits per 100 feet
Parking Lot	15 credits per 10 spaces

8.6.7 Parking Requirements

Per County of York Code of Ordinances, Section 24.1-607, parking lots shall be designed so that there are no more than 15 parking spaces in a row without a landscaped island. 15 Landscape Credit Units (LCU) are required per 10 spaces in parking lots. No automobile parking spaces should be located more than 750 feet from the main entrance. No handicapped automobile parking spaces should be located more than 100 feet from the main entrance. Minimum required parking spaces for Category 17 – Utilities is one space for every 5,000 square feet of storage area. Parking areas must be constructed of concrete, asphalt, or equivalent material.

It is anticipated that the two parking spaces shown to the east of the pressure reducing station are sufficient to meet code requirements. Additionally, the requirement for landscape islands as there will not be more than 15 parking spaces in a parking row.

ADA-compliant parking is assumed to not be required.

8.7 Fire Requirements

Existing and proposed fire hydrants shall be shown on site plans, along with calculations verifying suitability of fire flow, per County of York Code of Ordinances, Section 24.1-502. An existing fire hydrant is located approximately 250 feet southeast of the Access Road Property. Another existing fire hydrant is located on the southeastern corner of the Tabb High School Property.

Discussions with the York County Fire Chief, Deputy Fire Chief and the Fire Marshal have been conducted to get a preliminary confirmation on the proposed site features related to satisfying fire requirements. Per these conversations, the proposed fire apparatus turnaround area shown at the western

terminus of the access road south of the OLSFs is adequate. The Fire Department requested that turning radii on the turnaround feature a 33-foot radius thus these radii have been provided.

The proposed hydrant and supporting water infrastructure design on the Tabb PRS & OLSF Property has been updated since the version previously shared with the Fire Department thus it needs to be shared with them again to obtain confirmation it is adequate. Currently, a single fire hydrant is proposed on the site to serve the facilities.

Per discussion with the Fire Department, fire hydrants will need to be provided off the new 12-inch main on Victory Blvd, and thus these will need to be incorporated into the design. Given that this extension is approximately 2,200 linear feet in length, three hydrants on Victory Blvd are anticipated to be required based on them being spaced 800 feet apart.

It is assumed the external fire demand will be 1,500 gpm based on a review of the 2015 IFC. This demand is being confirmed with the Fire Marshal. The PRS is not sprinklered.

8.8 Newport News Water Work Requirements

The site's water improvements will be permitted by NNWW. The proposed water improvements include a new fire hydrant, supply to the cistern, and supply to the domestic water facilities within the PRS. The combined peak flow of these facilities is assumed to not exceed 1600 gpm, with 1500 gpm assigned to the fire flow.

Per preliminary conversations with NNWW regarding the water service to the site:

- The project's service cannot be supplied from the 8-inch line to the west on N. Bowman Terrace. It does not have enough capacity.
- The project will need to extend a 12-inch line from Big Bethel Road down the north side of Victory Blvd and connect to the 8-inch line on N. Bowman Terrace. An 8-inch service line to the project will be supplied off this line.
- NNWW will cost participate in the Victory Blvd water main improvements that are not specifically needed to serve the project. Accordingly, the portion of the water main west of the service connection to the Tabb site would be funded by NNWW and any sizing of the water main east of the service connection above and beyond what is needed to serve the site would also be funded by NNWW.

9. Environmental Evaluation

Johnson, Mirmiran, and Thompson (JMT) performed a waters of the U.S. delineation study on the proposed Tabb PRS and Offline Storage Facility site in March 2020. Hazen reviewed JMT's findings and conducted additional site evaluations in support of the proposed project. Hazen's assessment of the regulatory requirements that are anticipated to apply to the proposed project is provided below.

9.1 Waters of the U.S. and Commonwealth

Jurisdictional waters of the U.S. include open waters, streams, and wetlands. Wetlands, as defined by federal regulations [40 Code of Federal Regulations (CFR) 230.3(t)] and the Virginia State Water Control Law (Code of Virginia Title 62.1), are "…areas that are inundated or saturated by an accumulation of surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." The U.S. Army Corps of Engineers (USACE) requires the presence of three parameters (hydrophytic vegetation, hydric soils, and evidence of hydrology) in support of a jurisdictional wetland determination (Environmental Laboratory, 1987). The boundary between wetlands and deepwater habitat is defined as the maximum depth where rooted emergent vegetation may be found. Rooted emergent vegetation is generally present at depths less than six feet below mean low water during the growing season. Water of the Commonwealth are those features that have the three parameters but do not meet the additional criteria under the Navigable Waters Protection Rule (NWPR) to qualify as waters of the U.S.

JMT performed a delineation of waters of the U.S. in March 2020, prior to the implementation of the NWPR. The area assessed by JMT includes the Tabb PRS & OLSF Property only and does not include the Access Road Property. Within the area assessed by JMT, one nontidal wetland was identified in the northeast portion of the site (Appendix J, Figure 8-1).

Hazen performed an additional assessment of jurisdictional waters of the U.S. and of the Commonwealth in August 2020 to include the access road corridor and to determine the jurisdictional status of the wetland under the NWPR, which became effective in June 2020. One jurisdictional stream was identified crossing the access road corridor (Appendix J, Figure 8-1). The stream is an unnamed tributary to Moores Creek and is characterized as a nontidal, perennial water of the U.S. The stream is currently culverted under the existing gravel access road within the project area. The wetland was found to be jurisdictional under Section 401 of the Clean Water Act and not under the NWPR as the feature does not meet the criteria of either adjacency or annual inundation by floodwaters. The wetland is therefore categorized as a water of the Commonwealth. The jurisdictional boundaries and categorizations have not been confirmed by the USACE or DEQ. A preapplication site meeting is recommended to confirm the limits of jurisdiction under each agency and to discuss the permitting strategy for the project.

9.2 Resource Protection Area

The project area is located within the Chesapeake Bay watershed and is therefore subject to the Chesapeake Bay Preservation Act. Chesapeake Bay Preservation Areas (CBPAs), which have been divided into Resource Protection Areas (RPAs) and Resource Management Areas (RMAs), have been

defined by York County. RPAs include perennial streams (i.e. streams with continuous flow) and their associated wetlands, tidal wetlands, tidal shores, and a 100-foot vegetated buffer adjacent to and landward of these features within areas subject to the Chesapeake Bay Preservation Act. RMAs are areas with highly erodible or permeable soils, steep slopes, base flood hazard areas, nontidal wetlands that are not included in the RPA, and not less than 100 feet in width landward of and along both sides of the RPA. No portion of the project site is located within an RPA or RMA.

9.3 Federally Protected Species

The U.S. Fish and Wildlife Service (USFWS) identifies species of plants and animals that are in the process of decline and at risk of extinction. Federal law, under the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended, requires that any action likely to adversely affect a federally protected species be subject to review by USFWS. Other species may receive additional protection under separate federal laws.

Hazen reviewed the USFWS's Information for Planning and Consultation (IPaC) tool on August 26, 2020 to identify federally protected species that are known or expected to occur within the vicinity of the project. USFWS identified the northern long-eared bat (*Myotis septentrionalis*) (threatened). No known maternity roost trees or hibernacula are noted on or in the vicinity of the project area. Potential roosting sites for the northern long-eared bat are available within and in the vicinity of the project area. Tree-cutting will be necessary for completion of the proposed project. The current USFWS procedures do not require application of the tree removal moratorium to the proposed project due to the distance to the nearest maternity roost trees. Voluntary compliance with the moratorium, which is currently set as June 1 through July 31, is appreciated by USFWS.

9.4 Invasive Species

Invasive species include nonindigenous or non-native flora, fauna, insects, and aquatic life that adversely affect the habitats or ecosystems into which they are introduced. Invasive species may dominate the new habitat, forcing out existing species by outcompeting native species for nutrients, light, physical space, water, or food. Invasive species can cause harm to natural resources, economic activity, or humans. The Virginia Department of Conservation and Recreation's (DCR) Division of Natural Heritage currently identifies 90 invasive plant species that threaten or potentially threaten natural areas, parks, and other protected lands in Virginia.

An invasive species assessment of the site and immediate vicinity was performed in support of the Envision process, described further in Section 14. The assessment included identification of species known to be invasive in Virginia, determination of the extent of the spread of the invasive species, and evaluation of the intensity of the infestation at the time of the onsite assessment. The findings of the assessment are provided in Appendix J.

9.5 Historic and Cultural Resources

Hazen performed a desktop review of the project site and vicinity utilizing the Virginia Cultural Resource Information System (V-CRIS). The proposed project site is located in the vicinity of four historically

significant properties identified via V-CRIS (Appendix J). The four properties are located along Big Bethel Road and do not have an unobstructed view of the project site. A request for technical assistance has been submitted to Virginia Department of Historic Resources (DHR). DHR's findings letter identifies numerous known archaeological resources in the project vicinity and recommend a Phase I archaeological survey of the project Area of Potential Effects. Upon review of the survey report, DHR will be able to provide further guidance as to additional investigations or mitigative measures that may be warranted. The DHR findings letter is provided in Appendix J with the V-CRIS report.

9.6 Permitting

Permits to disturb the various resources identified in or immediately adjacent to the proposed construction area may be required by federal, state, and local regulations and restrictions. Permits that may be necessary are discussed in the following paragraphs. Permitting requirements will depend on the final design and the requirements of each permitting or compliance program.

One water of the U.S. (nontidal stream) and an additional water of the Commonwealth (nontidal wetland) are present within the project site. Construction activities associated with the proposed project are anticipated to impact the stream and the wetland. Impacts are expected to require permit authorizations under the Clean Water Act (CWA). Within Virginia, the Joint Permit Application (JPA) process allows for concurrent federal and state review of applications, including review by the USACE Regulatory Branch, Virginia Marine Resources Commission (MRC) Habitat Management Division, Virginia Department of Environmental Quality (DEQ) Water Division, and the Local Wetlands Board (LWB).

Impacts to the stream may require acquisition of a Section 404 of the CWA permit from the USACE prior to commencement of construction activities. Extension of an existing culvert in jurisdictional waters of the U.S. to accommodate access road improvements associated with construction of a utility substation may qualify for authorization under a Nationwide Permit (NWP). Mitigation for permanent impacts to jurisdictional waters of the U.S. is not anticipated but may be required at the discretion of the USACE District Engineer. At present, the 2017 NWP that is anticipated to apply to the project is NWP 12. On September 15, 2020, the USACE published Public Notice in the Federal Register of proposed changes to the 2017 NWPs, including issuance of a NWP specific to utility lines other than oil, natural gas, electric, and telecommunications. The proposed new NWP is identified in the Public Notice as NWP D. The proposed notification threshold for NWP D is impacts to 1/10 acre of waters of the U.S. It is our understanding that the USACE intends to issue the new NWPs no later than December 31, 2020, pending a public comment period that ends November 16, 2020.

The Virginia Water Protection Permit Program is Virginia's Section 401 CWA certification program that corresponds with Section 404 permits issued by the USACE per the CWA. Receipt of a Section 401 of the CWA Water Quality Certification (WQC) from DEQ is anticipated to be required since the project involves impacts to waters of the Commonwealth that are not regulated under Section 404 of the CWA. As a utility line activity, the project is expected to qualify for authorization under a VWP General Permit WP2.

Permits or authorizations are not anticipated to be required from MRC or the LWB. The project site does not contain tidal waters or shores, and the onsite jurisdictional waters do not have a contributing drainage

area of at least five square miles. Therefore, the project site does not fall under the jurisdiction of either MRC or LWB.

Since acquisition of permits or certifications from the USACE and DEQ is required prior to commencement of construction activities, submittal of the JPA at the earliest opportunity is recommended. It should be noted that submittal of the JPA should not occur until design of the proposed activities is at a point where the footprint of the structures is not going to change. Any changes to the location and size of structures that impact jurisdictional waters of the U.S. or of the Commonwealth after submittal of the JPA or receipt of permits described herein will require permit modifications, which may delay receipt of the permit(s) and may impact construction activities and schedule.

10. Coordination with Stakeholders

Numerous stakeholders have been identified that are likely to be impacted by the project. These include civic leagues and neighborhoods, Virginia Dominion Energy, Newport News Waterworks, VDOT, York County Fire Department, York County Public Schools, and York County Public Works. Except for the civic leagues and neighborhoods, preliminary coordination has occurred with each of these stakeholders in the development of this PER to understand how they may influence the design of the project. Additional coordination with these stakeholders will be required throughout design and construction.

10.1 Civic Leagues and Neighborhoods

Civic Leagues and neighboring Homeowner Associations are included as a stakeholder for this project because the Tabb PRS & OLSF Property abuts a residential neighborhood to the west and there is residential neighborhood south of the property, on the opposite side of Victory Blvd. Coordination with these neighborhoods will likely be a requirement during the Special Use Permit process, if it is required, due to the visual and noise implications the project will impact these neighborhoods.

West of the Tabb PRS & OLSF Property is the single-family residential subdivision of Hollymead. Based on an online review, a homeowner's association serving this subdivision was not identified. During design, Hazen will coordinate with the County to determine if there is an association serving this subdivision to facilitate engagement with this community.

On the south side of Victory Blvd is the neighborhood of Meadowlake Farms. There is a homeowner's association identified on the County's website serving this community thus a touchpoint for engaging this community has been identified and will be coordinated during the design process.

10.2 Virginia Dominion Energy

There is a 200-foot-wide Virginia Dominion Energy permanent easement that runs across the Access Road and Tabb High School Properties. The infrastructure within the easement includes transmission line towers and accompanying power lines.

An Encroachment Request will need to be submitted to the Eastern Region ROW representative. Per Virginia Dominion Energy requirements, the access road will need to be perpendicular to the transmission lines and be located a minimum of 50 feet from any permanent structure. Additionally, no HRSD structures such as manholes, valve covers, air vent covers or anything above ground are permitted within the easement.

Finally, a site plan will need to be submitted for approval to Virginia Dominion Energy showing the proposed access road and any new utility lines being installed. The review and approval process could take up to six weeks for an encroachment of the existing easement thus this review timeline will need to be incorporated into the project's design schedule.

10.3 Newport News Waterworks

Newport News Waterworks (NNWW) is included as a stakeholder since the project will require a water connection to and extension of NNWW's system. All the improvements will need to be designed per *Newport News Waterworks Distribution Standards for Materials & Construction*, dated July 2009. Specific design requirements based on conversations with NNWW were previously captured. Per NNWW's *Guideline to Process a Water Pipeline Design and Extension Agreement*, the following steps will be required in the design of the water line improvements:

1) Submit a completed "Request for Preliminary Water Pipeline Design" form (Pink Form) with two (2) copies of the site plans or one (1) site plan copy and one (1) in electronic format (AutoCad).

2) The plans submitted shall meet the criteria specified in Section III on the Pink Form. Proposed demands and pressures for water meters and fire sprinklers shall be stated on the Pink Form by the developer's engineer.

3) The proposed project's water pipeline design will be reviewed by Waterworks Distribution Engineering and returned with comments to the developer's agent/engineer in fifteen to twenty (15-20) working days. More complex or larger projects may require longer review times.

    a. If the pipeline returned is acceptable to the developer, then it should be drafted on the project's plans (Plan and Profile) and submitted with the request for water pipeline extension agreement form (Blue Form).

    b. If the developer has questions about the design returned, then the questions should be addressed, in writing, to this office prior to requesting a water pipeline extension agreement.

4) Submit a completed "Request for Water Pipeline Extension Agreement" (Blue Form), one (1) copy of the project's plan and one (1) in electronic format (AutoCad). The project's plans must be approved by the appropriate jurisdictional authority prior to the submittal to Waterworks. This submittal will be reviewed by Waterworks Distribution Engineering prior to preparing the formal agreement. The parties of the agreement are the developer (identified in Section 1 on the agreement form) and the City of Newport News. Typically, this submittal is returned within fifteen to twenty (15-20) working days. More complex or larger projects may require longer review times.

5) This agreement will be mailed to the developer for execution. It must be returned to the Director of Public Utilities (Waterworks) at 700 Town Center Drive, Suite 500, Newport News, Virginia, 23606-4700 within sixty (60) calendar days of the date on the cover letter.

6) Construction drawings will be prepared by this office in approximately fifteen to twenty (15-20) working days after the Director executes the agreement. Larger projects may require longer completion times. Construction of the water pipeline and/or appurtenances can only begin after the construction drawings are issued to the developer.

The above process will need to be included in the project's design schedule.

10.4 VDOT

VDOT is considered a stakeholder for this project since VDOT maintains Victory Blvd. The project will interface with VDOT based on the water line extension work on Victory Boulevard and based on the connection to the Victory Blvd drainage ditch at the southwestern corner of the Tabb PRS & OLSF site. Preliminary discussions have been conducted with the Williamsburg VDOT Resident Office to assess requirements associated with the connection to the ditch and to inquire about possibly providing access for the project off Victory Blvd. The water line extension work has not been discussed with VDOT.

Per discussions with the resident engineers in the Williamsburg Resident Office, it was explained that Victory Blvd was a state route and designated limited access. The resident engineers indicated proposals for extensions or access roads off Victory Blvd would need to be submitted for approval to the Commonwealth Transportation board and it was shared that this would be a lengthy and very involved process. Accordingly, it was decided access off Victory Blvd was likely not feasible for the project.

The resident engineers shared that connection to the existing drainage ditch is permissible if the connection meets all the stormwater regulation requirements.

VDOT review and approval will be required during the site plan review process thus their engagement will continue during the design process.

10.5 York County Fire Department

York County Fire Department is a stakeholder for this project since they will be sharing their access road during and after construction since County of York Fire Station #2 is located east of the Access Road Property and the station's rear access ties into the road feeding the main access road to the site. Preliminary discussions have been conducted with the Fire Department to review the project and required fire improvements.

Per discussions with the Fire Department, any improvements that may impact the station's rear access will need to be coordinated with the Fire Department during the design and construction process.

Additional coordination with the Fire Department during the site plan review process since they are part of that review.

10.6 York County Public Schools

As previously mentioned, Tabb High School neighbors this project and will be impacted by access to the site from construction and future HRSD traffic thus York County Public Schools is a stakeholder for the project. York County Public Schools will also be impacted because of the drainage ditch tie-in proposed north of the access road. Preliminary discussions have been conducted with the school district's Facilities Department and Tabb High School Principal.

Per discussion with the Facilities Department, construction schedules will need to be coordinated with school start and end times so that no heavy construction vehicles will be leaving or entering the site while busses and student vehicles are entering and leaving the school. Additionally, construction vehicles will need to adherer to these times daily to avoid further traffic congestion. The Facilities Department also

shared that noise during construction should be mitigated so that no distractions are present for the students during school hours. Finally, the school district also shared that any installation of any utility lines to the intersection with Big Bethel Road would need to be coordinated during times when school was not in session, such as winter, spring, or summer break.

10.7 York County Public Works

York County Public Works is stakeholder for this project since the proposed stormwater and wastewater networks will impact their existing systems. Preliminary discussions have been conducted with utility and stormwater engineers in the department.

The preliminary discussions with the County regarding the project were largely focused on comments and concerns with the PRS. Specifically, the County shared the following:

- The County is concerned about pressures on the downstream side of PRS when on and during tank draining.
- The County mentioned concerns related to pressure spiking on downstream side of existing Magruder Blvd PRS.
- The County is having to install bypass pumps to combat higher pressures if experienced.
- The County requested HRSD's SCADA system send signals to York County SCADA system to share information related to storing, drain, PRS on, etc. operations.
- The County mentioned they already have notifications from Telog but they were hoping for direct communication with their SCADA system.

The above comments and concerns will need to be considered in the design of the Tabb PRS & OLSF. It is recommended that HRSD evaluate the issues with the existing Magruder Blvd PRS.

11. Risk Management

11.1 Preconstruction Assessment and Damage Mitigation

In recent years, HRSD has received an increasing number of complaints from residents and locality staff regarding the condition of roads, sidewalks, drainage ditches, private property, damage to buildings, etc. within proximity to active construction. In accordance with HRSD's Preconstruction Assessments and Damage Mitigation Procedures, Hazen prepared a preliminary Stage 1 Construction Impact Research and Evaluation. This assessment provides evaluation of the potential construction related impacts to the surrounding area as well as monitoring and potential remediation strategies. The findings and preliminary recommendations are provided in Appendix L.

11.2 Risk Register

A Risk Register was developed for the Tabb PRS and OLSF to identify key areas of potential risk for the overall project. The register identifies key areas of risk and provides a risk score that incorporates probability, impact, mitigation strategies and potential contingencies. The detailed project risk register is included in **Appendix M**.

12. Opinion of Probable Costs

A preliminary opinion of probable cost was developed in accordance with the American Association for the Advancement of Cost Estimating (AACE) criteria for a Class 3 estimate. Class 3 estimates are best suited for budget authorization. As such, they carry potentially significant variances from the final project cost. The estimated range of accuracy for a Class 3 estimate is for final cost to be between -20% and +30% of the estimated value. Estimates were generated from each discipline based on the assumptions outlined below:

- The work is assumed to be tax exempt
- Direct costs are marked up 10% to cover the contractor's compliance with the general conditions of the contract
- Direct costs are marked up 3% to cover the contractor's bonds and insurance
- Engineering and construction administration costs are assumed to be 20% of construction costs
- Costs do not contain owner costs, legal, construction change orders, or overall project contingencies or any other costs that would not be specifically part of the bidding contractor's scope.
- This opinion of probable construction cost (OPCC) is consistent with the American Association for the Advancement of Cost. Estimating (AACE) criteria for a Class 3 Estimate. This level of estimate is appropriate for project definition between 10 and 40%. Expected accuracy at this level is L: -10% to -20% and H: +10% to +30%

Table 12-1: Opinion of Probable Cost

ITEM DESCRIPTION		TOTAL PRICE
Sitework		
Storage Tank (Including Odor Control)		$3,441,000
Sitework Lump Sum		$1,990,800
Newport News Water Works - Water Service Cost Share		$(411,000)
Sitework Subtotal		**$5,021,000**
Mechanical		$1,474,000
Instrumentation and Controls		$300,000
Electrical		$1,540,000
Structural		$4,782,000
Architectural		$785,000
Tabb PRS & OLSF Subtotal		**$13,902,000**
General Conditions	10%	$1,390,200
Bonds /Insurance	3%	$418,000
Sub-Total General Conditions + Bonds/Insurance		**$15,710,200**
Engineering Design / CA	20%	$3,142,040
High Range		$24,509,000
Class 3 Estimate		**$18,853,000**
Low Range		$15,083,000

13. Schedule

The proposed Tabb PRS and OLSF was originally slated (via the RWWMP) to begin 1/1/30 and end 3/2/34. The Sustainable Water Initiative for Tomorrow (SWIFT) process flow equalization needs have expedited this schedule, requiring completion by January 2024.

Critical items from the preliminary project schedule are as follows:

- The design scope and fee will be prepared and reviewed by HRSD to be presented at HRSD October 2020 Commission Meeting.
- Full design services shall be performed with a targeted design completion by August 2021.
- Property acquisition/subdivision is underway for the 5-Acre parcel and does not represent a critical path item.
- The process of submitting applications to environmental permitting agencies shall begin immediately following the 90% design review workshop. This process of obtaining permits is estimated to take 4 months, with a 1-month contingency provided in the schedule.

The design will be completed by August 2021. This allows over 9 months to finalize permits, perform bid phase services, and negotiate the construction contract. 600 Days is provided in the schedule to construct the project and provides flexibility on sequencing of the various project elements. The project bid results and recommendations will be presented at the May 2022 Commission Meeting with an anticipated construction start time of June 2022 with projected completion of January 2024. See **Table 13-1** for project schedule.

Table 13-1: Project Schedule

Task	Completion Date
Design Completion	August 2021
Advertise Project	March 2022
Receive Bids	April 2022
Construction NTP	June 2022
Substantial Completion	November 2023
Project Completion	January 2024

14. Envision

14.1 Overview

The Envision Sustainable Infrastructure Rating System, which is governed by the Institute for Sustainable Infrastructure (ISI), is a triple bottom line (social, environmental, and economic) based rating system that addresses the sustainability of civil infrastructure projects. The Envision framework not only provides an assessment of a project's sustainability, but also considers its holistic contribution to the community it serves. The Envision rating system is comprised of five Categories (Quality of Life, Leadership, Resource Allocation, Natural World, and Climate & Resilience) that quantifies a project's performance in two key areas: performance contribution and pathway contribution. Performance contributions address many typical parameters considered in infrastructure planning and design such as water consumption, energy efficiency, materials consumption, and other quantifiable ecological impacts. Collectively these criteria can be used to answer the question "*Are we doing the project right?*". Pathway contributions address a project's alignment with community goals, support of responsible and sustainable development, and meaningful integration with existing infrastructure systems. While these parameters may often fall on the "softer" side of utility planning and management, they are equally important and serve to answer the question "*Are we doing the right project?*".

HRSD has incorporate Envision on other projects to determine how they perform with respect to the sustainable metrics outlined in this framework. The following is an excerpt from HRSD's *Design and Construction Standards* (2020 ed.), Section 1.B Expectations, Outcomes, and Sustainability: "…HRSD strives to deliver projects sustainably. To be consistent and develop a common understanding of what sustainability means, FIRMs shall utilize the Institute for Sustainable Infrastructure (ISI) Envision checklist when evaluating and designing projects. The Envision checklist will assist the project team in identifying and engaging stakeholders, identifying project risks and opportunities, and evaluating the project from multiple perspectives. Because project adjustments can be most economically incorporated early in a project's life, the first use of the Envision checklist should occur sometime between the start of preliminary engineering and the start of project design. The primary goal of utilizing ISI Envision is to plan, design, and construct better infrastructure projects for HRSD, our ratepayers, and our local partners; not to receive accreditation or an award. In some instances, pursuing project accreditation and award may be justified. Better infrastructure projects are the result of evaluating the project from economic, social, and environmental perspectives (the triple bottom line), and evaluating project alternatives and project components based on their life cycle costs."

14.2 Scoring and Award Results

The HRSD and Hazen project team performed an Envision (version 3) workshop for this project on August 17, 2020. The purpose of the workshop was to work through ISI's "Envision Checklist (v3)", which was available for download from their website. The project team completed the checklist with the goal of identifying how the project currently aligns with the Envision criteria, while also exploring how the criteria can improve the project. Each of the workshop attendees serve a different role in the project and provided information and a voice to specific project and organizational elements. Given the current

phase of the design, the workshop also yielded action items for potential sustainable enhancements to the project, which will be investigated as the project advances. The workshop discussion also served to validate the sustainable elements already intrinsic to the project efforts and HRSD's culture and standards of practice.

The below **Figure 14-1** summarizes the Envision score resulting from the completion of the checklist. The graph indicates the total number of applicable points and the total points scored, segmented by the five categories.

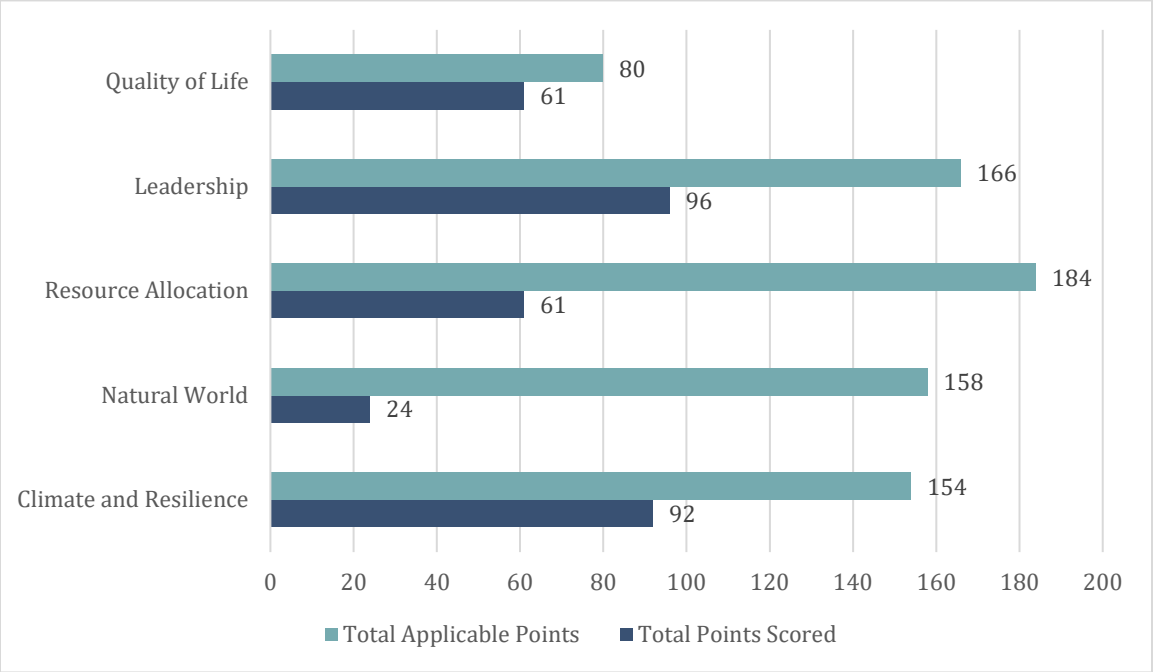


Figure 14-1: Envision Checklist Scoring Summary per Category

This checklist scoring indicates that the project is currently on track to achieve greater than 40% of the applicable points, which would qualify the project for a Gold award (second highest possible award). This assessment shows a current projected cumulative score of 45% (334 of 742 applicable points). The detailed scoring assessment is provided in Appendix K.

This scoring is subject to change due to several variables, including but not limited to:

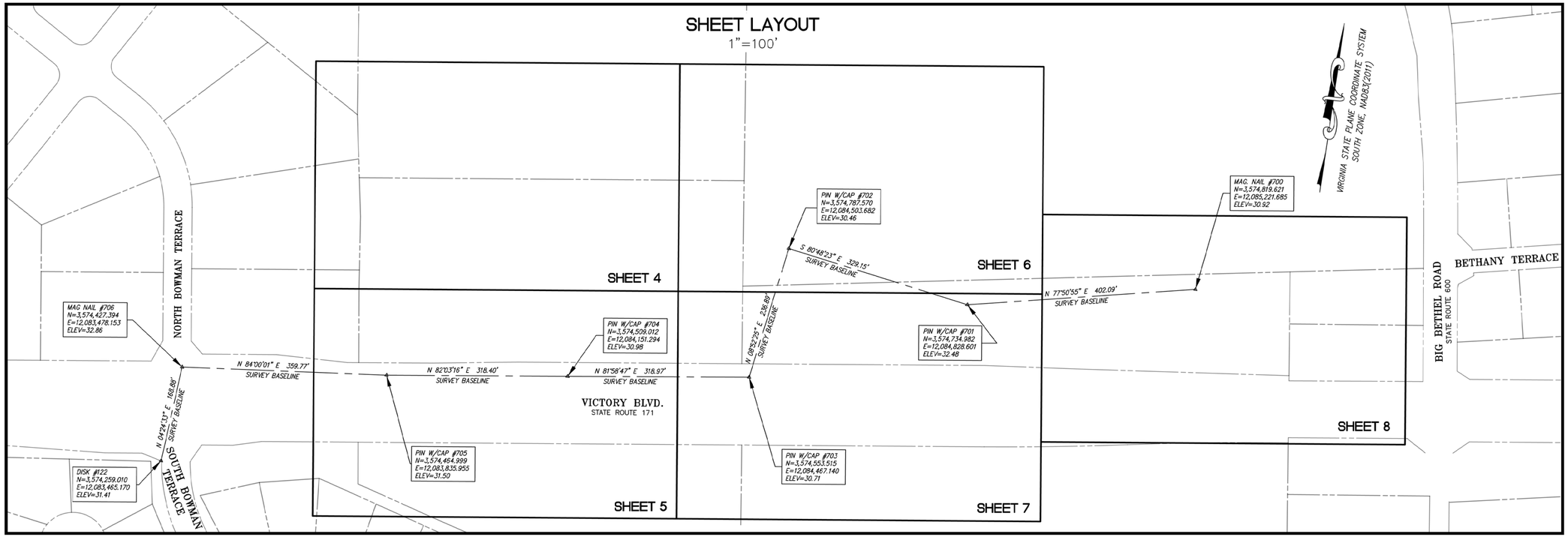
- More detailed assessment utilizing the complete, more stringent Envision criteria in the Envision Guidance Manual
- Review and input by other team members
- Project planning, design, and construction modifications in future phases
- Interpretation by an Envision third-party verifier (should an Envision verification/award be pursued)

14.3 Next Steps

The completion of the Envision checklist yielded several additional investigations and action items. The following list summarizes the actions that should be considered in future project phases:

- *QL 1.4: Minimize Noise and Vibration* – These parameters will be discussed with stakeholders, considered in the design, and discussed as part of the pre-construction assessment
- *QL 1.5: Minimize Light Pollution* – Lighting considerations should be discussed with stakeholders and County requirements should be determined due to proximity to a roadway and residential area
- *QL 1.6: Minimize Construction Impacts* – Identify a green buffer and consider limitation of nighttime construction activities
- *QL 2.3: Improve Access and Wayfinding* – Confirm location of existing or relocated entrance gate, and how Dominion Energy accesses their easement
- *QL 3.2: Preserve Historic and Cultural Resources* – Perform a Phase 1 archaeological survey of the project Area of Potential Effects (APE) per Virginia Department of Historic Resources
- *QL 3.3: Enhance Views and Local Character* – Tank and pressure reducing station aesthetics and buffer to be considered
- *LD 1.3: Provide for Stakeholder Input* – Perform stakeholder mapping exercise and perform "two-way" stakeholder engagement activities
- *LD 1.4: Pursue Byproduct Synergies* – Identify opportunities to pursue byproduct synergies with a nearby operation/organization
- *RA 1.1: Support Sustainable Procurement Policies* – Confirm HRSD's consideration of sustainable procurement policies
- *RA 2.3: Use Renewable Energy* – Confirm HRSD's purchase of "Green Power" program covers energy purchase reduction goals utility-wide
- *NW 2.3: Reduce Pesticide and Fertilizer Impacts* – Confirm HRSD's pesticide and fertilizer purchase and application policies
- *NW 3.4: Control Invasive Species* – Performed a field evaluation of existing invasive species, determine path forward for management or removal
- *CR 1.2: Reduce Greenhouse Gas Emissions* – Confirm HRSD's purchase of "Green Power" program covers greenhouse gas reduction goals utility-wide
- *CR 2.3: Evaluate Risk and Resilience* – Conduct a threat/hazard/risk assessment and review with stakeholders

Appendix A: Topographic Survey



SURVEY & UTILITY NOTES

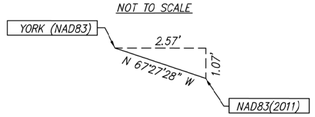
1. THE MERIDIAN SOURCE OF THIS TOPOGRAPHIC SURVEY IS BASED ON THE COUNTY OF YORK GEODETIC CONTROL NETWORK, VIRGINIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NORTH AMERICAN DATUM 1983(2011) (US SURVEY FEET).
2. ELEVATIONS REFER TO NAVD88 AND WERE ESTABLISHED FROM RTK GPS.
3. THIS SURVEY WAS PREPARED TO SHOW EXISTING FEATURES AS OF 08/15/2020 AND DOES NOT CERTIFY TO CHANGES TO SITE CONDITIONS WHICH OCCUR SUBSEQUENT TO THIS DATE AND OR TO PROPOSED IMPROVEMENTS.
4. THIS SURVEY DOES NOT CONSTITUTE A BOUNDARY SURVEY NOR A SUBDIVISION OF LAND.
5. PROPERTY AND R/W LINES WERE ESTABLISHED USING A COMPILATION OF DEEDS OF RECORD, PLATS OF RECORD AND EXISTING FIELD MEASUREMENTS.
6. THIS SURVEY DOES NOT INTEND TO DEPICT ANY WETLANDS, HAZARDOUS WASTE AND ENVIRONMENTAL FEATURES THAT MAY AFFECT SAID PROPERTY EXCEPT AS SHOWN.
7. PIPE MATERIAL TYPES ARE DETERMINED BY FIELD OBSERVATIONS TO THE BEST OF OUR ABILITY. PMI DOES NOT WARRANT THE MATERIAL TYPE OF PIPES LOCATED IN CONFINED OR INACCESSIBLE SPACES.
8. THE UNDERGROUND UTILITIES SHOWN, IF ANY, HAVE BEEN DESIGNATED BY ACCUMARK, INC. UTILIZING QL-B METHODS AND STANDARDS AND THE PAINT DESIGNATION LINES HAVE BEEN LOCATED IN THE FIELD. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED, ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES. THE SURVEYOR FURTHER NOTIFIES ALL PARTIES THAT VIRGINIA LAW REQUIRES VA811 TO BE CONTACTED PRIOR TO ANY EXCAVATION. SIZE AND MATERIAL INFORMATION IS BASED ON PLAN OR GIS DATA AND HAS NOT BEEN FIELD VERIFIED.
9. THIS TOPOGRAPHIC SURVEY WAS COMPLETED UNDER THE DIRECT AND RESPONSIBLE CHARGE OF IVAN LINEBERRY FROM AN ACTUAL ☌ GROUND OR ☐ AIRBORNE SURVEY MADE UNDER MY SUPERVISION; THAT THE IMAGERY AND/OR ORIGINAL DATA WAS OBTAINED BETWEEN 7-20-2020 & 8-12-2020; AND THAT THIS PLAT, MAP, OR DIGITAL GEOSPATIAL DATA INCLUDING METADATA MEETS MINIMUM ACCURACY STANDARDS UNLESS OTHERWISE NOTED.

COORDINATE SYSTEM CONVERSION DIAGRAM

VIRGINIA STATE PLANE COORDINATE SYSTEM NAD83(2011) TO COUNTY OF YORK HORIZONTAL CONTROL (NAD83)

1. INCREASE THE NORTHING U.S. SURVEY FEET VALUE BY 1.07'
2. REDUCE THE EASTING U.S. SURVEY FEET VALUE BY 2.57'

NOT TO SCALE



NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) TO NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)

1. INCREASE THE U.S. SURVEY FEET ELEVATION VALUE BY 1.08'

EXAMPLE: DISK 122 NAVD88 ELEVATION = 31.41 + 1.08 = DISK 122 NGVD29 ELEVATION = 32.49

LEGEND

	TEST BORING
DI	DRAINAGE INLET
CHH	CABLE HAND HOLE
EHH	ELECTRIC HAND HOLE
FM	FORCE MAIN WITNESS POST
L/P	LIGHT POLE W/MAST
SCO	SANITARY CLEAN OUT
Ⓢ	SANITARY MANHOLE
	SHRUB
	SIGN
Ⓓ	STORM MANHOLE
SFMV	SANITARY FORCEMAIN VALVE
TBM	TEMPORARY BENCHMARK
TCAB	TELEPHONE CABINET
THH	TELEPHONE HAND HOLE
TPED	TELEPHONE PEDESTAL
	CONTROL POINT
30128	TREE & IDENTIFIER
WV	WATER VALVE
	DITCH
X	FENCE
	GUARDRAIL
OHE	OVERHEAD ELECTRIC
UGC	UNDERGROUND COMMUNICATION LINE
UGE	UNDERGROUND ELECTRIC
W	UNDERGROUND WATER
	UNDERGROUND FORCE MAIN
CONC.	CONCRETE
ETRANS	ELECTRIC TRANSFORMER
FES	FLARED END SECTION
HW	HEADWALL
TOB	TOP OF BANK
TOS	TOE OF SLOPE
CLF	CHAINLINK FENCE
WF	WIRE FENCE

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 002320
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.

SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
www.precisionmeasurements.com
VIRGINIA BEACH – NEWPORT NEWS – RICHMOND – CHANTILLY, VIRGINIA
BALTIMORE, MARYLAND

TREE SPECIES IDENTIFIER TABLE

30019 15"PINE
30020 15"PINE
30021 15"PINE
30040 8"HOLLY
30041 8"HOLLY
30042 8"HOLLY
30043 8"SPLIT HOLLY
30061 24"PINE
30203 8"CEDAR
30204 8"CEDAR
30205 8"CEDAR
30214 8"CEDAR
30215 8"CEDAR
30216 8"CEDAR
30217 8"CEDAR
30218 8"CEDAR
30219 8"CEDAR
30254 8"TRIPLE OAK
30270 10"ASH
30271 8"CEDAR
30273 8"CEDAR
30274 8"CEDAR
30275 8"CEDAR
30276 8"CEDAR
30277 8"CEDAR
30278 8"CEDAR
30281 10"GUM
30282 24"PINE
30283 12"GUM
30284 6"GUM
30285 6"GUM
30286 12"PINE
30287 15"PINE
30288 15"PINE
30289 15"PINE
30290 8"PINE
30291 10"GUM
30292 10"GUM
30293 8"GUM
30294 8"GUM
30295 24"PINE
30296 24"PINE
30297 8"OAK
30298 15"MAPLE
30299 30"PINE
30300 8"OAK
30301 15"GUM
30302 15"TWIN DEAD PINE
30303 12"GUM
30304 15"PINE
30305 12"PINE
30306 8"PINE
30307 8"OAK
30308 8"PINE
30309 8"PINE
30310 6"OAK
30311 6"GUM
30312 6"OAK
30313 18"PINE
30314 15"PINE
30315 6"TRIPLE GUM
30316 18"PINE
30317 10"OAK
30318 10"GUM
30319 10"GUM
30375 30"MAPLE
30376 30"OAK
30388 36"OAK
30389 18"CREPE MYRTLE CLUSTER
30390 8"OAK
30391 15"OAK
30392 6"MAPLE
30446 18"GUM
30447 12"GUM
30448 12"GUM
30449 8"GUM
30450 6"GUM
30451 8"MAPLE
30456 8"MAPLE
30457 6"TWIN BIRCH
30458 10"TWIN GUM
30459 24"PINE
30460 8"GUM
30479 24"PINE
30482 12"GUM
30483 24"PINE
30484 6"MAPLE
30485 6"MAPLE
30496 18"PINE
30497 18"PINE
30502 15"PINE
30503 15"PINE
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30505 15"PINE
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30507 18"PINE
30508 18"PINE
30509 8"GUM
30510 6"POPLAR
30511 6"GUM
30512 6"GUM
30513 6"GUM
30514 6"GUM
30515 6"GUM
30516 8"GUM
30517 10"GUM
30518 12"GUM
30519 15"GUM
30520 8"MAPLE
30521 18"GUM
30522 6"MAPLE
30523 6"MAPLE
30524 24"PINE
30525 18"DEAD GUM
30526 18"MAPLE
30527 8"GUM
30528 8"GUM
30529 8"BIRCH
30530 12"MAPLE
30531 30"PINE
30532 8"MAPLE
30533 6"GUM
30534 12"POPLAR
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30547 12"MAPLE
30548 30"GUM
30549 18"GUM
30550 10"GUM
30560 18"PINE
30562 18"TWIN PINE
30563 6"GUM
30564 15"GUM
30565 10"DEAD HARDWOOD
30566 6"DEAD BEECH
30567 18"ASH

30568 6"BIRCH
30569 24"PINE
30570 18"GUM
30571 8"GUM
30572 18"GUM
30573 15"ASH
30574 12"BIRCH
30575 8"GUM
30576 30"PINE
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30578 12"GUM
30579 8"BIRCH
30580 8"MAPLE
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30584 18"PINE
30588 30"PINE
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30591 6"GUM
30592 6"CEDAR
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30662 12"PINE
30663 6"CEDAR
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30666 15"GUM
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30757 6"PINE
30758 10"GUM
30759 8"MAPLE
30760 8"TWIN OAK
30761 12"GUM
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30763 6"PINE
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30768 8"MAPLE
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30770 18"GUM
30771 24"GUM
30772 30"PINE
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30774 12"GUM
30775 15"GUM
30776 18"GUM
30785 18"GUM
30786 18"GUM
31169 18"DEAD HARDWOOD
31170 30"PINE
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31407 15"GUM
31408 8"MAG
31409 8"MAG
31410 8"PINE
31411 6"GUM
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31673 8"GUM
31674 8"GUM
31675 8"MAP
31676 10"GUM
31677 6"TRIPLE MAPLE
31678 6"TWIN GUM
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31680 12"GUM
31681 12"GUM
31682 18"GUM
31683 15"GUM
31684 18"GUM
31685 12"MAPLE
31686 12"MAPLE
31687 8"HOLLY
31688 15"MAP
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31700 18"GUM
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31702 8"PINE
31703 15"MAPLE

31704 15"MAPLE
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31708 15"MAPLE
31709 8"BEECH
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31893 8"GUM
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31897 18"MAPLE
31898 6"HOLLEY
31899 12"OAK
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31901 15"GUM
31902 30"MAGNOLIA
31904 18"PINE
31905 10"BEECH
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31957 6"GUM
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31960 18"BEECH
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31962 18"GUM
31963 12"GUM
31964 8"BEECH
31965 18"BEECH

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31967 12"PINE
31968 12"DEAD HARDWOOD
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31973 6"PINE
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31992 6"GUM
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32054 8"MAP
32055 8"GUM
32056 18"OAK
32057 10"OAK
32058 12"MAP
32059 18"PINE
32060 15"GUM
32061 24"BEECH
32062 8"GUM
32063 8"GUM
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32084 8"BEECH
32085 8"BEECH
32086 8"BEECH
32087 8"BEECH
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32091 6"PINE
32092 8"MAP
32093 12"MAP
32094 8"PINE
32095 8"PINE
32096 15"OAK
32097 6"HOLLEY
32098 6"PINE
32099 6"TWIN PINE
32100 6"PINE
32254 6"BIRCH
70133 10"PINE
70134 15"PINE
70135 8"GUM
70136 6"GUM
70137 8"OAK
70138 8"GUM
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70145 18"BIRCH
70146 8"OAK
70147 8"OAK
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70149 18"GUM
70150 8"POPLAR
70151 8"OAK
70152 15"HARDWOOD
70154 25"HARDWOOD
70169 15"OAK
70170 10"BEECH
70171 18"BEECH
70172 10"HARDWOOD
70174 18"BEECH
70175 18"BEECH
70176 18"BEECH
70178 6"BIRCH
70179 6"BIRCH
70180 6"BIRCH
70181 8"BIRCH
70182 15"OAK
70183 15"OAK
70184 15"OAK
70185 18"OAK
70186 15"OAK
70187 24"BEECH
70188 18"TWIN OAK
70189 18"HOLLY
70190 54"TWIN BEECH
70191 15"PINE
70192 6"PINE
70193 6"PINE
70194 8"PINE
70195 12"PINE
70196 6"GUM
70197 6"GUM
70198 6"GUM
70199 6"GUM
70200 8"PINE
70201 12"PINE
70202 15"PINE
70203 6"GUM
70204 12"PINE
70205 12"PINE

70206 6"PINE
70207 6"GUM
70208 10"GUM
70209 24"BEECH
70210 10"PINE
70211 8"PINE
70212 8"PINE
70213 6"GUM
70214 6"GUM
70215 6"GUM
70216 6"PINE
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70219 6"GUM
70220 6"GUM
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70234 8"GUM
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70236 8"GUM
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70238 24"TWIN OAK
70239 10"GUM
70240 12"GUM
70241 6"BEECH
70242 8"POPLAR
70243 30"BEECH
70244 15"POPLAR
70245 18"POPLAR
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70247 12"BEECH
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70250 6"POPLAR
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70254 8"BEECH
70255 8"POPLAR
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70258 15"BEECH
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70260 6"GUM
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70307 6"POPLAR
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70311 6"BEECH
70312 8"GUM
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70314 15"PINE
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70317 18"PINE
70318 18"PINE
70319 6"BEECH
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70322 20"GUM
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70324 8"BIRCH
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70357 6"BEECH
70358 6"GUM
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70360 18"BEECH
70361 24"TWIN BEECH
70362 12"BEECH

70363 18"GUM
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70388 6"BEECH
70389 12"BEECH
70390 6"BEECH
70391 6"BEECH
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70393 8"BEECH
70394 15"BIRCH
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70417 6"GUM
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70433 15"BEECH
70434 15"BEECH
70435 12"GUM
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70438 15BEECH
70439 12"BIRCH
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70449 24"BEECH
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70456 6"BEECH
70458 24"BEECH
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70461 6"BEECH
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70467 15"PINE
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70473 15"BIRCH
70474 18"TWIN BIRCH
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70476 8"BEECH
70477 15"BIRCH
70478 15"BIRCH
70479 12"BEECH
70480 12"BEECH
70481 15"BEECH
70482 15"BEECH
70483 15"BIRCH
70484 12"GUM
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70499 24"TWIN BIRCH
70501 8"HOLLY
70529 8"OAK
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70550 12"BIRCH
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70553 10"OAK
70554 10"OAK
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70583 6"BIRCH
70584 6"BIRCH
70585 6"BEECH
70586 15"GUM
70587 18"BEECH
70588 18"BEECH
70589 15"BIRCH
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70591 15"BIRCH
70592 10"BIRCH
70593 10"BEECH
70594 24"GUM
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70596 6"BIRCH
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70807 18"OAK
70808 8"PINE

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70914 15"PINE
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70916 15"MAPLE
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70919 15"DEAD BEECH
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70941 10"OAK
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70947 15"PINE
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70966 10"MAPLE
70967 6"BEECH
70968 30"PINE

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70986 6"BIRCH
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70999 12"MAPLE
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71002 12"MAPLE
71003 18"PINE
71004 12"PINE
71005 12"BEECH
71006 6"MAPLE
71007 18"MAPLE
71008 6"BIRCH
71009 18"BEECH
71010 18"PINE
71034 8"TWIN BEECH
71036 10GUM
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71047 6"GUM
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71060 6"MAPLE
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71092 8"GUM
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71099 6"MAPLE
71100 18"GUM
71101 8"BEECH
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71106 12"BEECH
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71124 15"TWIN BEECH
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71129 6"BEECH
71130 12"GUM
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71177 8"TWIN BEECH
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71179 10"GUM
71180 10"GUM
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71192 12"BEECH
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71198 18"BEECH
71199 12"BEECH
71207 15"GUM
71208 6"BEECH
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71211 15"PINE
71212 6"GUM
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71215 30"BEECH
71216 12"PINE
71217 24"FALLEN BEECH
71218 12"GUM
71219 12"GUM
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71371 12"MAPLE
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71377 12"GUM
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71383 8"MAPLE
71384 12"PINE
71385 12"PINE
71386 12"PINE
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71474 15"OAK
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71497 12"PINE
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71499 15"STUMP
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71571 15"GUM

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71591 30"PINE
71592 8"MAPLE
71595 12"OAK
71597 15"MAPLE
71598 8"MAPLE
71599 15"MAPLE
71600 12"BIRCH
71601 18"GUM
71603 36"GUM
71604 15"GUM
71606 24"TWIN MAPLE
71615 12"MAPLE
71616 18"PINE
71617 6"GUM
71618 15"PINE
71619 15"PINE
71620 18"PINE
71622 18"PINE
71623 6"PINE
71624 12"PINE
71625 12"MAPLE
71626 12"MAPLE
71627 6"MAPLE
71629 18"PINE
71630 24"PINE
71631 15"PINE
71633 15"OAK
71634 12"MAPLE
71635 8"BIRCH
71636 8"MAPLE
71637 15"PINE
71638 15"PINE
71639 6"BIRCH
71640 30"BEECH
71641 6"MAPLE
71642 30"BEECH
71643 30"GUM
71644 10"BIRCH
71646 30"PINE
71647 12"MAPLE
71648 6"MAPLE
71650 6"MAPLE
71651 12"MAPLE
71652 24"BEECH
71653 24"TWIN MAPLE
71655 10"MAPLE
71657 8"MAPLE
71658 15"MAPLE
71659 6"MAPLE
71660 30"BEECH
71662 10"MAPLE
71663 24"BEECH
71665 15"PINE
71666 6"HOLY
71667 8"MAPLE
71668 6"MAPLE
71669 8"DEAD PINE
71670 6"MAPLE
71673 18"PINE
71674 15"BIRCH
71675 6"BEECH
71676 15"PINE
71677 15"PINE
71678 15"PINE
71680 6"STUMP

0 20 40 60
GRAPHIC SCALE
1"=20'

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 002630
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

CONTROL RECOVERY SKETCHES

CONTROL ID: 700
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

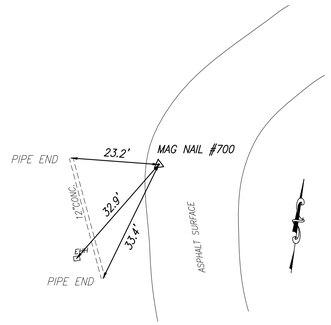
HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,819.621
X(EAST): 12,085,221.685

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 30.92

DETAILED DESCRIPTION:

CONTROL POINT IS A MAG NAIL SET IN ASPHALT.



NOT TO SCALE

CONTROL ID: 701
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,734.982
X(EAST): 12,084,828.601

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 32.48

DETAILED DESCRIPTION:

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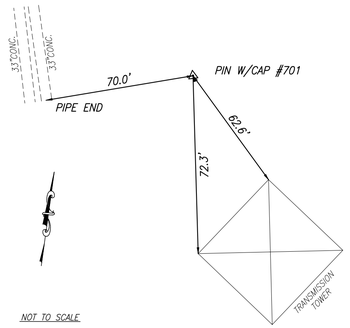

NOT TO SCALE

CONTROL ID: 702
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,787.570
X(EAST): 12,084,503.682

VERTICAL DATUM BASED ON NAVD88
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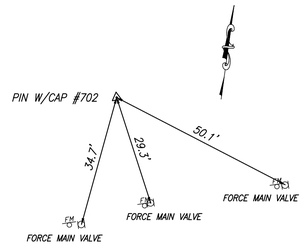

NOT TO SCALE

CONTROL ID: 703
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,553.515
X(EAST): 12,084,467.140

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 30.71

DETAILED DESCRIPTION:

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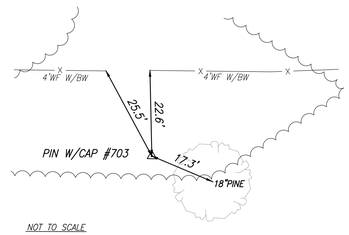

NOT TO SCALE

0 20 40 60
GRAPHIC SCALE
1"=20'

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION
YORK COUNTY, VIRGINIA
SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.
SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
www.precisionmeasurements.com
VIRGINIA BEACH – NEWPORT NEWS – RICHMOND – CHANTILLY, VIRGINIA
BALTIMORE, MARYLAND

PROPERTY LINE SHOWN PER SUBDIVISION PLAT PROVIDED BY HAMPTON ROADS SANITATION DISTRICT. THIS PLAT HAS NOT BEEN RECORDED AS OF 08-12-2020.

NOW OR FORMERLY
HARRY RICHARD ASHE
D.B. 1103, PG. 312
(P.B. 10, PG. 530)
GPIN# T04D-3932-0449

PIPE(F)

DITCH

TOS

TOB

SMALL PINES & SAPLINGS

MATCHLINE SEE SHEET 6

MATCHLINE SEE SHEET 5

VIRGINIA STATE PLANE COORDINATE SYSTEM
SOUTH ZONE, NAD83(2011)

0 20 40 60
GRAPHIC SCALE
1"=20'

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 002230
8/12/2020
LAND SURVEYOR

PRECISION MEASUREMENTS, INC.

SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
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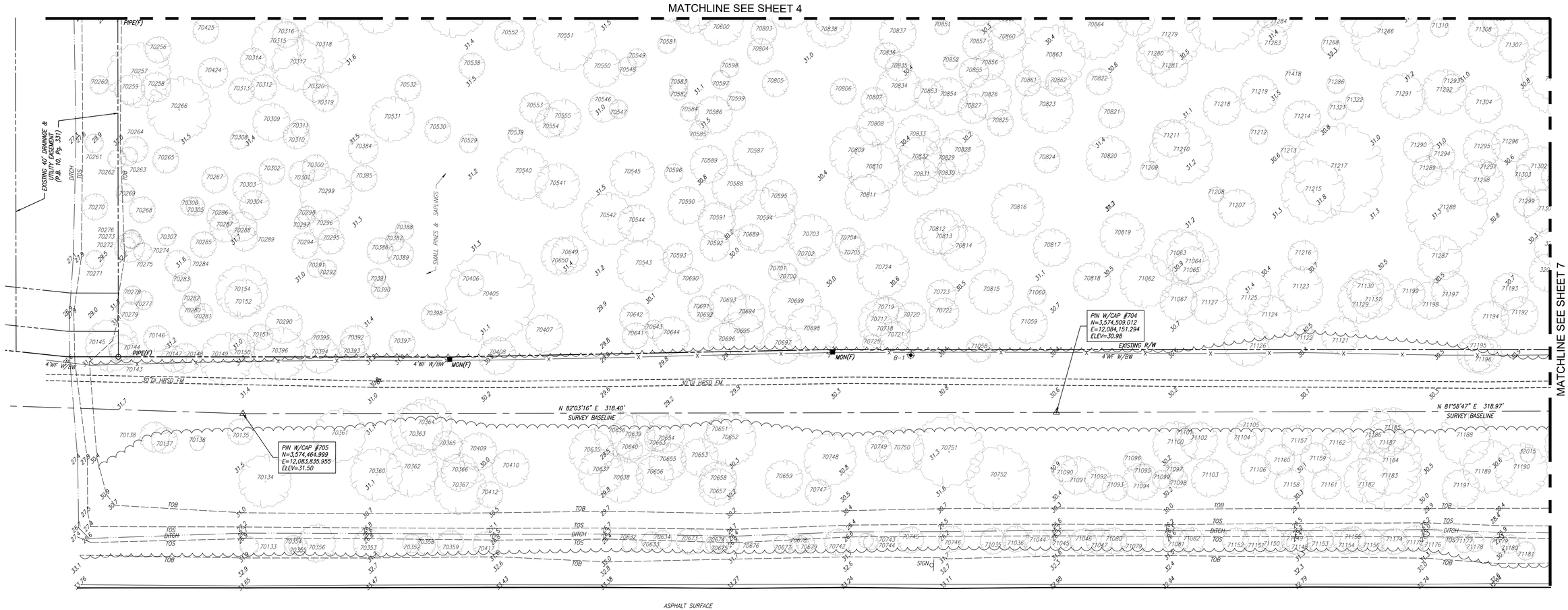
BALTIMORE, MARYLAND



VICTORY BOULEVARD
(VARIABLE WIDTH R/W)
STATE ROUTE 171

VIRGINIA STATE PLANE COORDINATE SYSTEM
SOUTH ZONE, NAD83(2011)

0 20 40 60
GRAPHIC SCALE
1"=20'

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.

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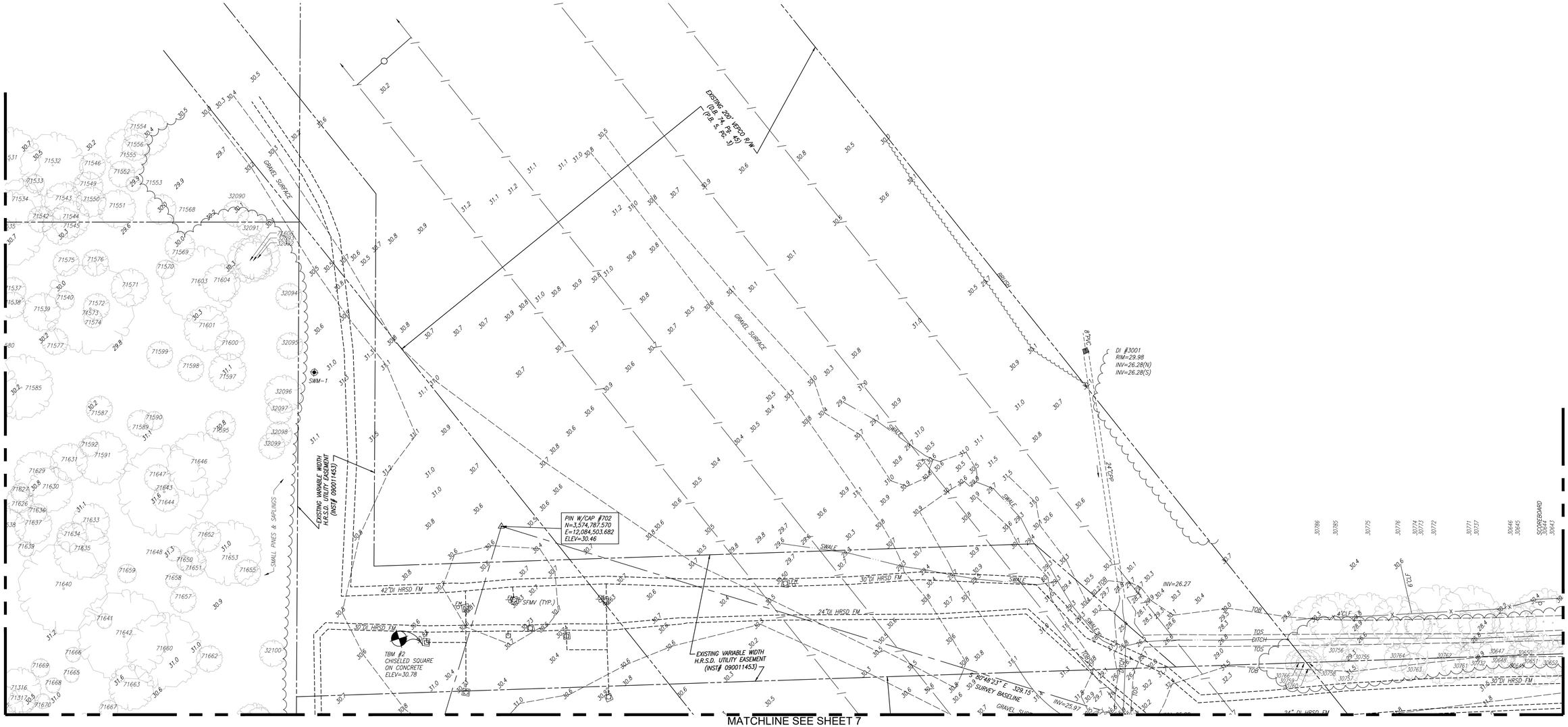
BALTIMORE, MARYLAND



VIRGINIA STATE PLANE COORDINATE SYSTEM
SOUTH ZONE, NAD83(2011)

0 20 40 60
GRAPHIC SCALE
1"=20'

EXISTING CONDITIONS
OF
TABB PUMPING REDUCING STATION
YORK COUNTY, VIRGINIA
SCALE: 1"=20' AUGUST 12, 2020

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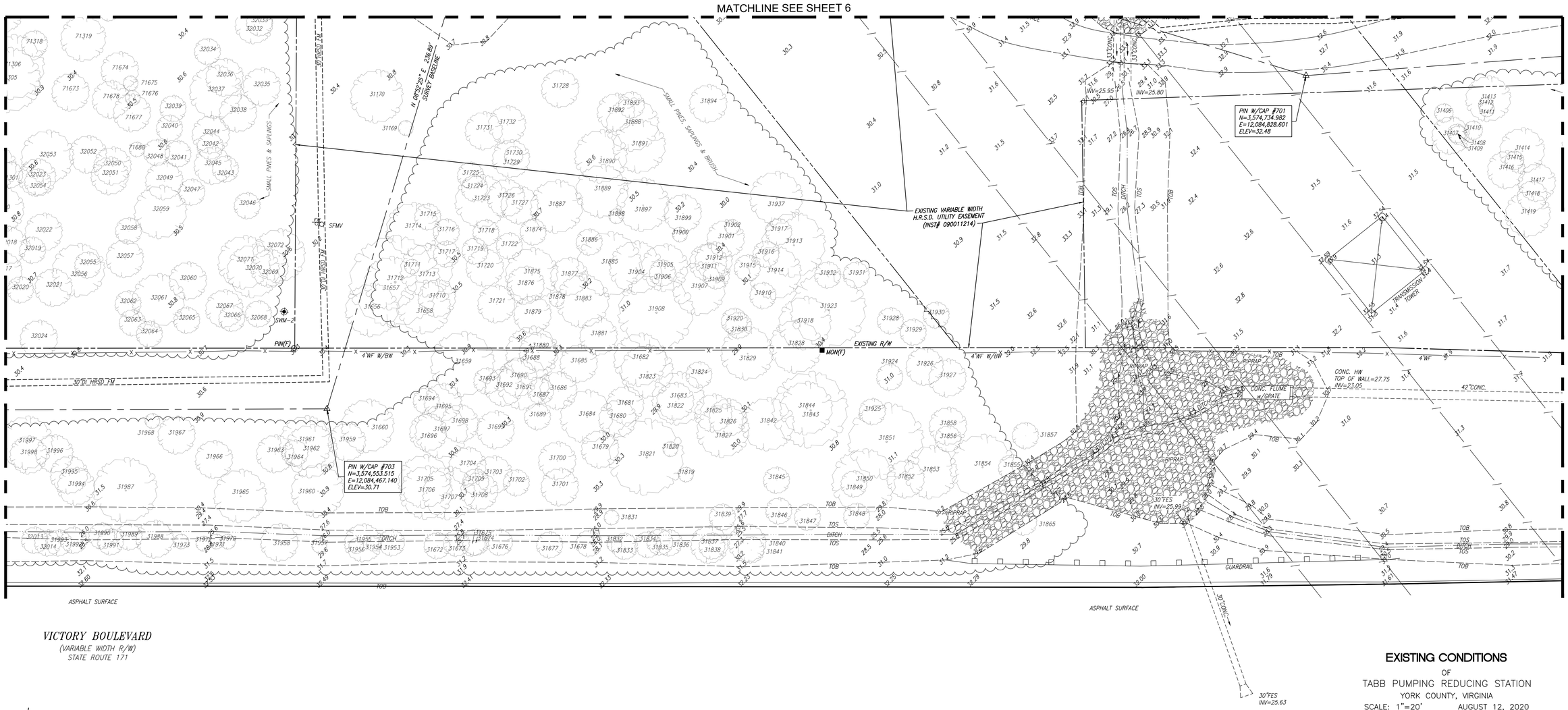
BALTIMORE, MARYLAND



EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

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IVAN R. LINEBERRY
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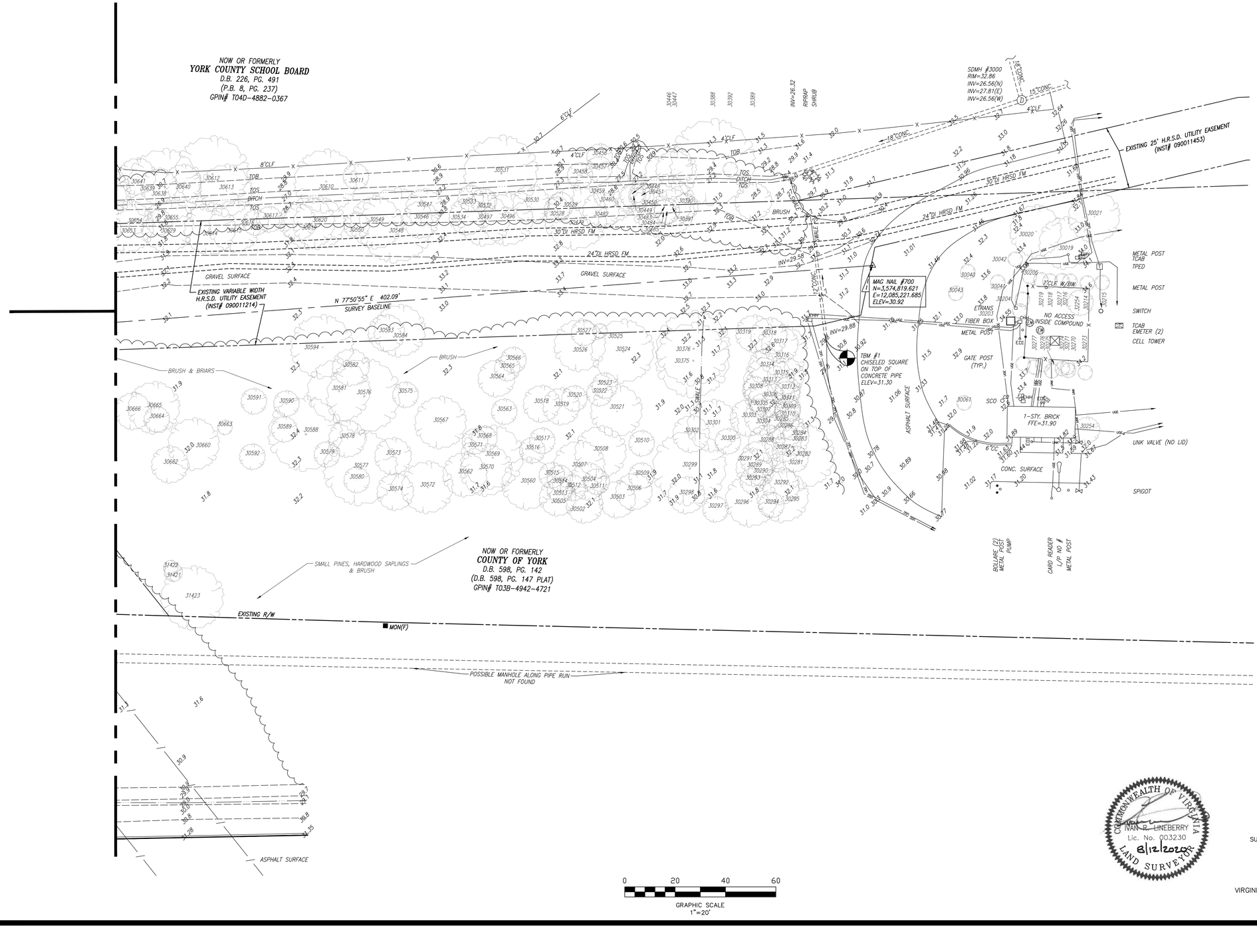

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
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BALTIMORE, MARYLAND

Appendix B: Geotechnical Report

PRELIMINARY REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING

HRSD Tabb Pressure Reducing Station and Offline Storage Facility

York County, Virginia

G E T Project No: WM20-140G

September 18, 2020

PREPARED FOR:

Hazen and Sawyer
2809 S. Lynnhaven Road, Suite 350
Virginia Beach, Virginia 23452

701 Alexander Lee Parkway Williamsburg, VA 23185
Phone: (757)-564-6452
www.getsolutionsinc.com

GET Solutions, Inc.
Geotechnical • Environmental • Testing

September 18, 2020

TO: **Hazen and Sawyer**
2809 S. Lynnhaven Road, Suite 350
Virginia Beach, Virginia 23452

Attn: Mr. P. Troy McPherson, PE, ENV SP

RE: Preliminary Report of Subsurface Exploration and Geotechnical Engineering Services
HRSD Tabb Pressure Reducing Station and Offline Storage Facility
York County, Virginia
G E T Project No: WM20-140G

Dear Mr. McPherson:

In compliance with your instructions, we have completed our Preliminary Subsurface Exploration and Geotechnical Engineering Services for the above referenced project. The results of this study, together with our recommendations, are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

We appreciate the opportunity to work with you on this project. We trust that the information contained herein meets your immediate need, and should you have any questions or if we could be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
G E T Solutions, Inc.

James R. Wheeler, P.G.
Senior Project Geologist

Bruce R. Spiro, P.E.
Principal Engineer
VA Lic. # 015791



Copies: (1) Client

701 Alexander Lee Parkway • Williamsburg, VA 23185 • Phone: (757)-564-6452 • Fax: (757)-564-6453
info@getsolutionsinc.com

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EXECUTIVE SUMMARY

The project site is located along the northside of Victory Boulevard (Route 171) west of Big Bethel Road in York County, Virginia. The project site is currently an undeveloped and heavily wooded parcel located directly west of an existing Dominion Energy utility easement.

This project is in the early stages of planning and design and for those reasons specific project details, site grades, final layout, foundation loading, etc. are not known at this time. However, the intended construction is expected to consist of building a new pump station along with two water storage tanks. Currently we have been informed that the pump station will likely include two levels with an approximate footprint of about 90-ft by 55-ft. The upper level will extend above grade and the lower level will be located below grade with a finished floor elevation at approximately -5-ft MSL. As provided by the Structural Engineer, the pump station structure will likely be supported on a mat foundation with a maximum contact pressure around its exterior of 3,500 psf, which is located beneath the exterior walls. The Structural Engineer indicated this contact pressure will dissipate quickly moving inward from the exterior of the mat foundation, but no further information into specific pressures is available at this time. Currently, it is our understanding that each of the water storage tanks will be placed at grade and have a 2.5 million-gallon capacity, a 115-ft diameter, and a 32.2-ft water depth. The construction is at this site is also expected to include installing below grade utilities, an access driveway, possibly a storm water management facility, and other associated infrastructure components. Although a preliminary concept layout has been provided, the final selected location of the pump station, water tanks, and other site features has not been finalized. In addition, the concept drawing did not indicate the location of the possible storm water management facility.

The project site is predominantly wooded; however, we were not allowed to clear any trees for drill rig access during this preliminary investigation. As a result, our field exploration was limited to cleared areas accessible to our drill rig, which included a utility easement along the south side of the project site running along the northside of Victory Boulevard and along the Dominion Energy easement along the eastside of the project site. As a result, our soil borings were performed towards the perimeter of the project site and not within the anticipated footprint of the pump station and water tanks. It is possible the subsurface soil and groundwater conditions at the pump station, water tank, and storm water management facility locations could vary from those conditions encountered during this preliminary field exploration.

Our field exploration program included one (1) 80-ft and two (2) 15-ft deep Standard Penetration Test (SPT) borings located in areas that did not require any clearing for our drill rig to access. Also, in-situ infiltration tests were conducted directly adjacent to each of the 15-ft deep SPT borings and a temporary groundwater monitoring well was installed at one of these borings to obtain a 24-hr stabilized groundwater level.

The initial groundwater table was measured to occur at a depth of 5 feet below the existing site grades at the boring locations. The boreholes were backfilled upon completion for safety considerations. As such, the reported groundwater levels may not be indicative of the static groundwater level. The 24-hr stabilized groundwater level measured at the temporary groundwater monitoring well was at 4.5 feet below existing grades. The actual elevation of the groundwater table is not known at this time since topographic information was not available when preparing this preliminary report. A description of the subsurface conditions encountered at the boring locations is tabulated in Section 3.4 of this report.

The following evaluations and preliminary recommendations were developed based on our field exploration and laboratory-testing program. **Once the design characteristics have been finalized a more comprehensive geotechnical investigation will be required to substantiate the preliminary findings presented herein. At that time, more comprehensive recommendations regarding foundations, earthwork, and quality control needs can be provided:**

- A field-testing program during construction is recommended, the components of which will vary depending upon the final design characteristics. Such activities may include subgrade proofrolling, test pits, compaction testing, test pile program, monitoring production pile installation, and shallow foundation excavation observations for bearing capacity verification. Some of these aspects are briefly discussed in this preliminary report but will need to be further expanded upon in the Final Design Geotechnical Engineering Report.

- Uncontrolled FILL material was encountered at one of the boring locations that extended to a depth of 2 feet below existing grades. Uncontrolled FILL must be undercut and removed from beneath all shallow foundations (where applicable) but may be suitable for slab and pavement support pending a further field investigation prior to final design.

- The subsurface SAND (SP and SP-SM) and some of the Silty SAND (SM) soils encountered at the boring locations meet the criteria recommended in this report for reuse as structural fill. However, moisture manipulation will likely be required due to shallow groundwater conditions encountered at this site.

- The weight of the pump station structure is expected to be less than the weight of the soil that will need to be removed to reach an elevation of -5-ft MSL or deeper, thus resulting in the structure heaving upward instead of settling. In addition, the base of the structure will be located well below the groundwater table, so buoyancy will also contribute to the structure heaving upward. It does not appear economically feasible to counteract these uplift forces with just increasing the thickness of the mat foundation and for these reasons it is recommended to support the proposed pump station on a deep foundation system likely consisting of Square Precast Prestressed Concrete (SPPC) piles in order to address these uplift forces.

- Below grade parameters are provided in the report that can be in the preliminary design for the pump station's below grade walls.

- It is expected that an enclosed coffererdam ill be required to construct the pump station considering the finish floor elevation of -5-ft MSL for the lower level, which is well below the groundwater table. This cofferdam system should be designed by others but would likely consist of interlocking sheet piles with bracing.

- The proposed 2.5 million-gallon water storage tanks could be supported by a deep foundation system likely consisting of Square Precast Prestressed Concrete (SPPC) piles. Preliminary pile capacity recommendations and pile testing program are discussed in Section 4.6. These recommendations cannot be considered final until the specific tank locations have been finalized, access to these locations is obtained, and the completion of a more comprehensive geotechnical investigation.

- As an alternative to supporting the water storage tanks on piles, supporting the tanks on full displacement aggregate piers, known as Rammed Aggregate Piers (RAP) could potentially be implemented as further discussed in Section 4.7 of this report. The design of full displacement aggregate piers should be provided by a qualified contractor who specializes in the design and installation of these aggregate piers.

- Based on our experience in the vicinity of the project site and the composition of the soils recovered within the upper 80 feet (maximum explored depth during feasibility study) at the boring locations, it is our opinion that the site characteristics are indicative of a Site Class “D” in accordance with Table 20.3-1 of ASCE 7-10 as referenced by the 2018 International Building Code (IBC).

This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed our preliminary subsurface exploration and geotechnical engineering services for the proposed Hampton Roads Sanitation District (HRSD) Tabb Pressure Reducing Station and Offline Storage Facility project located in York County, Virginia. The geotechnical engineering services were conducted in general accordance with the scope presented in **G E T** Proposal No. PWM20-189G. Authorization to proceed with our services was received from the client in the form of a signed subcontract agreement dated June 30, 2030.

1.2 Project Site Locations and Descriptions

The project site is located along the northside of Victory Boulevard (Route 171) west of Big Bethel Road in York County, Virginia. The project site is currently an undeveloped and heavily wooded parcel located directly west of an existing Dominion Energy utility easement. Based on visual observations during our site reconnaissance, the project site is relatively flat with grade changes generally less than 1 foot every 100 linear feet. As an exception, existing drainage channels/ditches that border the site (along the shoulder of Victory Boulevard, western perimeter of site, and within the Dominion energy utility easement east of the site) extend several feet below surrounding grades, most of which contained water towards the bottom of these channels/ditches during our site reconnaissance. A site vicinity map obtained from Google Earth is provided in Figure 1 below with this project site indicated.

Figure 1: Site Vicinity Map



1.3 Project Construction Description

This project is in the early stages of planning and design and for those reasons specific project details, site grades, final layout, foundation loading, etc. are not known at this time. However, the intended construction is expected to consist of building a new pump station along with two water storage tanks. Currently we have been informed that the pump station will likely include two levels with an approximate footprint of about 90-ft by 55-ft. The upper level will extend above grade and the lower level will be located below grade with a finished floor elevation at approximately -5-ft MSL. As provided by the Structural Engineer, the pump station structure will likely be supported on a mat foundation with a maximum contact pressure around its exterior of 3,500 psf, which is located beneath the exterior walls. The Structural Engineer indicated this contact pressure will dissipate quickly moving inward from the exterior of the mat foundation, but no further information into specific pressures is available at this time.

Currently, it is our understanding that each of the water storage tanks will be placed at grade and have a 2.5 million-gallon capacity, a 115-ft diameter, and a 32.2-ft water depth. The water storage tanks could be supported by a deep foundation, likely consisting of Square Precast Prestressed Concrete (SPPC) piles. The structural engineer has requested pile design recommendations for piles that can provide an allowable capacity of about 120 tons per pile in compression.

The construction is at this site is also expected to include installing below grade utilities, an access driveway, possibly a storm water management facility, and other associated infrastructure components. Although a preliminary concept layout has been provided, the final selected location of the pump station, water tanks, and other site features has not been finalized. In addition, the concept drawing did not indicate the location of the possible storm water management facility.

If any of the noted information is incorrect or has changed, please inform G E T Solutions, Inc. so that we may amend the preliminary recommendations presented in this report, if appropriate. Given the preliminary nature of this report and considering our field exploration was limited to areas likely outside of the footprint of the proposed pump station, water storage tanks, and possibly the storm water management facility all preliminary recommendations presented in this report should only be used as a general guideline for planning purposes. All recommendations will need to be validated upon completion of a more comprehensive geotechnical engineering investigation. At that time, more comprehensive recommendations regarding foundations, earthwork, and quality control needs can be provided.

1.4 Purpose and Scope of Services

The purpose of this study was to obtain information on the general subsurface conditions at the proposed project sites. The subsurface conditions encountered were then evaluated with respect to the available project characteristics. In this regard, preliminary engineering assessments for the following items were formulated:

1. General assessment of the soils revealed by the borings performed at the proposed development.

2. General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.

3. Assessment of the shallow subsurface soils' expansive properties.

4. Preliminary construction considerations for soil subgrade preparation (stripping, grading, and compaction).

5. Preliminary feasibility of utilizing a deep foundation system for support of the proposed pump station. Evaluation of driven SPPC piles, including embedment depths and preliminary capacities.

6. Preliminary feasibility of utilizing a deep foundation system for support of the proposed water storage tanks. Evaluation of driven SPPC piles, including embedment depths and preliminary capacities. As an alternative, considerations for supporting the proposed water storage tanks on full displacement aggregate piers.

7. Determine pertinent information regarding the soil and groundwater conditions at the preliminary boring locations for storm water management purposes based on field exploration activities.

8. Seismic site class determination in accordance with the 2015 International Building Code.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around these sites. Prior to development of these sites, an environmental assessment is advisable.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated design parameters and preliminary recommendations, the following exploration program was performed:

- One (1) 80-foot deep Standard Penetration Test (SPT) boring (designated as B-1) was drilled in an area that did not require any clearing for our drill rig to access (central southern portion of site).

- Two (2) 15-foot deep SPT borings (designated as SWM-1 and SWM-2) were drilled in areas that did not require any clearing for our drill rig to access (eastern portion of site).

- In-situ soil permeability tests (designated as SWM-1 and SWM-2) were performed directly adjacent to boring locations SWM-1 and SWM-2 at a depth of 3 feet below existing grades as directed by the project Civil Engineer.

The project site is predominantly wooded; however, we were not allowed to clear any trees for drill rig access during this preliminary investigation. As a result, our field exploration was limited to cleared areas accessible to our drill rig, which included a utility easement along the south side of the project site running along the northside of Victory Boulevard and along the Dominion Energy easement along the eastside of the project site. As a result, our soil borings were performed towards the perimeter of the project site and not within the anticipated footprint of the pump station and water tanks. Once the design characteristics have been finalized a more comprehensive geotechnical investigation will be required.

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to a depth of 12 feet, and at 5-foot intervals thereafter, starting at a depth of 13 feet below grade. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using a safety hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer and overburden pressure). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a sealed glass jar, and returned to our laboratory for review.

The boring locations were established and marked in the field by **G E T Solutions, Inc.** measuring from existing landmarks. The approximate boring locations are shown on the attached "Boring Location Plan" (Appendix I) which was reproduced from a preliminary concept drawing provided by the client.

2.2 Field and Laboratory Testing

Soil testing provided by **G E T Solutions, Inc.** was performed in accordance with American Society for Testing and Materials (ASTM) standards. All soils and materials tests were performed in our AASHTO re:source (formally AMRL) and US Army Corps of Engineers certified Williamsburg laboratory.

2.2.1 Soil Classification and Index Testing

Representative portions of all soil samples collected during drilling operations were labeled, preserved and transferred to our laboratory in accordance with ASTM D4220 for classification and analysis. Soil descriptions on the boring logs are provided using visual-manual methods in general accordance with ASTM D2488 using the Unified Soil Classification System (USCS). Soil samples that were selected for index testing were classified in general accordance with ASTM D2487. It should be noted that some variation can be expected between samples classified using the visual-manual procedure (ASTM D2488) and the USCS (ASTM D2487). A summary of the soil classification system is provided in Appendix II.

Representative split-spoon soil samples were selected and subjected to natural moisture, #200 sieve wash, and Atterberg Limits testing in order to corroborate the visual classification. These test results are presented in Appendix III and on the soil test boring logs provided in Appendix IV. A generalized subsurface soil profile is provided in Appendix V.

2.2.2 Infiltration Testing

Infiltration tests, designated as SWM-1 and SWM-2, were performed directly adjacent to boring locations SWM-1 and SWM-2, respectively. The tests were performed at a depth of 3 feet below the existing site grades as directed by the project Civil Engineer. It is noted that the evaluated locations may not align with actual storm water management basins once site design is completed, and that the results presented in this report may not be applicable to the final locations.

The boreholes were prepared utilizing an auger to remove soil clippings from the base. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

A support stand was assembled and placed adjacent to the boreholes. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 2-meter (6.6 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended above the bottom of the borehole at an elevation of approximately 5 times the borehole diameter. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until relatively consistent flow rates were documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

Based on the field testing and corroborated with laboratory testing results (published values compared to classification results), the hydraulic conductivities of the soils at the locations and depths tested are tabulated below (Table I) and are presented on the “Hydraulic Conductivity Worksheet” reports included in Appendix VI.

Table I – Infiltration Test Results

Infiltration Test/Boring No.	Boring Depth (Feet)(1)	USCS Classification	% Passing #200 Sieve	K_{sat} Value (in/hour)	K_{sat} Value (cm/sec)	K_{sat} Class
SWM-1	3.0	SP-SM	9	5.558	3.92×10^{-3}	High
SWM-2	3.0	SM	18	1.858	1.31×10^{-3}	High

Notes: (1) Depth below existing grades.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Geology

The project site is located within the Atlantic Coastal Plain physiographic province. Bedrock of the Late Mesozoic age is present at depths of greater than 2,000 ft, and is overlain by Lower and Upper Cretaceous, Tertiary, Pleistocene and Recent Sediments.

Across the outer Coastal Plain, the Pliocene age Yorktown Formation of the Tertiary Period is widespread, occurring from Maryland to North Carolina. Its age is estimated between 4.8 million and 2.8 million years and is estimated to have been deposited during three transgressive episodes. The depositional environment was shallow marine in nature, consisting of inner shelf, barrier-island, estuarine and lagoonal patterns. The Yorktown Formation is a glauconitic, fossiliferous, Silty to Clayey greenish-gray fine Sand. This material has been pre-consolidated by an increased effective overburden pressure generated due to a drop in the sea level at the end of the Tertiary Period, and by previously overlying sediments, which eroded away as the sea level subsequently lowered.

As sea levels rose during the Pleistocene Epoch of the Quaternary Period, areas within the project limits were filled and overlain by soils of the Sedgefield Member of the Tabb Formation, which is composed of fluvial and estuarine deposits. The geologic stratigraphy encountered in our subsurface explorations generally consisted of marine deposited Sands and Clays of this formation.

3.2 Preliminary Subsurface Soil Conditions

A summary of the preliminary subsurface soil conditions encountered at the SPT boring locations is presented in Table II on the following page.

Table II – Subsurface Soil Conditions

Average Depth (ft)	Stratum	Description	Ranges of SPT(1) N-Values
0 to 0.2 - 1.5	Topsoil	➢ 2 to 18 inches of Topsoil	–
1.5 to 2.0	FILL	➢ Silty SAND (SM), contains fibrous organic material *FILL materials were not observed at boring locations B-1 and SWM-2.*	5
0.2 - 1.5 to 11.8 - 12.5	I	➢ SAND (SP, SP-SM, and SM) with varying amounts Gravel, Silt, and/or fibrous organic material	2 - 16
11.8 - 12.5 to 15.0 - 16.5	II	➢ Lean CLAY (CL) with varying amounts of Gravel, Sand, and/or fibrous organic material. ➢ Silty, Clayey SAND (SC-SM) was encountered in lieu of Lean CLAY (CL) at boring location B-1 *Borings SWM-1 and SWM-2 were terminated within this stratum.*	CLAY 7 SAND 3
16.5 to 31.5	III	➢ Silty SAND (SM) with varying amounts of Gravel	4 - 22
31.5 to 80.0	IV	➢ Silty SAND (SM) with varying amounts of Clay and/or marine shell fragments, “Yorktown Formation”	4 - 14

Note(s): (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot (uncorrected)

It is noted that the topsoil designation references the presence of surficial organic laden soil and does not represent any particular quality specification. This material should be tested for approval prior to its use.

The subsurface descriptions are of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included in Appendix IV (Boring Log sheets) and in Appendix V (Generalized Soil Profile) which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual.

3.3 Groundwater Discussion

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The initial groundwater level was measured to occur at a depth of 5 feet below existing grades at the boring locations.

During drilling operations, fluid (clay-water slurry) is introduced into the bore hole generally impairing the ability to accurately determine groundwater levels. Additionally, as subsurface soils begin to dry, moisture moves upwards through the soil profile by means of capillary action. Based on the subsurface soil composition (soils containing more than 30% of fines by weight), the initial groundwater level reading (based on the relative wetness of the soils) could be in part attributed to the capillary action of the soils. As such, the reported initial groundwater level may not be indicative of the static groundwater level. The boreholes were backfilled upon completion for safety considerations.

A stabilized groundwater level was measured at the temporary groundwater monitoring well located at boring SWM-2. The groundwater information associated with this well is presented in Table III below.

Table III – Temporary Well Reading

Boring Location	Initial Groundwater Reading (ft)(1)	24-hour Stabilized Groundwater Reading (ft)(1)
SWM-2	5	4.5

Note: (1) Depth below existing site grades.

The actual elevation of the groundwater table is not known at this time since topographic information was not available when preparing this preliminary report.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, sidewalks, etc.). In the project's area, seasonal groundwater fluctuations of ±3 feet are common; however, greater fluctuations have been documented. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

3.4 Shrink-Swell Soils Discussion

The soils recovered during our field investigation were tested and evaluated for their potential to expand or contract with moisture changes (typically termed shrink-swell). Shallow foundations and other on-grade features constructed on expansive soils at certain depths may be subjected to detrimental uplift or horizontal forces caused by the swelling of these soils as a result of an increase in the moisture content. Conversely, as these Clays lose moisture they may shrink, adversely affecting the foundations. The depth to which soils are normally affected by moisture changes extends from the ground surface to approximately 6 feet below existing grades in this area, depending on site topography and drainage characteristics.

The predominant soils within the project sites are mapped by the USDA web-based Soil Survey as the 5-Bethera, 29A-Slagle, and 38 Yemassee. These soils are described by the Soil Survey as possessing low to moderate expansive (shrink-swell) potential. Based on our field and laboratory investigation, the subsurface soils at this project site encountered within the upper 10 feet are considered to have a low expansive (shrink-swell) potential.

4.0 PRELIMINARY EVALUATIONS AND RECOMMENDATIONS

Our preliminary recommendations are based on the previously discussed project information, our interpretation of the soil test borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what was described, we request the opportunity to review our recommendations and make any necessary changes.

The recommendations presented in this study are preliminary in nature and should only be used as a general guideline for planning purposes. All recommendations will need to be validated upon completion of a more comprehensive geotechnical engineering investigation. Further recommendations relative to these aspects provided in this preliminary report will be provided in the Final Design Geotechnical Engineering Report.

4.1 Clearing and Grading

The proposed construction areas should be cleared by means of removing vegetation, topsoil, trees, root mat, fibrous materials, unsuitable FILL, or any otherwise unsuitable materials. Based on the borings completed as part of this preliminary study, it is estimated that an initial cut of up to 18 inches in depth will be required to remove the topsoil materials at the project site, but could likely extend deeper in other unexplored locations particularly within the wooded areas that were beyond the limits of our preliminary field exploration. Removing trees will also consist of stump and large root removal. The stump and large root removal will likely leave holes that may extend several feet in depth throughout the project site. Surface water may accumulate in these holes and lead to subgrade deterioration if not properly addressed. These holes should be backfilled as recommended in Section 4.3.

Uncontrolled FILL material was observed at boring location SWM-1 that extended to a depth of 2 feet below existing grades. It is suspected that the Uncontrolled FILL material is associated with previous construction activities associated with the utility easement. The undeveloped wooded portion of the site was not explored as part of this preliminary study and therefore its unknown if these Uncontrolled FILL materials are present elsewhere across the project site. Uncontrolled FILL must be undercut and removed from beneath all shallow foundations (where applicable) but may be suitable for slab and pavement support pending a further field investigation prior to final design.

4.2 Subgrade Preparation

Following the clearing operation, the exposed subgrade soils should be densified with a large static drum roller. After the subgrade soils have been densified, they should be evaluated by **G E T Solutions, Inc.** for stability. Accordingly, the subgrade soils should be proofrolled to check for pockets of loose material hidden beneath a crust of better soil. Several passes should be made by a large rubber-tired roller or loaded dump truck over the construction areas. The number of passes will be determined in the field by the Geotechnical Engineer depending on the soil conditions. Any pumping or unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the direction of the Geotechnical Engineer.

In addition to the proofroll, several 2 to 3-foot deep test pits should be excavated within the proposed construction area where Uncontrolled FILL materials are present. These test pits are considered necessary to determine the thickness and composition of the Uncontrolled FILL material and thus the suitability for it to remain in-place (beneath the slabs and pavements if applicable). The test pits should be performed under the observation of a representative **G E T Solutions, Inc.**, who will evaluate the composition of the recovered soils. It is possible that some subgrade improvements will be required to provide suitable soils for slab and pavement support. Regardless, all Uncontrolled FILL materials must be removed from the base of all footing excavations.

4.3 Fill and Placement

Any material to be used for fill should be evaluated and tested by the Geotechnical Engineer in an AMRL certified laboratory prior to placement to determine the suitability for the intended use. For this project the following soil material definitions are given:

Suitable Structural Fill Material

Suitable structural fill material should consist of sand or gravel containing less than 25% by weight of fines (SP, SM, SW, GP, GW – with dimensions not to exceed 2 inches in diameter), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 98% of the Standard Proctor maximum dry density, in accordance with ASTM D698. The moisture content of the structural fill should be within +/- 2 percentage points of the optimum moisture content at the time of placement. In general, the compaction should be accomplished by placing the fill in maximum 8-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density.

Unsuitable Material

Any soil material which contains more than 5% by weight organic matter, has an unstable bearing capacity, contains deleterious debris (wood, plastic, coal, etc.), has an excessive moisture content (a moisture content that prohibits proper compaction), or soils with a Liquid Limit (LL) greater than 40% and a Plasticity Index (PI) greater than 12%.

4.4 Suitability of On-site Soils

Based on the boring log information and soil classification testing, the soils classified as SAND (SP and SP-SM) and some of the soils classified as Silty SAND (SM) appear to be suitable for reuse as structural fill material in accordance with Section 4.3 of this report. However, a more comprehensive study including soil borings performed within the limits of the project site and additional soil classification tests will need be required to substantiate these preliminary findings.

Moisture manipulation will be required when reusing soils located near or below the groundwater table. This manipulation will likely require stockpiling of wet soils and/or placing the material in thin layers.

4.5 Preliminary SPPC Pile Foundation Recommendations

The weight of the pump station structure is expected to be less than the weight of the soil that will need to be removed to reach an elevation of -5-ft MSL or deeper, thus resulting in the structure heaving upward instead of settling. In addition, the base of the structure will be located well below the groundwater table, so buoyancy will also contribute to the structure heaving upward. It does not appear feasible to counteract these uplift forces with just increasing the thickness of the mat foundation and for these reasons it is recommended to support the proposed pump station on a deep foundation system in order to address these uplift forces. Also, deep foundations are expected to be required to support the 2.5 million-gallon water storage tanks. The following sections describe the pile capacity analyses and provide our preliminary recommendations for static axial compressive pile capacities, pile testing program, and pile construction criteria.

It is noted that the soil borings completed as part of this preliminary study were not located within the anticipated footprint of the proposed pump station and water storage tanks (per the preliminary concept drawing) and therefore the following preliminary deep foundation recommendations may not be applicable.

4.5.1 Preliminary Axial Compression Capacity Recommendations

We conducted pile capacity analyses using static formulas with coefficients recommended by Geoffrey Myerhoff and George Sowers. The analyses include the contributions of shaft friction and end bearing to the pile capacity. The piles will derive their required capacity from shaft friction and end bearing at elevations presented in Tables IV and V.

The soil materials typically exhibit time-dependent strength characteristics; consequently, shaft friction and end bearing support tend to increase from initial installation through a process termed “soil setup”. Essentially, the dynamics of driving piles will cause excess pore pressures to develop, thereby decreasing driving resistance during initial pile installation. The pile capacities developed during driving are usually much lower than the design values. Once driving is complete, the excess pore pressures dissipate with time (soil setup occurs) and the bearing capacity of the pile increases. Based upon our experience with similar projects in the area, approximately 5 days is usually required for the full pore pressures to dissipate and soil setup to occur.

For the reasons previously described, it will not be possible to confirm pile capacities with a simple driving criterion such as number of hammer blows per foot of advanced pile. Instead, driving criteria will likely consist of a target tip elevation with specified driving resistance.

Tables IV and V on the following page provides our preliminary recommended pile lengths and capacities for the water storage tank and pump station foundations. The allowable capacity for the piles includes a safety factor of at least 2.0 to allow for a pile load test program that relies primarily on dynamic testing. The capacity of a group of piles spaced at least 3 pile diameters apart, center to center, can be taken as the sum of the individual capacities with no reduction factor. If closer pile spacing is anticipated, the geotechnical engineer should be contacted to evaluate the efficiency of the specific pile group.

As previously mentioned, the borings were not completed within the footprint of the proposed structures. In addition, the boring used to develop our preliminary pile capacity recommendations (boring B-1) only extended to a depth of 80 feet below existing grades, which is at or near the pile tip depth recommended in Tables IV and V. So, we had to speculate on soil conditions beyond the depth explored. Therefore, a more comprehensive geotechnical investigation will need to be completed prior to finalizing these preliminary recommendations, which will need to include deeper soil borings located within the footprint of these structures.

Table IV – Preliminary SPPC Pile Recommendations – Water Storage Tanks

SPPC Pile Size (in)	Embedment Depth (ft)(1)	Pile Cut Off Depth	Total Pile Length (ft)(2)	Ultimate Compression Capacity (tons)	Allowable Compression Capacity (tons)	Allowable Tension Capacity (tons)	Pre-Auger Depth (ft)
12	75	Grade	75	240	120	60	5
14	65	Grade	65	240	120	60	5

Notes: (1) Below existing site grades.
(2) Includes pile length from pile cut off elevation to tip elevation.

Table V – Preliminary SPPC Pile Recommendations – Pump Station

SPPC Pile Size (in)	Embedment Depth Below Mat (ft)(1)	Pile Cut Off Elevation (ft)	Total Pile Length (ft)(2)	Ultimate Compression Capacity (tons)	Allowable Compression Capacity (tons)	Allowable Tension Capacity (tons)	Pre-Auger Depth (ft)
12	50	-6	50	180	90	45	0
14	50	-6	50	200	100	50	0

Notes: (1) Below elevation -6 feet MSL (estimated elevation of bottom of mat foundation).
(2) Includes pile length from pile cut off elevation to tip elevation.

4.5.2 Pile Group Settlement

Pile group settlement is equal to the displacement of the pile tip plus the elastic shortening of the pile between the pile cap and pile tip. For end bearing piles the tip displacement is relatively small and the principal displacement is the elastic shortening of the pile. For friction the tip displacement will be the significant quantity causing settlement. Pile groups supported on cohesionless soils, as is the case anticipated for this project, will produce only elastic (immediate) settlements. Accordingly, the settlements will occur almost immediately when the pile group is loaded.

Elastic shortening of the SPPC piles under the allowable compression capacity is computed by the following expression:

$$\Delta = \frac{Qa\,L}{A\,E}$$

Notes: Qa = Allowable compression capacity
L = Pile length
A = Cross-sectional area of the pile
E = Elastic modulus

We have evaluated the pile group with the following design characteristics:

- Pile cap is designed as a rigid member supported directly on the ground surface.
- Piles are vertical.
- Load is applied to the center of the pile group.
- The pile group is symmetrical.

Using these design characteristics, settlements can be evaluated under the assumption that each pile in a group carries equal load. Based on the results of load tests performed on piles driven in similar soils conditions and the results of the settlement analysis, it is anticipated that the total post-construction pile settlements (including elastic shortening) will not exceed about ½-inch, which is the settlement necessary to mobilize the soil/pile resistance in combination with the pile group settlements due to the stress increase in the underlying soils.

4.5.3 Test Pile Program

A test pile program will be implemented for the purpose of assisting in the development of final tip elevations and to confirm that the contractor's equipment and installation methods are acceptable. Recommendations for the test pile program should be provided in the Final Design Geotechnical Engineering Report.

4.6 Aggregate Piers

As an alternative supporting the water storage tanks on a deep foundation system, the foundations could potentially be placed on full displacement aggregate piers, also known as rammed aggregate piers. Aggregate piers are designed to improve loose and/or compressible soils allowing shallow foundation support with minimal settlement. It is recommended that the aggregate piers be installed by means of a bottom feed process. During installation, the aggregate should be compacted in lifts by means of vibratory or impact systems. The design of full displacement aggregate piers should be provided by a qualified contractor who specializes in the design and installation of these aggregate piers. Based on previous experience, the allowable bearing capacity after the installation of full displacement aggregate piers can be increased to at least 5,000 psf or more. The actual bearing capacity should be provided by the contractor's design engineer.

4.7 Below Grade Walls (Pump Station)

It is expected that the below grade walls for the pump station will consist of earth-retaining structures supported over a mat foundation bearing at an elevation of about -6-ft MSL (estimated 1-ft below finish floor elevation of lower level of pump station). As previously mentioned, the mat foundation will need to be supported by a deep foundation system to resist uplift and buoyancy forces. In addition, it is expected that an enclosed cofferdam system will be required to construct the pump station considering the finish floor elevation of -5-ft MSL for the lower level, which is well below the groundwater table. This cofferdam system should be designed by others but would likely consist of interlocking sheet piles with bracing.

In order to reduce the magnitude of lateral loads being applied to the below grade walls and to promote positive water drainage, it is recommended that a granular backfill be placed directly behind the walls. These granular soils should be a relatively clean, free draining granular material (SAND) classified as SP-SM or better, containing less than 12% passing the No. 200 sieve (0.074 mm). Filter fabric should be installed between the drainage material and the existing site soils to prevent fines from contaminating the drainage material.

The walls should be sized with consideration given to hydrostatic pressures. These pressures should assume the water table to occur near the ground surface. In all cases, the below grade walls should be designed for the 100-year FEMA flood loads. Also, the below grade structure should be designed to resist uplift forces. With regard to the design of the below grade walls to resist lateral earth pressures, the estimated soil parameters presented in Table VI below can be used.

Table VI – Below Grade Estimated Soil Parameters

Soil Type	SAND (SM, SP, SP-SM)	SAND (SP, SP-SM, SM, and SC-SM)	CLAY (CL)
Stratum	Structural Fill	I, II, III, & IV	II
Depth (ft)(1)	-	0 to 80	11.8-12.5 to 15
Average SPT N-value	-	8	7
Estimated Moist Unit Weight (pcf)	120	120	110
Estimated Saturated Unit Weight (pcf)	125	125	115
Estimated Submerged Unit Weight (pcf)	63	63	53
Friction Angle (ϕ) degrees	32	30	5
Cohesion (c) pcf	0	0	500
Active Soil Pressure Ka	0.31	0.33	0.83
At-Rest Soil Pressure Ko	0.47	0.50	0.91
Passive Soil Pressure Kp	3.23	3.03	1.20
Coefficient of Friction	0.42	0.38	0.06

Notes: (1) Depth below existing grades

4.8 Storm Water Management Discussion

The specific design of the storm water management facility and location on the project site are not known at this time. However, it is expected that the SWM facility will likely be created mainly by excavation. It is noted that the soil borings completed as part of this preliminary study may not be located within the anticipated footprint of the storm water management facility since its location is currently unknown and therefore the following discussion may not be applicable.

1. The soils encountered at the boring locations consisted of SAND (SP, SP-SM, and SM) that extended to depths greater than 10 feet below existing grades. Based on laboratory test results, these soils encountered within the upper 10 feet contained a fines content (Silt/Clay) ranging from 2% to 8%. In-situ infiltration tests were conducted within these granular soils at a depth of 3 feet below existing grades as directed by the Civil Engineer. The infiltration test results indicated a high hydraulic conductivity.

2. The stabilized groundwater level at boring location SWM-2 was at 4.5 feet below the existing grades. The actual elevation of the groundwater table is not known at this time since topographic information was not available when preparing this preliminary report. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on construction procedures, if necessary.

3. Basin side slopes may tend to slough or erode over time from temporary water levels following rain events. To minimize sloughing or erosion, the slopes could be benched. Cut slopes should be graded to a maximum slope of 3H:1V or flatter for stability.

It should be noted that the storm water excavation/construction methods are to be developed by the contractor.

4.9 Seismic Evaluation

Based on our experience in the vicinity of the project sites and the composition of the soils recovered within the upper 80 feet (maximum explored depth) at the boring locations, it is our opinion that the site characteristics are indicative of a Site Class “D” in accordance with Table 20.3-1 of ASCE 7-10 as referenced by the 2018 International Building Code (IBC); however, the seismic evaluation requires soils information associated with the upper 100 feet. If the site classification is critical to the structural design, it will be necessary to perform a 100-foot deep Cone Penetration Test (SCPTu) boring with shear wave velocity testing to substantiate this site classification.

4.10 Additional Geotechnical Investigation

A comprehensive geotechnical investigation is recommended once the final design characteristics (layout, loading conditions, site grades, etc.) are determined to better ascertain the soil conditions within the vicinity of the proposed structures and associated infrastructure and to substantiate the preliminary findings presented herein. Specifically, it is recommended to perform additional SPT borings and laboratory testing. The frequency of tests should be developed based on the final design scheme and will likely require refined laboratory testing (CBRs, Atterberg Limits, gradation, moisture content, and consolidation testing). The subsurface data documented during this preliminary study can be incorporated within the final geotechnical investigation.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Dewatering

It is expected that dewatering will be required for excavations that extend near or below the existing groundwater table (approximate depths ranging from 4.5 to 5 feet or shallower). Dewatering above the groundwater level could probably be accomplished by pumping from sumps. **Dewatering at depths below the groundwater level will likely require well pointing and likely shoring.**

It is expected that an enclosed cofferdam system will be required to construct the pump station considering the finish floor elevation of -5-ft MSL for the lower level, which is well below the groundwater table. This cofferdam system should be designed by others but would likely consist of interlocking sheet piles with bracing.

5.2 Site Utility Installation

The base of the utility trenches should be observed by a qualified inspector prior to the pipe placement to verify the suitability of the bearing soils. It is expected that the utilities will be located near or below the groundwater level (at the time of this reporting 4.5 to 5 feet below current grades), bearing in wet granular soils. In these instances, the bearing soils may require some stabilization to provide suitable bedding. This stabilization is commonly accomplished by adding 12 inches or more of bedding stone (Type VDOT No. 57). The resulting excavations should be backfilled with structural fill, as described in Section 4.3 of this report. As mentioned previously, some of the subsurface materials encountered within the project site may be suitable for reuse as backfill. Soils containing appreciable amounts of fines or deleterious debris should be discarded.

6.0 REPORT LIMITATIONS

The preliminary recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by the client and their designated agents for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the preliminary recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project. **Furthermore, the recommendation presented in this report are preliminary in nature and will need to be validated through the completion of a more comprehensive geotechnical investigation once the design characteristics have been finalized.**

The Geotechnical Engineer warrants that the findings, preliminary recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of the client and their designated agents for the specific application to the proposed HRSD Tabb Pressure Reducing Station and Offline Storage Facility project located in York County, Virginia.

APPENDICES

APPENDIX I	BORING LOCATION PLAN
APPENDIX II	CLASSIFICATION SYSTEM FOR SOIL EXPLORATION
APPENDIX III	SUMMARY OF LABORATORY CLASSIFICATION RESULTS
APPENDIX IV	BORING LOGS
APPENDIX V	GENERALIZED SOIL PROFILE
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APPENDIX I

BORING LOCATION PLAN

Locations are approximate



Boring Location Plan

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Project:	**HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
	York County, Virginia
Project No:	**WM20-140G**
Client:	**Hazen and Sawyer**

Scale: Not To Scale
Date: 8/14/2020
Plot By: JW

APPENDIX II

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
5465 Greenwich Road
Virginia Beach, VA 23462
(757) 518-1703

Williamsburg
701 Alexander Lee Parkway
Williamsburg, Virginia 23185
(757) 564-6452

Elizabeth City
504 East Elizabeth St. Suite 2
Elizabeth City, NC 27909
(252) 335-9765

Jacksonville
415-A Western Boulevard
Jacksonville, NC 28546
(910) 478-9915

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

Particle Size Identification

Boulders		8 inch diameter or more
Cobbles		3 to 8 inch diameter
Gravel	Coarse	1 to 3 inch diameter
	Medium	$^1/_2$ to 1 inch diameter
	Fine	$^1/_4$ to $^1/_2$ inch diameter
Sand	Coarse	2.00 mm to $^1/_4$ inch (diameter of pencil lead)
	Medium	0.42 to 2.00 mm (diameter of broom straw)
	Fine	0.074 to 0.42 mm (diameter of human hair)
Silt		0.002 to 0.074 mm (cannot see particles)

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Relative Proportions

Descriptive Term	Percent
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

GW - Well-graded Gravel
GP - Poorly graded Gravel
GW-GM - Well-graded Gravel w/Silt
GW-GC - Well-graded Gravel w/Clay
GP-GM - Poorly graded Gravel w/Silt
GP-GC - Poorly graded Gravel w/Clay
GM - Silty Gravel
GC - Clayey Gravel
GC-GM - Silty, Clayey Gravel
SW - Well-graded Sand
SP - Poorly graded Sand
SW-SM - Well-graded Sand w/Silt
SW-SC - Well-graded Sand w/Clay
SP-SM - Poorly graded Sand w/Silt
SP-SC - Poorly graded Sand w/Clay
SM - Silty Sand
SC - Clayey Sand
SC-SM - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt

Liquid Limit 50% or greater

CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

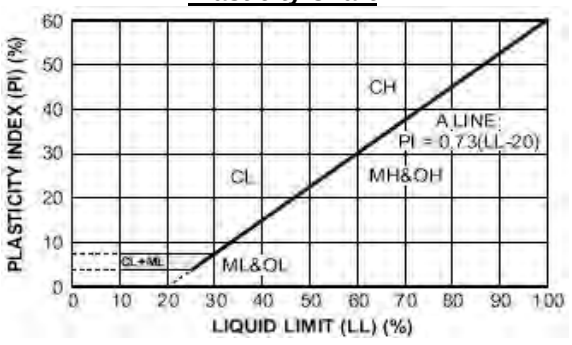
Highly Organic Soils

PT - Peat

Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW,SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

Plasticity Chart



Form 18.03.01 Revision 2/11/2019

APPENDIX III

SUMMARY OF LABORATORY CLASSIFICATION RESULTS

GET Solutions INC

SUMMARY OF LABORATORY RESULTS

CLIENT Hazen and Sawyer **PROJECT NAME** HRSD Tabb Pressure Reducing Station and Offline Storage Faci

PROJECT NUMBER WM20-140G **PROJECT LOCATION** York County, VA

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	3.0				0.075	5		10.0			
B-1	7.0				0.075	6		49.0			
B-1	14.0	24	17	7	0.075	49	SC-SM	22.0			
B-1	39.0				0.075	23		38.0			
B-1	59.0				0.075	31		40.0			
SWM-1	3.0				0.075	6		9.0			
SWM-1	5.0				0.075	2		21.0			
SWM-1	11.0	NP	NP	NP	0.075	14	SM	28.0			
SWM-2	3.0				0.075	18		16.0			
SWM-2	9.0				0.075	8		60.0			
SWM-2	14.0	44	25	19	0.075	82	CL	33.0			

(1) GET - LABORATORY TEST SUMMARY - GET_STANDARD_DATATEMPLATE(03-17-14).GDT - 7/24/20 11:21 - G:\DOCUMENTS\GET W\GEOTECH\2020 GEO\WM20-140G HRSD TABB PRS\BORING LOGS.GPJ

APPENDIX IV

BORING LOGS

RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B-1

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
PROJECT NUMBER: **WM20-140G**
CLIENT: **Hazen and Sawyer**
SURFACE ELEVATION (MSL) (ft):
PROJECT LOCATION: **York County, VA**
LOGGED BY: **T. Vaughn**
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **7/8/2020**
DRILLING METHOD(S): **GET Solutions, Inc.**
DATE COMPLETED: **7/8/2020**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER ___ HOURS (ft) ▼: ___ CAVE-IN (ft) ▽: ___
DRILLER: **GET Solutions, Inc.**
The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.2	2-in of Topsoil						
	2.0	Dark brown, moist, Silty fine to coarse SAND (SM), contains fibrous organic material, loose		1	SPT	18	4-3-2-4 (5)	
	4.0	Orange-brown, moist, poorly graded fine to coarse SAND (SP), loose		2	SPT	18	4-4-4-4 (8)	5
▽	5	Brown to dark gray, moist to wet, poorly graded fine to coarse SAND (SP-SM) with Silt, very loose Wet below 5-ft		3	SPT	17	3-2-2-3 (4)	
				4	SPT	20	2-2-1-2 (3)	6
	8.0	Dark gray, wet, Silty fine to medium SAND (SM), very loose		5	SPT	24	2-2-2-1 (4)	
	10			6	SPT	24	1-1-1-1 (2)	
	12.5	Dark gray, wet, Silty, Clayey fine to medium SAND (SC-SM), very loose		7	SPT	20	1-1-2-2 (3)	49
	15							
	16.5	Dark gray, wet, Silty fine to medium SAND (SM), very loose to medium dense		8	SPT	16	1-2-2-4 (4)	
	20							
				9	SPT	12	5-6-8-8 (14)	
	25							
	26.5	Gray, wet, Silty fine to medium SAND (SM) with trace fine Gravel, medium dense		10	SPT	10	6-10-12-16 (22)	
	30							
	31.5	Dark gray, wet, Silty fine to medium SAND (SM), contains marine shell fragments, very loose to medium dense, "Yorktown Formation"		11	SPT	24	1-2-2-3 (4)	
	35							

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
B-1

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
PROJECT NUMBER: **WM20-140G**
CLIENT: **Hazen and Sawyer**
SURFACE ELEVATION (MSL) (ft):
PROJECT LOCATION: **York County, VA**
LOGGED BY: **T. Vaughn**
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **7/8/2020**
DRILLING METHOD(S): **GET Solutions, Inc.**
DATE COMPLETED: **7/8/2020**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER ____ HOURS (ft) ▼: ____ CAVE-IN (ft) ▽: ____
DRILLER: **GET Solutions, Inc.**
The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS
	40	Dark gray, wet, Silty fine to medium SAND (SM), contains marine shell fragments, very loose to medium dense, "Yorktown Formation" (layer continued from previous page)		12	SPT	24	2-3-4-2 (7)	23	
	45			13	SPT	24	3-4-7-8 (11)		
	50			14	SPT	24	2-3-4-5 (7)		
	55			15	SPT	24	3-3-4-6 (7)		
	60			16	SPT	24	3-4-6-8 (10)	31	
	65			17	SPT	24	2-3-5-7 (8)		
66.5		Dark gray, wet, Silty fine to medium SAND (SM) with trace Clay, contains marine shell fragments, loose, "Yorktown Formation"		18	SPT	24	3-3-4-6 (7)		
	70								

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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BORING ID
B-1

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
PROJECT NUMBER: **WM20-140G**
CLIENT: **Hazen and Sawyer**
SURFACE ELEVATION (MSL) (ft):
PROJECT LOCATION: **York County, VA**
LOGGED BY: **T. Vaughn**
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **7/8/2020**
DRILLING METHOD(S): **GET Solutions, Inc.**
DATE COMPLETED: **7/8/2020**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER ____ HOURS (ft) ⧗: ____ CAVE-IN (ft) ▽: ____
DRILLER: **GET Solutions, Inc.**
The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS
	71.5								Plastic Limit X——X Liquid Limit Water Content - ● Penetration - ▨ 10 20 30 40 50 60 70
		Dark gray, wet, Silty fine to medium SAND (SM), contains marine shell fragments, loose to medium dense		19	⧗	24	3-4-6-6 (10)		▨
75									
				20	⧗	24	4-5-9-8 (14)		▨
80	80.0	Boring terminated at 80 feet below existing grade.							

Sample Type(s):
⧗ SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
SWM-1

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
PROJECT NUMBER: **WM20-140G**
CLIENT: **Hazen and Sawyer**
SURFACE ELEVATION (MSL) (ft):
PROJECT LOCATION: **York County, VA**
LOGGED BY: **T. Vaughn**
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **7/8/2020**
DRILLING METHOD(S): **GET Solutions, Inc.**
DATE COMPLETED: **7/8/2020**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER ____ HOURS (ft) ▼: ____ CAVE-IN (ft) ▽: ____
DRILLER: **GET Solutions, Inc.**
The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	1.5	18-in of Topsoil		1		18	2-2-3-2 (5)	
	2.0	Dark brown, moist, Silty fine to coarse SAND (SM), contains fibrous organic material, loose, "FILL"		2		15	3-5-11-9 (16)	6
	4.0	Brown, moist, poorly graded fine to medium SAND (SP-SM) with trace fine Gravel, medium dense						
▽ 5		Light gray, moist to wet, poorly graded fine to coarse SAND (SP), medium dense		3		17	6-8-7-7 (15)	2
	6.0	Wet below 5-ft						
		Dark gray, wet, poorly graded fine to medium SAND (SP-SM) with Silt, loose		4		21	4-3-3-4 (6)	
	8.0	Dark gray, wet, Silty fine to medium SAND (SM) with trace fine Gravel, loose		5		24	2-3-3-4 (6)	
10	10.0	Dark gray, wet, Silty fine to medium SAND (SM), very loose		6		24	1-1-1-1 (2)	14
	12.5	Dark gray, wet, Sandy lean CLAY (CL), contains fibrous organic material, medium stiff		7		24	2-3-4-3 (7)	
15	15.0	Boring terminated at 15 feet below existing grade.						

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

Virginia Beach
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1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID
SWM-2

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**
PROJECT NUMBER: **WM20-140G**
CLIENT: **Hazen and Sawyer**
SURFACE ELEVATION (MSL) (ft):
PROJECT LOCATION: **York County, VA**
LOGGED BY: **T. Vaughn**
BORING LOCATION: **See Attached Boring Location Plan**
DATE STARTED: **7/8/2020**
DRILLING METHOD(S): **GET Solutions, Inc.**
DATE COMPLETED: **7/8/2020**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER **24** HOURS (ft) ▼: **4.5** CAVE-IN (ft) ▽:
DRILLER: **GET Solutions, Inc.**
The initial groundwater readings are not intended to indicate the static groundwater level.

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.7	8-in of Topsoil						
		Light gray and brown, moist, Silty fine to coarse SAND (SM), loose		1		18	1-2-3-3 (5)	
				2		14	3-4-4-4 (8)	18
	4.0							
	5	Light gray to dark gray, moist to wet, poorly graded fine to medium SAND (SP-SM) with Silt, loose Wet below 4.5-ft		3		17	4-5-5-6 (10)	
				4		22	4-4-4-3 (8)	
	8.0							
		Dark gray, wet, poorly graded fine to medium SAND (SP-SM) with Silt and trace fine Gravel, very loose		5		24	3-2-1-1 (3)	8
	10			6		24	1-1-2-3 (3)	
	11.8							
		Dark gray, wet, Lean CLAY (CL) with Sand and trace fine Gravel, medium stiff		7		20	3-3-4-4 (7)	82
	15							
	15.0	Boring terminated at 15 feet below existing grade.						

TEST RESULTS
Plastic Limit X——X Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

Sample Type(s):
SPT - Standard Penetration Test

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

APPENDIX V

GENERALIZED SOIL PROFILE

GENERALIZED SOIL PROFILE

PROJECT NAME: **HRSD Tabb Pressure Reducing Station and Offline Storage Facility**

PROJECT NUMBER: **WM20-140G**

PROJECT LOCATION: **York County, VA**

CLIENT: **Hazen and Sawyer**



(Numerical Value) = Sample N-Value

APPENDIX VI

HYDRAULIC CONDUCTIVITY TEST REPORTS

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Tabb PRS & Offline Storage Facility	Project No.....:	WM20-140G	Terminology and Solution (R. E. Glover Solution)*	
Boring No.....:	SWM-1	Proj. Location...:	York County, VA	$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (°C)	14
Investigators.....:	T. Vaughn	Date.....:	7/28/2020	Q: Rate of flow of water from the borehole	
Boring Depth.....:	3 ft (m, cm, ft, in)	WCU Base Ht. h:	15.0 cm	H: Constant height of water in the borehole	
Boring Diameter..:	8.3 cm	WCU Susp. Ht. S:	6.4 cm	r: Radius of the cylindrical borehole	
Boring Radius r...:	4.15 cm	Const. Wtr. Ht. H:	21.4 cm	V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
Soil/Water Tmp. T:	12 °C	H/r **.....:	5.2	$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
Dyn. Visc. @ T °C.:	0.001236 kg/m·s	Dyn. Visc. @ T_B °C.:	0.001170 kg/m·s	$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	$Ksat_B$ Equivalent Values (cm/sec)	$Ksat_B$ Equivalent Values (cm/day)	$Ksat_B$ Equivalent Values (in/hr)	$Ksat_B$ Equivalent Values (ft/day)
2,000		2:17:55 PM								
1,900	100	2:18:09 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,800	100	2:18:23 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,700	100	2:18:37 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,600	100	2:18:51 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,500	100	2:19:05 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,400	100	2:19:20 PM	0:00:15	0.25	400.00	0.223	3.72E-03	321.009	5.266	10.532
1,300	100	2:19:34 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,200	100	2:19:48 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
1,100	100	2:20:03 PM	0:00:15	0.25	400.00	0.223	3.72E-03	321.009	5.266	10.532
1,000	100	2:20:17 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
900	100	2:20:31 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
800	100	2:20:46 PM	0:00:15	0.25	400.00	0.223	3.72E-03	321.009	5.266	10.532
700	100	2:21:00 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
600	100	2:21:14 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284
500	100	2:21:28 PM	0:00:14	0.23	428.57	0.239	3.98E-03	343.938	5.642	11.284

Natural Moisture.....:	9%	Consistency.....:	Medium Dense	Field-Estimated Ksat:	0.235	3.92E-03	338.843	5.558	11.117
USDA Txt./USCS Class:	SP-SM	Water Table Depth...:	5-ft	Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.					
Struct./% Pass. #200.:	6%	Init. Saturation Time.:	2:05:00 PM						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name.....:	Tabb PRS & Offline Storage Facility	Project No.....:	WM20-140G	Terminology and Solution (R. E. Glover Solution)*	
Boring No.....:	SWM-2	Proj. Location...:	York County, VA	$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (°C)	14
Investigators.....:	T. Vaughn	Date.....:	7/28/2020	Q: Rate of flow of water from the borehole	
Boring Depth.....:	3 ft (m, cm, ft, in)	WCU Base Ht. h:	15.0 cm	H: Constant height of water in the borehole	
Boring Diameter..:	8.3 cm	WCU Susp. Ht. S:	6.4 cm	r: Radius of the cylindrical borehole	
Boring Radius r...:	4.15 cm	Const. Wtr. Ht. H:	21.4 cm	V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
Soil/Water Tmp. T:	12 °C	H/r **.....:	5.2	$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
Dyn. Visc. @ T °C.:	0.001236 kg/m·s	Dyn. Visc. @ T_B °C.:	0.001170 kg/m·s	$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2,000		1:39:37 PM								
1,900	100	1:40:14 PM	0:00:37	0.62	162.16	0.090	1.51E-03	130.139	2.135	4.270
1,800	100	1:40:55 PM	0:00:41	0.68	146.34	0.082	1.36E-03	117.442	1.927	3.853
1,700	100	1:41:38 PM	0:00:43	0.72	139.53	0.078	1.30E-03	111.980	1.837	3.674
1,600	100	1:42:22 PM	0:00:44	0.73	136.36	0.076	1.27E-03	109.435	1.795	3.590
1,500	100	1:43:04 PM	0:00:42	0.70	142.86	0.080	1.33E-03	114.646	1.881	3.761
1,400	100	1:43:47 PM	0:00:43	0.72	139.53	0.078	1.30E-03	111.980	1.837	3.674
1,300	100	1:44:31 PM	0:00:44	0.73	136.36	0.076	1.27E-03	109.435	1.795	3.590
1,200	100	1:45:17 PM	0:00:46	0.77	130.43	0.073	1.21E-03	104.677	1.717	3.434
1,100	100	1:46:01 PM	0:00:44	0.73	136.36	0.076	1.27E-03	109.435	1.795	3.590
1,000	100	1:46:48 PM	0:00:47	0.78	127.66	0.071	1.19E-03	102.450	1.681	3.361
900	100	1:47:32 PM	0:00:44	0.73	136.36	0.076	1.27E-03	109.435	1.795	3.590
800	100	1:48:17 PM	0:00:45	0.75	133.33	0.074	1.24E-03	107.003	1.755	3.511
700	100	1:49:03 PM	0:00:46	0.77	130.43	0.073	1.21E-03	104.677	1.717	3.434
600	100	1:49:48 PM	0:00:45	0.75	133.33	0.074	1.24E-03	107.003	1.755	3.511
500	100	1:50:33 PM	0:00:45	0.75	133.33	0.074	1.24E-03	107.003	1.755	3.511

Natural Moisture.....:	16%	Consistency.....:	Loose	Field-Estimated Ksat:	0.079	1.31E-03	113.241	1.858	3.715
USDA Txt./USCS Class:	SM	Water Table Depth...:	4.5-ft	Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.					
Struct./% Pass. #200.:	18%	Init. Saturation Time.:	1:20:00 PM						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13

Appendix C: HRSD Record Drawings

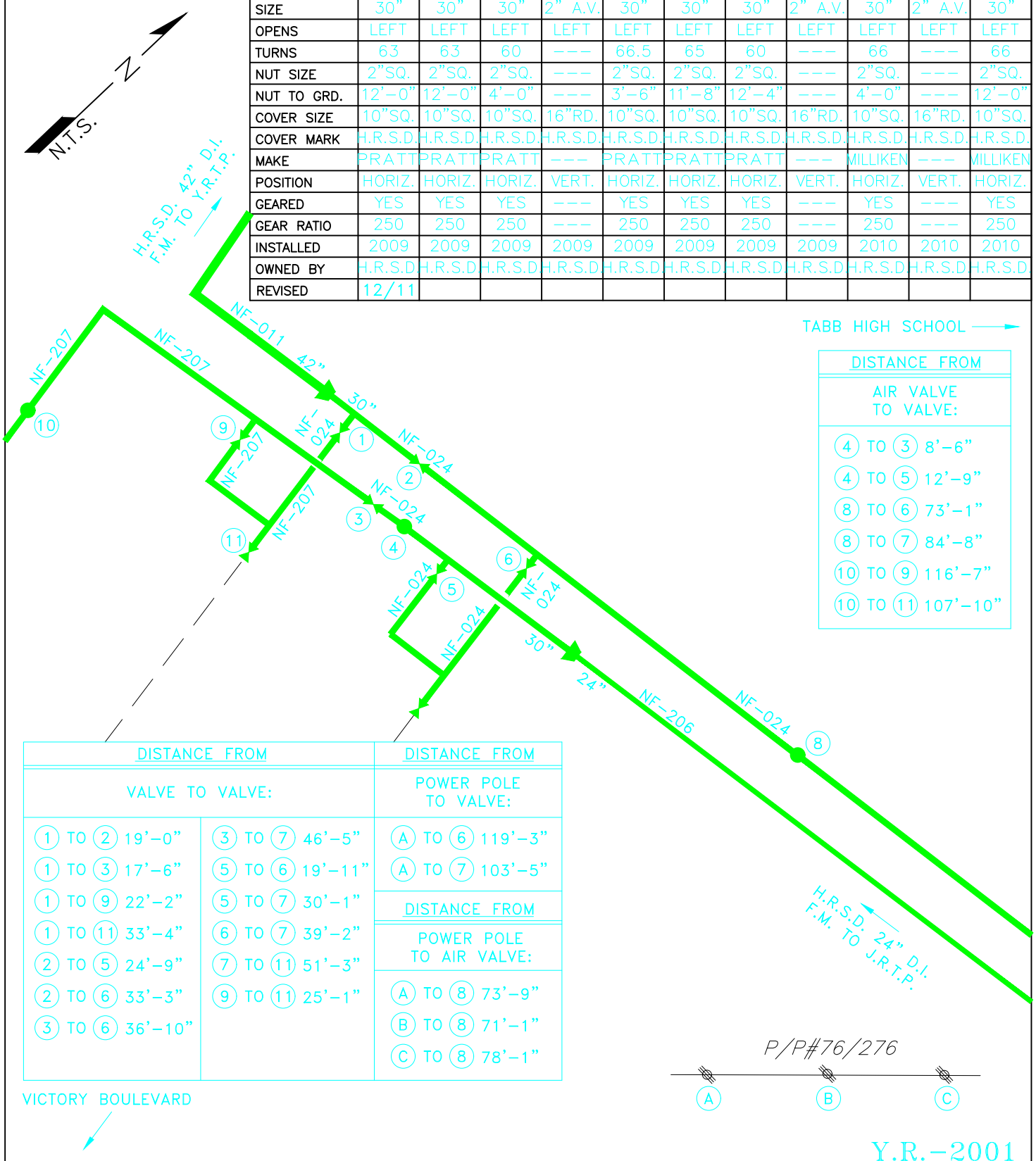
HAMPTON ROADS SANITATION DISTRICT
INTERCEPTOR SYSTEMS DEPARTMENT
VALVE GUIDE

NUMBER **Y.R.-2001**

LOCATION YORKTOWN ROAD BEHIND TABB HIGH SCHOOL IN POWER EASEMENT

DRAWING KILN CREEK INTERCEPTOR FORCE MAIN AND ROUTE 171 INTERCEPTOR FORCE MAIN – CONTRACT B
SHT. 16 OF 42 (11) (24) (206) (207)

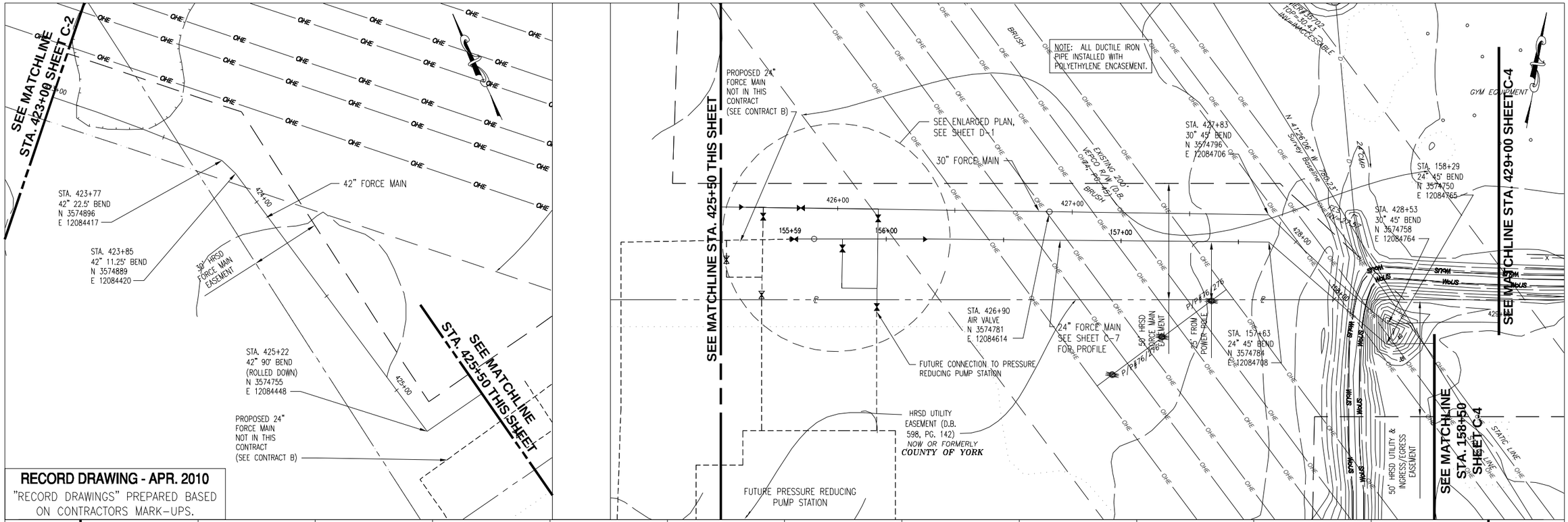
VALVE No.	1	2	3	4	5	6	7	8	9	10	11
SIZE	30"	30"	30"	2" A.V.	30"	30"	30"	2" A.V.	30"	2" A.V.	30"
OPENS	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
TURNS	63	63	60	---	66.5	65	60	---	66	---	66
NUT SIZE	2"SQ.	2"SQ.	2"SQ.	---	2"SQ.	2"SQ.	2"SQ.	---	2"SQ.	---	2"SQ.
NUT TO GRD.	12'-0"	12'-0"	4'-0"	---	3'-6"	11'-8"	12'-4"	---	4'-0"	---	12'-0"
COVER SIZE	10"SQ.	10"SQ.	10"SQ.	16"RD.	10"SQ.	10"SQ.	10"SQ.	16"RD.	10"SQ.	16"RD.	10"SQ.
COVER MARK	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.
MAKE	PRATT	PRATT	PRATT	---	PRATT	PRATT	PRATT	---	MILLIKEN	---	MILLIKEN
POSITION	HORIZ.	HORIZ.	HORIZ.	VERT.	HORIZ.	HORIZ.	HORIZ.	VERT.	HORIZ.	VERT.	HORIZ.
GEARED	YES	YES	YES	---	YES	YES	YES	---	YES	---	YES
GEAR RATIO	250	250	250	---	250	250	250	---	250	---	250
INSTALLED	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010
OWNED BY	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.	H.R.S.D.
REVISED	12/11										



DISTANCE FROM AIR VALVE TO VALVE:	
(4) TO (3)	8'-6"
(4) TO (5)	12'-9"
(8) TO (6)	73'-1"
(8) TO (7)	84'-8"
(10) TO (9)	116'-7"
(10) TO (11)	107'-10"

DISTANCE FROM VALVE TO VALVE:		DISTANCE FROM POWER POLE TO VALVE:
(1) TO (2)	19'-0"	(A) TO (6) 119'-3"
(1) TO (3)	17'-6"	(A) TO (7) 103'-5"
(1) TO (9)	22'-2"	
(1) TO (11)	33'-4"	DISTANCE FROM POWER POLE TO AIR VALVE:
(2) TO (5)	24'-9"	(A) TO (8) 73'-9"
(2) TO (6)	33'-3"	(B) TO (8) 71'-1"
(3) TO (6)	36'-10"	(C) TO (8) 78'-1"
(3) TO (7)	46'-5"	
(5) TO (6)	19'-11"	
(5) TO (7)	30'-1"	
(6) TO (7)	39'-2"	
(7) TO (11)	51'-3"	
(9) TO (11)	25'-1"	

Y.R.-2001



NO.	DATE	BY	REVISIONS

GRAPHIC SCALES

20' 15' 10' 5' 0 10' 20' 40'

HORIZONTAL SCALE: 1" = 20'

4' 3' 2' 1' 0 2' 4' 8'

VERTICAL SCALE: 1" = 4'

WR&A
WHITMAN, REQUARDT AND ASSOCIATES
ENGINEERS AND PLANNERS
11870 MERCHANTS WALK, SUITE 100
NEWPORT NEWS, VA 23606
PHONE: (757)-599-5101 FAX: (757)-599-5320

HAMPTON ROADS SANITATION DISTRICT

SCALE:
HORIZ: 1" = 20'
VERT.: 1" = 4'

DATE: DECEMBER 2009
DESIGNED: DGW
DRAWN: GLS
CHECKED: DGW/JAL
PROJECT NO.: 19120

KILN CREEK INTERCEPTER FORCE MAIN, AND ROUTE 171 INTERCEPTOR FORCE MAIN CONTRACT A

YORK COUNTY, VIRGINIA

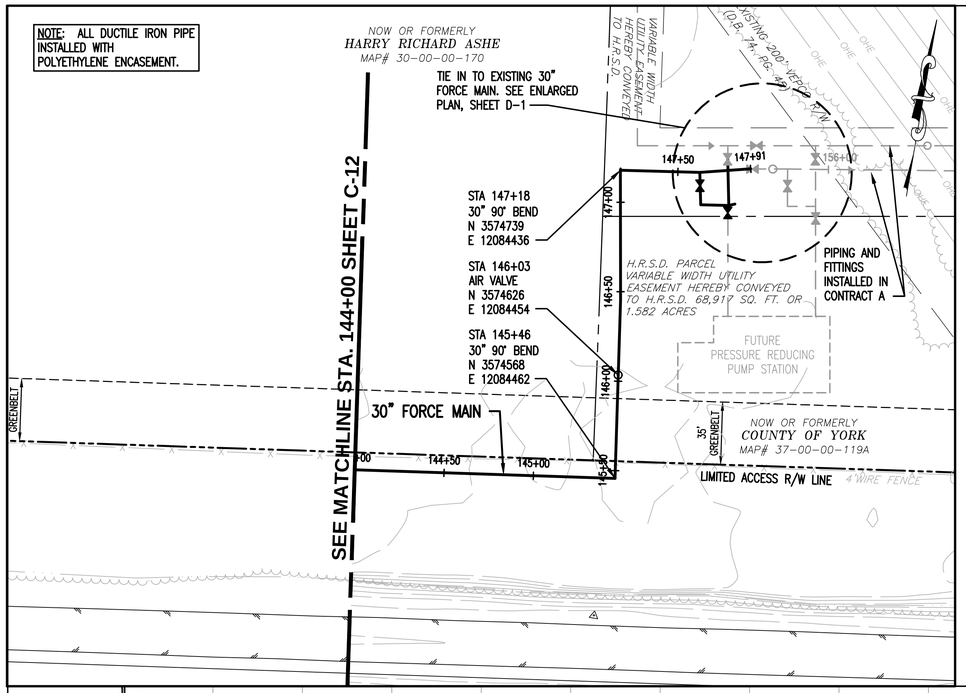
PLAN & PROFILE:
STA. 423+00 TO STA. 429+00
PLAN: STA. 155+59 TO STA. 158+50

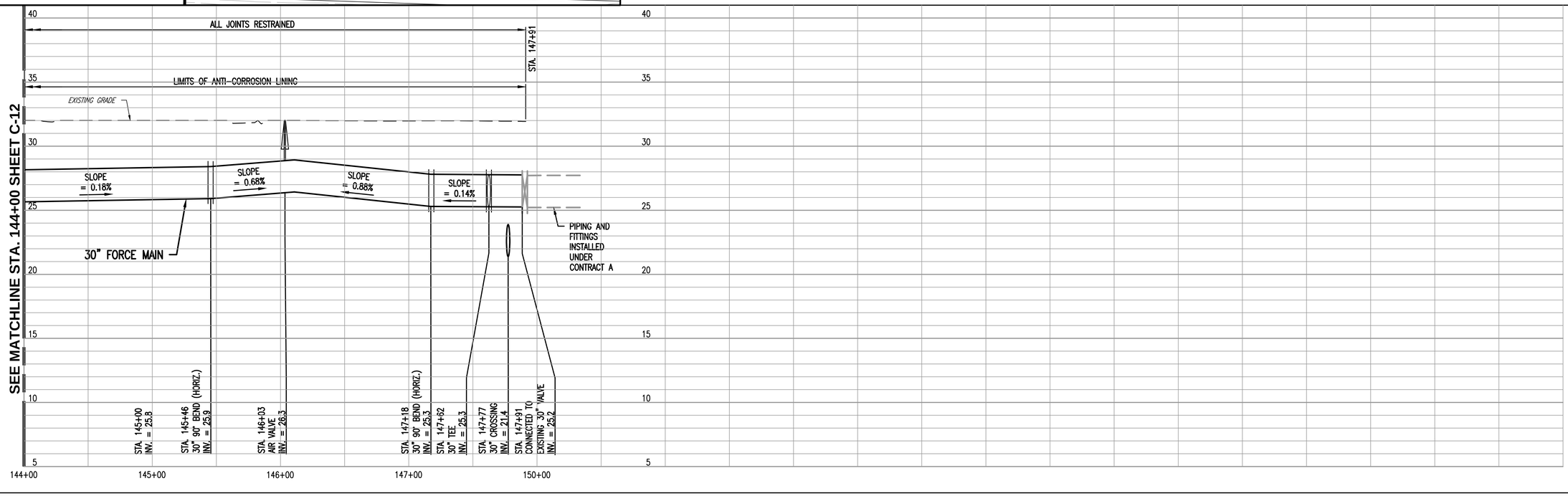
DRAWING C-3

SHEET 5 OF 16

Z:\Planning\Projects\Meridian_PlanSheets\DWGs\York River\Kiln Creek Interceptor Force Main and Route 171 Interceptor Force Main Consheet 05 of 16.dwg Mar 11, 2013 - 11:53am

NOTE: ALL DUCTILE IRON PIPE INSTALLED WITH POLYETHYLENE ENCASEMENT.





NO.	DATE	BY	REVISIONS

GRAPHIC SCALES

40' 30' 20' 10' 0 20' 40' 80'

HORIZONTAL SCALE: 1" = 40'

4' 3' 2' 1' 0 2' 4' 8'

VERTICAL SCALE: 1" = 4'

WR&A
WHITMAN, REQUARDT AND ASSOCIATES
ENGINEERS AND PLANNERS
11870 MERCHANTS WALK, SUITE 100
NEWPORT NEWS, VA 23606
PHONE: (757)-599-5101 FAX: (757)-599-5320

HAMPTON ROADS SANITATION DISTRICT

RECORD DRAWING
APRIL - 2011
"RECORD DRAWINGS"
PREPARED BASED ON
CONTRACTORS MARK-UPS.

SCALE: HORIZ.: 1"=40' VERT.: 1"=4'
DATE: JANUARY 2010
DESIGNED: DGW
DRAWN: GLS/MDC
CHECKED: DGW/JAL
PROJECT NO.: 19048

KILN CREEK INTERCEPTOR FORCE MAIN, AND ROUTE 171 INTERCEPTOR FORCE MAIN - CONTRACT B
YORK COUNTY - BETHEL DISTRICT AND CITY OF POQUOSON, VIRGINIA

PLAN & PROFILE
STA. 144+00 TO STA. 147+91

DRAWING C-13
SHEET 16 OF 42

N:\19141-000\CADD\CONTRACT B RECORD 4-6-11\sheet 16 of 42 C13.dwg Jul 21, 2011 - 4:21pm

Appendix D: Summary of HRSD Model Results

Data Provided by HRSD
Dry Weather Flow

Hazen notes in this row | Received 7/23/2020 | EQ Flow Analysis

Time	gpm @ plant JRTP	gpm @ plant YRTP	Node at Eastern valve stub (gpm) Tabb Influent
12/30/29 12:00 AM	8,616	8,327	3,045
12/30/29 12:04 AM	9,978	7,473	3,599
12/30/29 12:08 AM	8,923	8,149	6,001
12/30/29 12:12 AM	8,131	8,540	5,155
12/30/29 12:16 AM	8,342	9,303	8,077
12/30/29 12:20 AM	8,444	8,475	5,241
12/30/29 12:24 AM	9,308	8,207	3,425
12/30/29 12:28 AM	10,040	7,401	6,005
12/30/29 12:32 AM	8,916	7,753	5,818
12/30/29 12:36 AM	8,132	7,467	6,049
12/30/29 12:40 AM	8,050	7,654	7,047
12/30/29 12:44 AM	8,232	8,346	3,850
12/30/29 12:48 AM	7,827	7,908	4,547
12/30/29 12:52 AM	7,537	8,783	5,338
12/30/29 12:56 AM	8,304	7,758	3,969
12/30/29 1:00 AM	7,193	7,486	3,175
12/30/29 1:04 AM	7,163	7,201	5,330
12/30/29 1:08 AM	7,158	7,502	5,360
12/30/29 1:12 AM	7,450	7,794	3,774
12/30/29 1:16 AM	9,491	7,885	7,274
12/30/29 1:20 AM	9,451	7,902	6,298
12/30/29 1:24 AM	7,620	7,874	3,460
12/30/29 1:28 AM	7,356	7,143	5,769
12/30/29 1:32 AM	7,042	7,898	4,921
12/30/29 1:36 AM	7,420	7,522	3,172
12/30/29 1:40 AM	7,891	7,609	4,059
12/30/29 1:44 AM	7,015	7,508	1,365
12/30/29 1:48 AM	6,862	7,321	5,299

Row Labels	Average of JRTP	Average of YRTP	Average of Tabb Influent
12 AM	8772	8690	5371
1 AM	7491	7817	4370
2 AM	6390	7042	3975
3 AM	5765	6400	3807
4 AM	5808	6104	3797
5 AM	6079	6127	4151
6 AM	7413	6540	4601
7 AM	8934	8078	5718
8 AM	10035	9201	6222
9 AM	10819	9826	6515
10 AM	11469	10081	6856
11 AM	11414	9937	6789
12 PM	11462	10126	6343
1 PM	10903	10081	6462
2 PM	10398	9825	6138
3 PM	10424	9706	5874
4 PM	10456	9605	5957
5 PM	10713	9733	5844
6 PM	10708	10042	6099
7 PM	11129	10203	6245
8 PM	11330	10428	6501
9 PM	11464	10518	6397
10 PM	11007	10340	6194
11 PM	10120	9657	5794
Grand Total	**9602**	**9003**	**5667**

Targets (gpm)	**10,906**	**7,700**
MGD	**15.7**	**11.1**

	gpm @ plant JRTP	gpm @ plant YRTP
12 AM	8,772	8,690
1 AM	7,491	7,817
2 AM	6,390	7,042
3 AM	5,765	6,400
4 AM	5,808	6,104
5 AM	6,079	6,127
6 AM	7,413	6,540
7 AM	8,934	8,078
8 AM	10,035	9,201
9 AM	10,819	9,826
10 AM	11,469	10,081
11 AM	11,414	9,937
12 PM	11,462	10,126
1 PM	10,903	10,081
2 PM	10,398	9,825
3 PM	10,424	9,706
4 PM	10,456	9,605
5 PM	10,713	9,733
6 PM	10,708	10,042
7 PM	11,129	10,203
8 PM	11,330	10,428
9 PM	11,464	10,518
10 PM	11,007	10,340
11 PM	10,120	9,657

Data Provided by HRSD
Dry Weather Flow

Dry Weather gpm		gpm over 26.8MGD (total plant target)	Gallons over 26.8MGD (total plant target)	gpm	gpm required to reach 26.8MGD total	Gallons required to reach 26.8MGD total	gpm of EQ flow towards YR	gpm of EQ flow towards JR		JR receives most of EQ flow
Tabb Influent		Desired Inflow Rate	Inflow Volume	Tabb Bypass	Desired Outflow Rate	Outflow Volume	YR Outflow	JR Outflow	YR Outflow Split	JR Outflow Split
5,371	Drain	0	0	5371	1,144	68639	0	1144	0%	100%
4,370	Drain	0	0	4370	3,299	197912	0	3299	0%	100%
3,975	Drain	0	0	3975	5,174	310459	658	4516	13%	87%
3,807	Drain	0	0	3807	6,441	386469	1300	5141	20%	80%
3,797	Drain	0	0	3797	6,694	401641	1596	5098	24%	76%
4,151	Drain	0	0	4151	6,399	383967	1573	4827	25%	75%
4,601	Drain	0	0	4601	4,653	279203	1160	3493	25%	75%
5,718	Drain	0	0	5718	1,594	95656	0	1594	0%	100%
6,222	Store	629	37,769	5593	0	0	0	0		
6,515	Store	2,039	122,363	4476	0	0	0	0		
6,856	Store	2,945	176,680	3911	0	0	0	0		
6,789	Store	2,745	164,709	4044	0	0	0	0		
6,343	Store	2,982	178,904	3361	0	0	0	0		
6,462	Store	2,377	142,637	4085	0	0	0	0		
6,138	Store	1,616	96,988	4521	0	0	0	0		
5,874	Store	1,524	91,469	4350	0	0	0	0		
5,957	Store	1,454	87,265	4503	0	0	0	0		
5,844	Store	1,840	110,407	4004	0	0	0	0		
6,099	Store	2,143	128,608	3956	0	0	0	0		
6,245	Store	2,726	163,568	3519	0	0	0	0		
6,501	Store	3,152	189,130	3348	0	0	0	0		
6,397	Store	3,376	202,587	3020	0	0	0	0		
6,194	Store	2,741	164,488	3452	0	0	0	0		
5,794	Store	1,171	70,234	4623	0	0	0	0		
			2,127,804 Tank EQ Required			2,123,946				

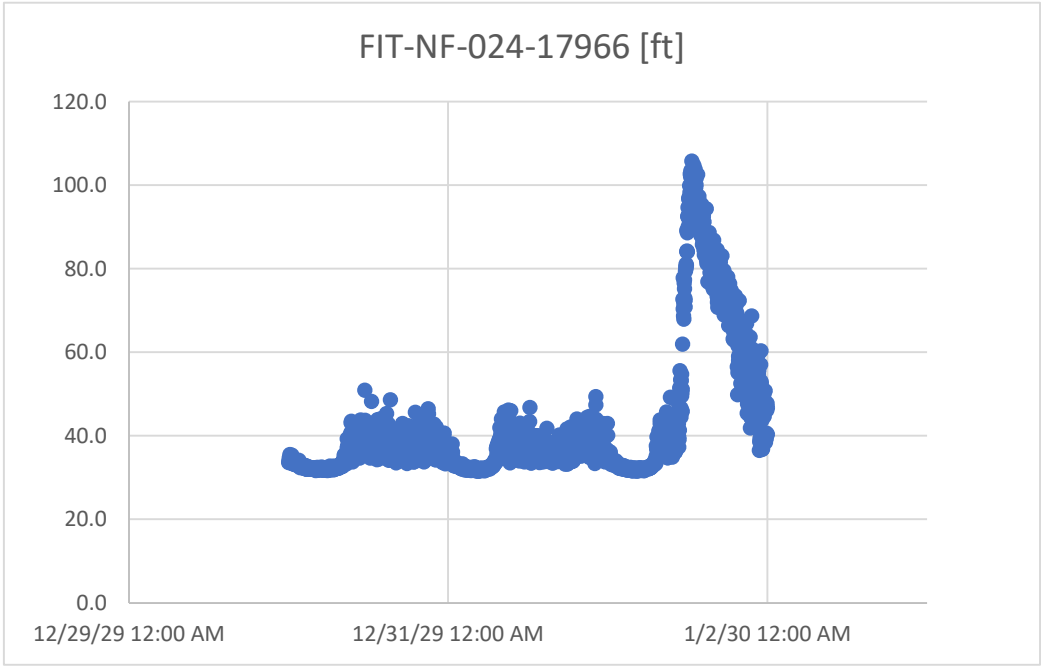
Data Provided by HRSD
Wet Weather Flow

Hazen notes in this row | Received 7/23/2020 | Wet weather flow and HGL at Tabb. All valves are open at Tabb and no storage at Coliseum. Dry weather conditions through 1/1/2030 00:00 (Row 1444)

	North Pipe YRTP	South Pipe JRTP	
Time	NF-024-30837 [gal/min]	NF-024-30842 [gal/min]	FIT-NF-024-17966 [ft]
12/30/29 12:00 AM	2,980	1,598	33.7
12/30/29 12:02 AM	3,320	1,925	33.9
12/30/29 12:04 AM	3,102	1,954	34.3
12/30/29 12:06 AM	3,479	2,089	34.8
12/30/29 12:08 AM	3,215	1,924	34.6
12/30/29 12:10 AM	2,819	1,742	35.6
12/30/29 12:12 AM	2,300	1,352	34.1
12/30/29 12:14 AM	3,000	1,728	33.8
12/30/29 12:16 AM	5,135	3,082	35.0
12/30/29 12:18 AM	2,624	1,449	34.0
12/30/29 12:20 AM	2,743	1,639	33.6
12/30/29 12:22 AM	3,019	1,821	33.7
12/30/29 12:24 AM	3,142	1,787	33.6
12/30/29 12:26 AM	3,699	2,164	34.0
12/30/29 12:28 AM	4,198	2,436	35.4
12/30/29 12:30 AM	3,156	1,922	34.2
12/30/29 12:32 AM	1,992	1,230	33.4
12/30/29 12:34 AM	3,086	1,814	33.4
12/30/29 12:36 AM	3,845	2,275	33.6
12/30/29 12:38 AM	3,739	2,207	33.8
12/30/29 12:40 AM	4,097	2,565	34.2
12/30/29 12:42 AM	3,861	2,148	34.3
12/30/29 12:44 AM	3,429	1,980	34.5
12/30/29 12:46 AM	3,808	2,273	34.3
12/30/29 12:48 AM	3,057	1,664	33.8
12/30/29 12:50 AM	2,338	1,417	33.2
12/30/29 12:52 AM	2,313	1,243	33.7
12/30/29 12:54 AM	3,262	1,803	33.7

FloatBase_WetWeather_NoColiseum_2yrSDF80FloatJRYR.PRF

Float Tabb area, all flow naturally goes to YR.
Coliseum tank off

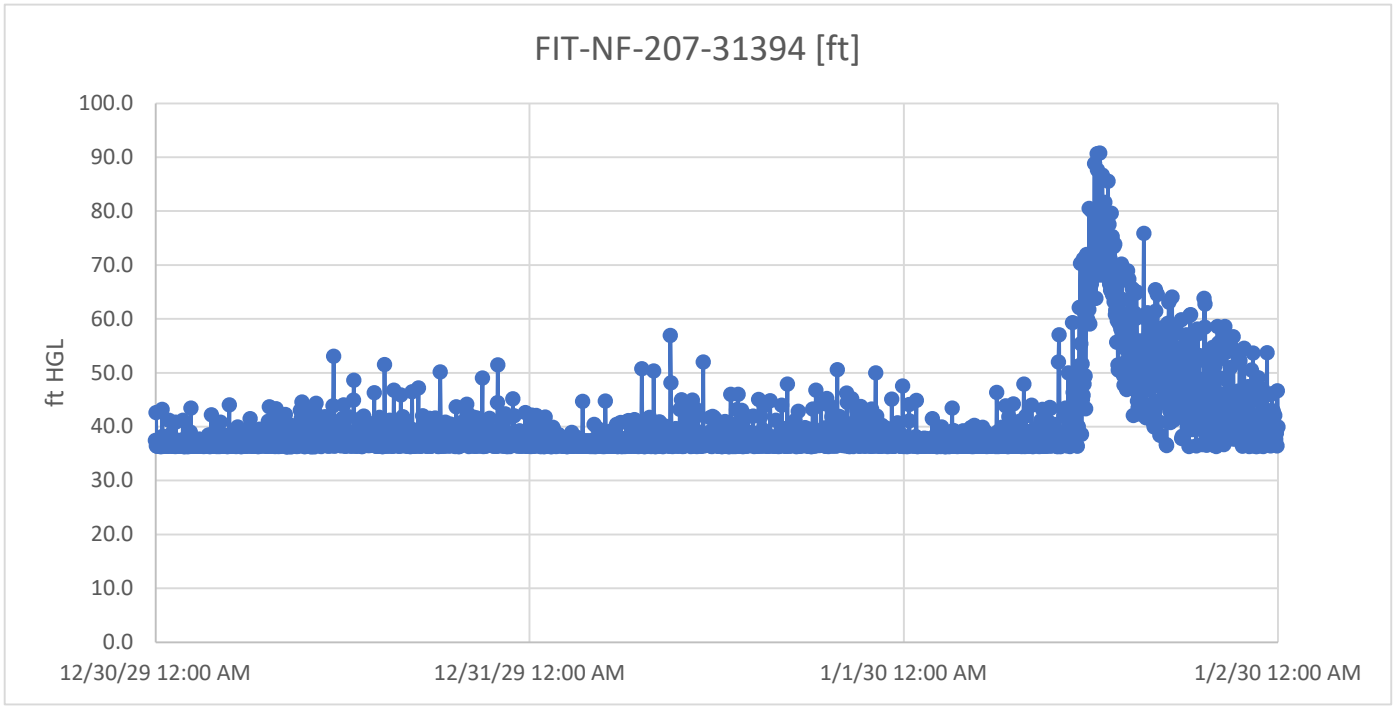


Data Provided by HRSD
Simulation with near term improvements

Hazen notes Received 9/1/2020 Results show moving the JR/YR split point to Tabb.
in this row This reflects near term improvements and valving in the Jefferson Ave area.

Time	FIT-NF-207-31394 [ft]
12/30/29 12:00 AM	37.5
12/30/29 12:02 AM	42.7
12/30/29 12:04 AM	36.5
12/30/29 12:06 AM	36.4
12/30/29 12:08 AM	36.6
12/30/29 12:10 AM	36.6
12/30/29 12:12 AM	36.9
12/30/29 12:14 AM	37.5
12/30/29 12:16 AM	37.3
12/30/29 12:18 AM	36.4
12/30/29 12:20 AM	36.4
12/30/29 12:22 AM	37.3
12/30/29 12:24 AM	36.4
12/30/29 12:26 AM	43.2
12/30/29 12:28 AM	38.3
12/30/29 12:30 AM	37.5
12/30/29 12:32 AM	36.4
12/30/29 12:34 AM	37.9
12/30/29 12:36 AM	36.6
12/30/29 12:38 AM	36.4
12/30/29 12:40 AM	36.9
12/30/29 12:42 AM	37.7
12/30/29 12:44 AM	37.5
12/30/29 12:46 AM	36.4
12/30/29 12:48 AM	36.4
12/30/29 12:50 AM	36.7
12/30/29 12:52 AM	41.2

Hard Valve at Tabb
Float at Patrick Henry
Jefferson IFM PH3 Complete

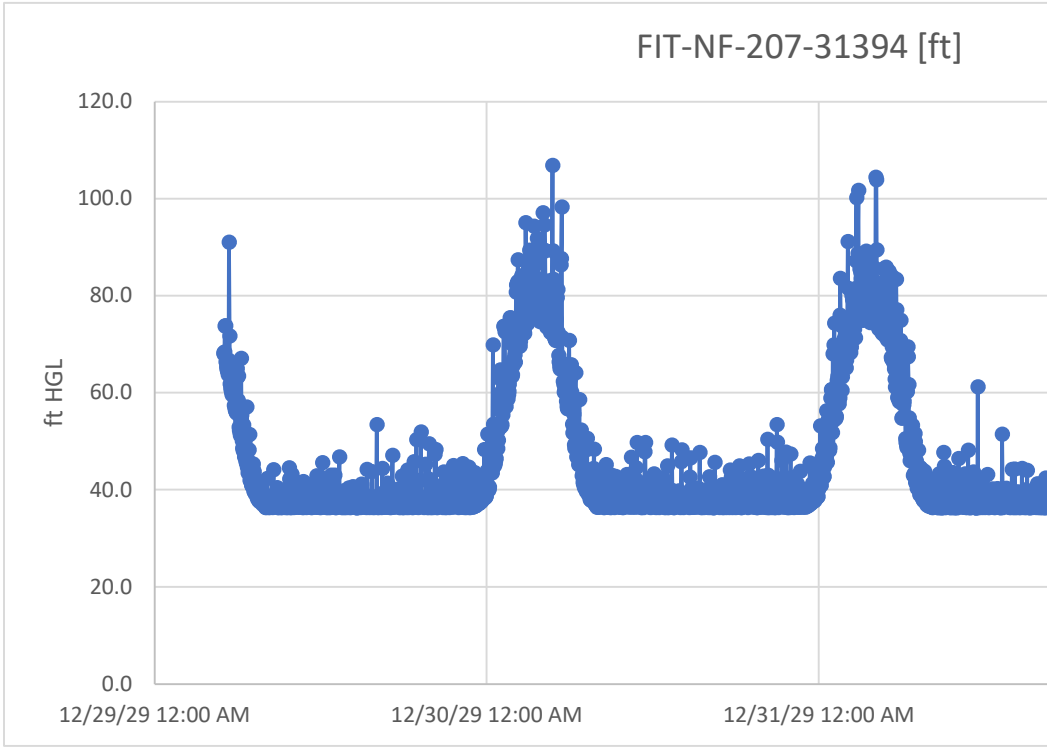


Data Provided by HRSD

JRTP Dry Weather Tank Drain Simulation

Hazen notes	Received 9/3/2020	EQ discharge time series added to JR at Tabb
in this row	Dry weather conditions through 1/1/2030 00:00 (Row 1444)	

Time	FIT-NF-207-31394 [ft]	Hard Valve at Tabb
12/29/29 4:59 AM	68.2	Float at Patrick Henry
12/29/29 5:01 AM	68.0	Jefferson IFM PH3 Complete
12/29/29 5:03 AM	68.5	Inject time series at Tabb (JR side) from spreadsheet +10%
12/29/29 5:05 AM	73.8	
12/29/29 5:07 AM	73.9	
12/29/29 5:09 AM	66.4	
12/29/29 5:11 AM	65.4	
12/29/29 5:13 AM	64.9	
12/29/29 5:15 AM	64.4	
12/29/29 5:17 AM	64.6	
12/29/29 5:19 AM	63.8	
12/29/29 5:21 AM	66.8	
12/29/29 5:23 AM	91.1	
12/29/29 5:25 AM	71.7	
12/29/29 5:27 AM	61.8	
12/29/29 5:29 AM	61.0	
12/29/29 5:31 AM	60.6	
12/29/29 5:33 AM	60.1	
12/29/29 5:35 AM	59.6	
12/29/29 5:37 AM	62.0	
12/29/29 5:39 AM	62.3	
12/29/29 5:41 AM	64.8	
12/29/29 5:43 AM	60.9	
12/29/29 5:45 AM	57.4	
12/29/29 5:47 AM	57.0	
12/29/29 5:49 AM	56.5	
12/29/29 5:51 AM	56.1	



Appendix E: Offline Storage and Equalization Calculations

Tabb OLSF
EQ Calculations

9/18/2020

Tank Dia: 115 **Site Elev: 31**

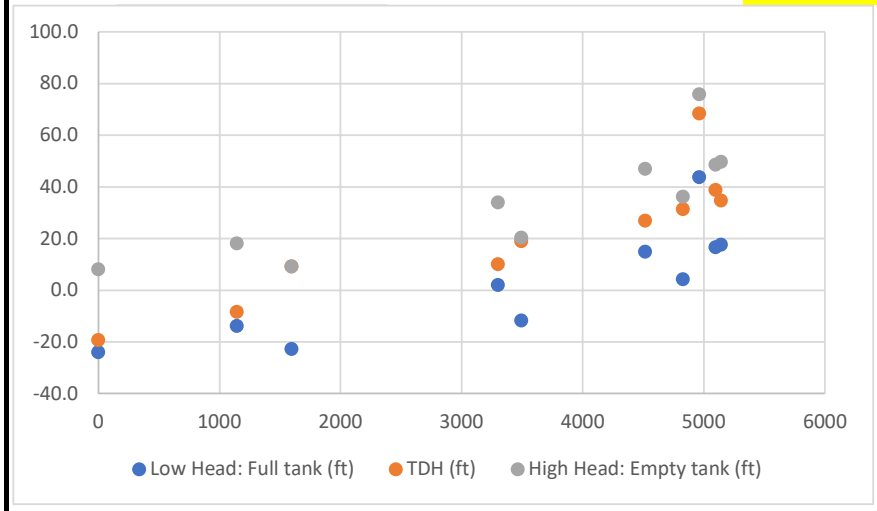
	JRTP (MGD)	YRTP (MGD)	JR + YR (MGD)	System HGL (ft)	Tank Operations						
					Tank Operation	Tank Rate (gpm) **Dia (in): 16**	Velocity (fps)	Hourly Tank Volume (gal)	Cumulative Tank Volume (gal)	Liquid Depth (ft)	Tank Pressure (ft)
12:00 AM	12.6	12.5	25.1	36.1							
12:00 AM	12.6	12.5	25.1	34.2	Drain	1,144	1.8	68,639	2,059,165	27	58
1:00 AM	10.8	11.3	22.0	33.1	Drain	3,299	5.3	197,912	1,861,254	24	55
2:00 AM	9.2	10.1	19.3	32.5	Drain	5,174	8.3	310,459	1,550,795	20	51
3:00 AM	8.3	9.2	17.5	32.2	Drain	6,441	10.3	386,469	1,164,326	15	46
4:00 AM	8.4	8.8	17.2	32.1	Drain	6,694	10.7	401,641	762,685	10	41
5:00 AM	8.8	8.8	17.6	32.1	Drain	6,399	10.2	383,967	378,718	5	36
6:00 AM	10.7	9.4	20.1	32.5	Drain	4,653	7.4	279,203	99,514	1	32
7:00 AM	12.9	11.6	24.5	34.8	Drain	1,594	2.5	95,656	3,858	0	31
8:00 AM	14.5	13.2	27.7	36.5	Store	629	1.0	37,769	37,769	0	31
9:00 AM	15.6	14.1	29.7	37.8	Store	2,039	3.3	122,363	160,131	2	33
10:00 AM	16.5	14.5	31.0	38.3	Store	2,945	4.7	176,680	336,811	4	35
11:00 AM	16.4	14.3	30.7	37.9	Store	2,745	4.4	164,709	501,520	6	37
12:00 PM	16.5	14.6	31.1	37.8	Store	2,982	4.8	178,904	680,425	9	40
1:00 PM	15.7	14.5	30.2	37.1	Store	2,377	3.8	142,637	823,061	11	42
2:00 PM	15.0	14.1	29.1	37.0	Store	1,616	2.6	96,988	920,049	12	43
3:00 PM	15.0	14.0	29.0	36.2	Store	1,524	2.4	91,469	1,011,518	13	44
4:00 PM	15.1	13.8	28.9	36.2	Store	1,454	2.3	87,265	1,098,783	14	45
5:00 PM	15.4	14.0	29.4	36.2	Store	1,840	2.9	110,407	1,209,190	16	47
6:00 PM	15.4	14.5	29.9	37.1	Store	2,143	3.4	128,608	1,337,798	17	48
7:00 PM	16.0	14.7	30.7	37.8	Store	2,726	4.4	163,568	1,501,366	19	50
8:00 PM	16.3	15.0	31.3	38.1	Store	3,152	5.0	189,130	1,690,496	22	53
9:00 PM	16.5	15.1	31.7	38.1	Store	3,376	5.4	202,587	1,893,082	24	55
10:00 PM	15.9	14.9	30.7	37.4	Store	2,741	4.4	164,488	2,057,570	26	57
11:00 PM	14.6	13.9	28.5	36.1	Store	1,171	1.9	70,234	2,127,804	27	58

Tabb OLSF
EQ Calculations

9/18/2020

Max Tank Height: 32 82% 18%

James River							York River								
Flow from EQ (MGD)	Flow from EQ (gpm)	Volume from EQ (gal)	Model HGL	Low Head: Full tank (ft)	TDH (ft)	High Head: Empty tank (ft)	Volume from EQ (gal)	Tank Rate (gpm)	Tank Rate (MGD)	Low HGL	High HGL	Min TDH (ft)	Max TDH (ft)	Flow from EQ (MGD)	
		1,746,678 gal total to YR					**377,268 gal total to YR**								
0	0		39.1	-23.9	**-19.2**	8.1									0 12:00 AM
1.6	1,144	68,639	49.3	-13.7	**-8.3**	18.3	0	0	0.0	35	55	-28	24	0.0	Drain 12:00 AM
4.7	3,299	197,912	65.1	2.1	**10.1**	34.1	0	0	0.0	35	55	-28	24	0.0	Drain 1:00 AM
6.5	4,516	270,966	78.0	15.0	**27.0**	47.0	39,493	658	0.9	35	55	-28	24	0.9	Drain 2:00 AM
7.4	5,141	308,468	80.8	17.8	**34.8**	49.8	78,000	1,300	1.9	*35*	*55*	*-28*	*24*	1.9	Drain 3:00 AM
7.3	5,098	305,851	79.7	16.7	**38.9**	48.7	95,790	1,596	2.3	*35*	*55*	*-28*	*24*	2.3	Drain 4:00 AM
7.0	4,827	289,600	67.3	4.3	**31.4**	36.3	94,367	1,573	2.3	*35*	*55*	*-28*	*24*	2.3	Drain 5:00 AM
5.0	3,493	209,586	51.4	-11.6	**19.1**	20.4	69,617	1,160	1.7	*35*	*55*	*-28*	*24*	1.7	Drain 6:00 AM
2.3	1,594	95,656	40.3	-22.7	**9.2**	9.3	**0**	**0**	**0.0**	**35**	**55**	**-28**	**24**	**0.0**	Drain 7:00 AM
Max:	4,962		106.9	43.9	68.5	**75.9**	37,769	629	0.9	35	55	-24	28		Store 8:00 AM
							122,363	2,039	2.9	35	55	-24	28		Store 9:00 AM
							176,680	2,945	4.2	35	55	-24	28		Store 10:00 AM
							164,709	2,745	4.0	35	55	-24	28		Store 11:00 AM
							178,904	2,982	4.3	35	55	-24	28		Store 12:00 PM
							142,637	2,377	3.4	35	55	-24	28		Store 1:00 PM
							96,988	1,616	2.3	35	55	-24	28		Store 2:00 PM
							91,469	1,524	2.2	35	55	-24	28		Store 3:00 PM
							87,265	1,454	2.1	35	55	-24	28		Store 4:00 PM
							110,407	1,840	2.6	35	55	-24	28		Store 5:00 PM
							128,608	2,143	3.1	35	55	-24	28		Store 6:00 PM
							163,568	2,726	3.9	35	55	-24	28		Store 7:00 PM
							189,130	3,152	4.5	35	55	-24	28		Store 8:00 PM
							202,587	**3,376**	**4.9**	**35**	**55**	**-24**	**28**		Store 9:00 PM
							164,488	2,741	3.9	35	55	-24	28		Store 10:00 PM
							70,234	**1,171**	1.7	35	55	-24	28		Store 11:00 PM



TABB PRS
Wet Weather Analysis

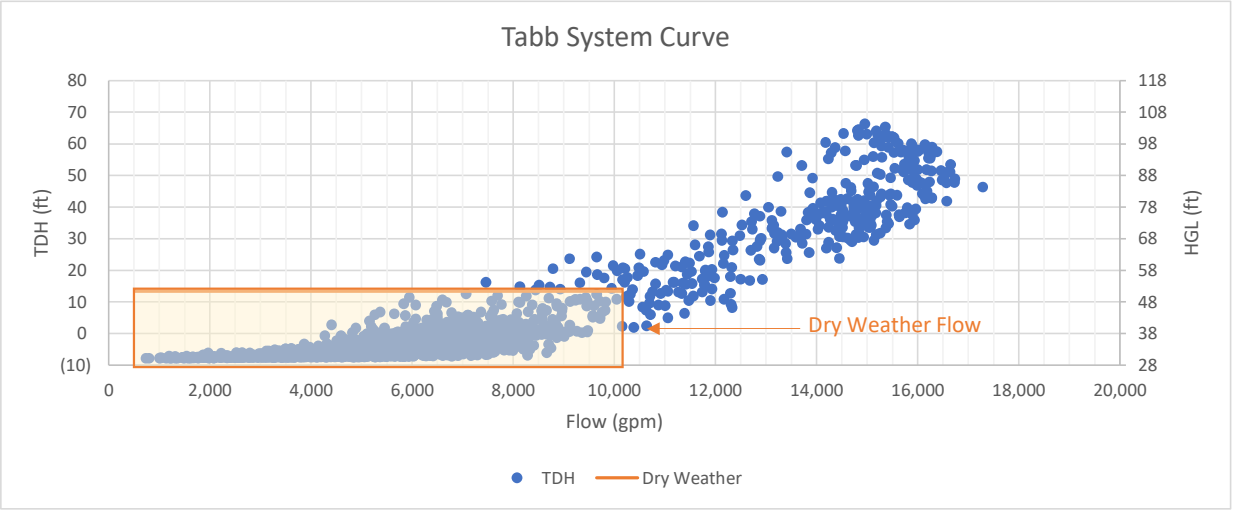
9/18/2020

Site Conditions	
51	**ft = Peak Dry Weather HGL**
106	**ft = Peak Wet Weather HGL**
29.5	**ft = Top of suction FM***
39.5	**ft = Suction HGL: Top of FM +10' buffer**
66.5	**ft = Peak Wet Weather Design TDH**

*High points for both incoming FMs were considered

To YR: STA 426+81 vertical bend at 27' (Secondary high point at STA 435+18 air valve is 29.5' and is accounted for in the 10' buffer)

To JR: STA 156+16 eccentric reducer at 27' (Secondary high point at STA 166+44 vertical bend is 29.5' and is accounted for in the 10' buffer)



Min	0.5	31.6	(7.9)
Max	12.3	105.8	66.3

511	gpm = dry weather minimum flow
0.4	fps = dry weather minimum velocity
10,148	gpm = dry weather maximum flow
7.2	fps = dry weather maximum velocity
10,776	gpm = wet weather maximum flow
7.6	fps = wet weather maximum velocity
31.6	ft = dry weather minimum HGL
35.8	ft = Average Dry Weather HGL
31.0	ft = Site Elev
-3.7	ft = Average Dry Weather TDH

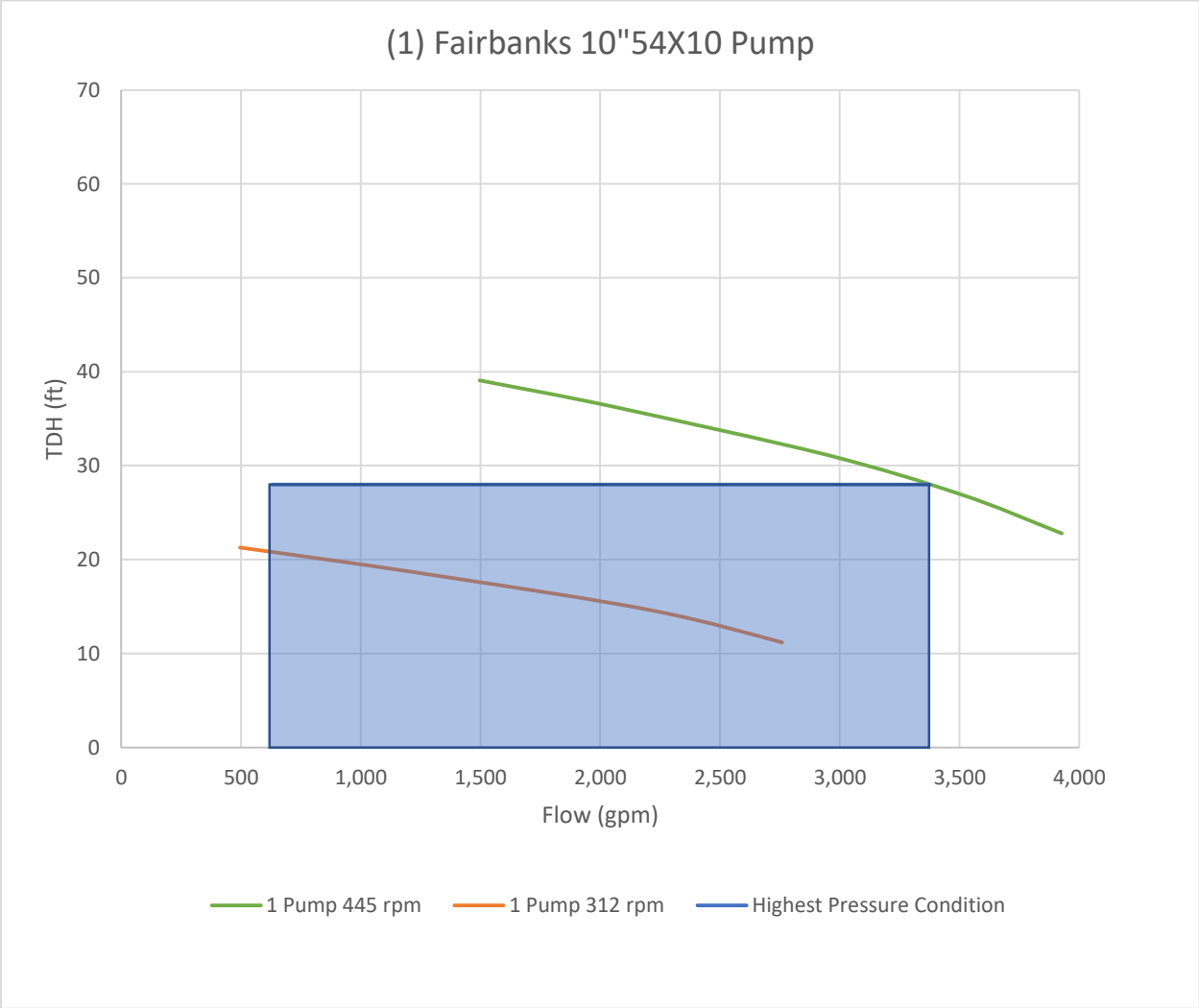
Prop Dia (in): 24

	Sum of WW Data		FIT-NF-024-17966 [ft]	System less Suction HGL
Time	**Tabb Flow (gpm)**	**Tabb Flow (fps)**	**System Pressure (ft)**	**TDH**
12/30/29 12:00 AM	4,578	3.2	34	(6)
12/30/29 12:02 AM	5,245	3.7	34	(6)
12/30/29 12:04 AM	5,056	3.6	34	(5)
12/30/29 12:06 AM	5,568	3.9	35	(5)
12/30/29 12:08 AM	5,138	3.6	35	(5)
12/30/29 12:10 AM	4,561	3.2	36	(4)
12/30/29 12:12 AM	3,652	2.6	34	(5)
12/30/29 12:14 AM	4,728	3.4	34	(6)
12/30/29 12:16 AM	8,217	5.8	35	(5)
12/30/29 12:18 AM	4,073	2.9	34	(6)
12/30/29 12:20 AM	4,383	3.1	34	(6)
12/30/29 12:22 AM	4,840	3.4	34	(6)
12/30/29 12:24 AM	4,929	3.5	34	(6)
12/30/29 12:26 AM	5,862	4.2	34	(6)
12/30/29 12:28 AM	6,634	4.7	35	(4)
12/30/29 12:30 AM	5,077	3.6	34	(5)
12/30/29 12:32 AM	3,222	2.3	33	(6)
12/30/29 12:34 AM	4,901	3.5	33	(6)
12/30/29 12:36 AM	6,120	4.3	34	(6)

Appendix F: Pump Selections

York River Pumps

Option 1



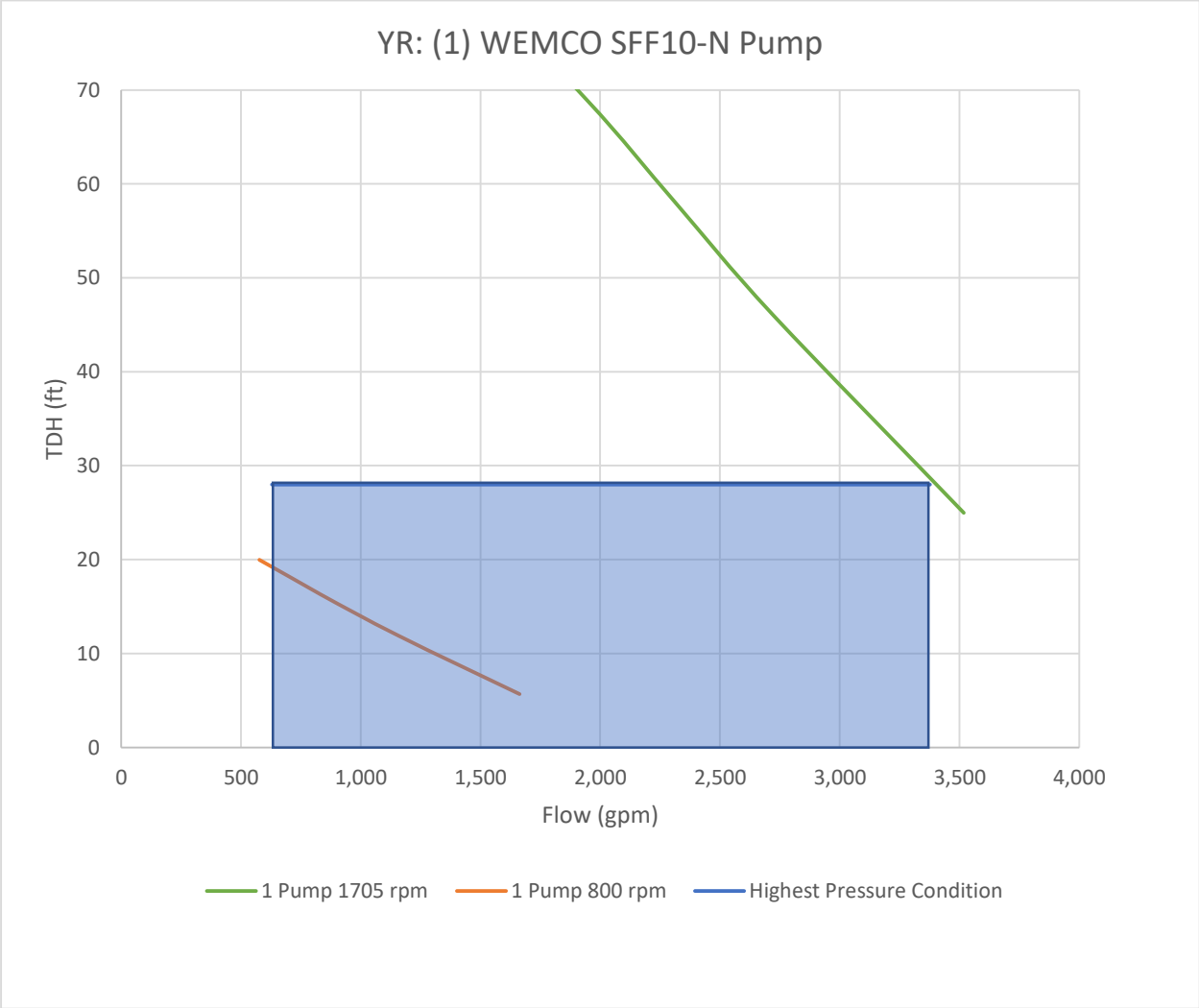
Fairbanks 8" 54X4S 40 hp 60 Hz
25.15" Impeller 445 rpm

1 Pump 445 rpm	2 Pumps (gpm)	Head (ft)
1,496		39.1
2,051		36.3
2,939		**31.2**
3,501		27
3,927		22.8

312 rpm

1 Pump 312 rpm	2 Pumps (gpm)	Head (ft)
496		21.3
1,321		18
2,217		**14.6**
2,760		11.2

Option 2



WEMCO SFF10-Z 40 hp 60 Hz

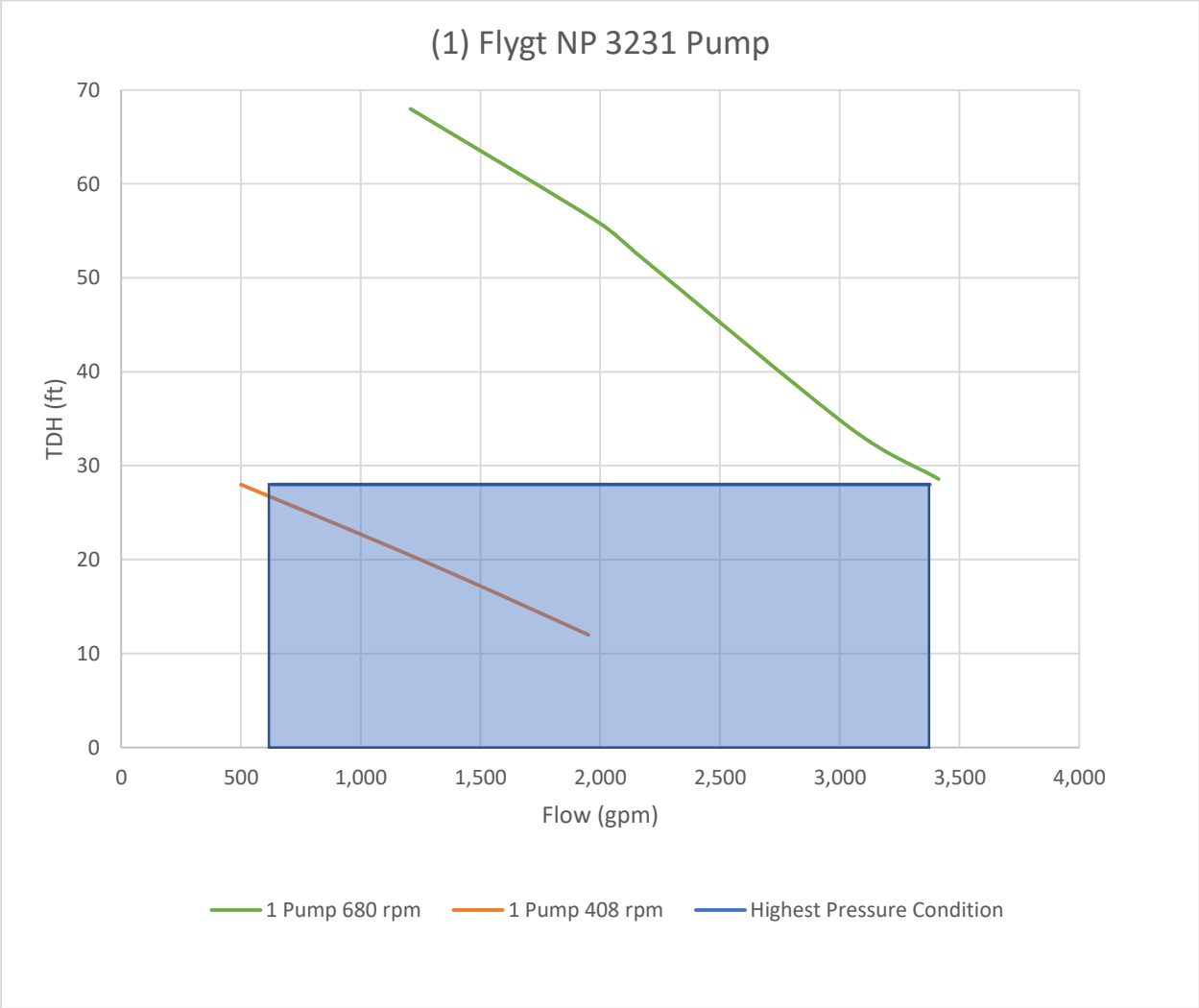
1705 rpm

1 Pump 1705 rpm	2 Pumps (gpm)	Head (ft)
1,373		84
1,943		69
2,314		**58**
2,724		46
3,517		25

800 rpm

1 Pump 800 rpm	2 Pumps (gpm)	Head (ft)
577		20
833		16
1,157		**11.9**
1,663		5.7

Option 3



Flygt NP 3231 78 hp 50 Hz 30 Hz
~8" Diameter discharge 680 rpm 408 rpm

1 Pump 680 rpm	2 Pumps (gpm)	Head (ft)
1,207		68
1,987		56
2,180		**52**
3,045		34
3,412		28.6

1 Pump 408 rpm	2 Pumps (gpm)	Head (ft)
500		28
1,250		**20**
1,950		12

Item number	: Default	Size	: 10" 54X10
Service	:	Stages	: 1
Quantity	: 1	Based on curve number	: 10-54x10-900-TPA256
Quote number	:	Date last saved	: 18 Sep 2020 1:34 AM

Operating Conditions

Flow, rated	: 3,376.0 USgpm
Differential head / pressure, rated (requested)	: 28.00 ft
Differential head / pressure, rated (actual)	: 28.01 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed, rated	: 445 rpm
Impeller diameter, rated	: 25.15 in
Impeller diameter, maximum	: 25.88 in
Impeller diameter, minimum	: 21.00 in
Efficiency	: 79.31 %
NPSH required / margin required	: 4.18 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 34 / 175 Metric units
Minimum Continuous Stable Flow	: 600.0 USgpm
Head, maximum, rated diameter	: 48.16 ft
Head rise to shutoff	: 71.95 %
Flow, best eff. point	: 2,887.6 USgpm
Flow ratio, rated / BEP	: 116.91 %
Diameter ratio (rated / max)	: 97.18 %
Head ratio (rated dia / max dia)	: 91.19 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids diameter limit	: 6.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

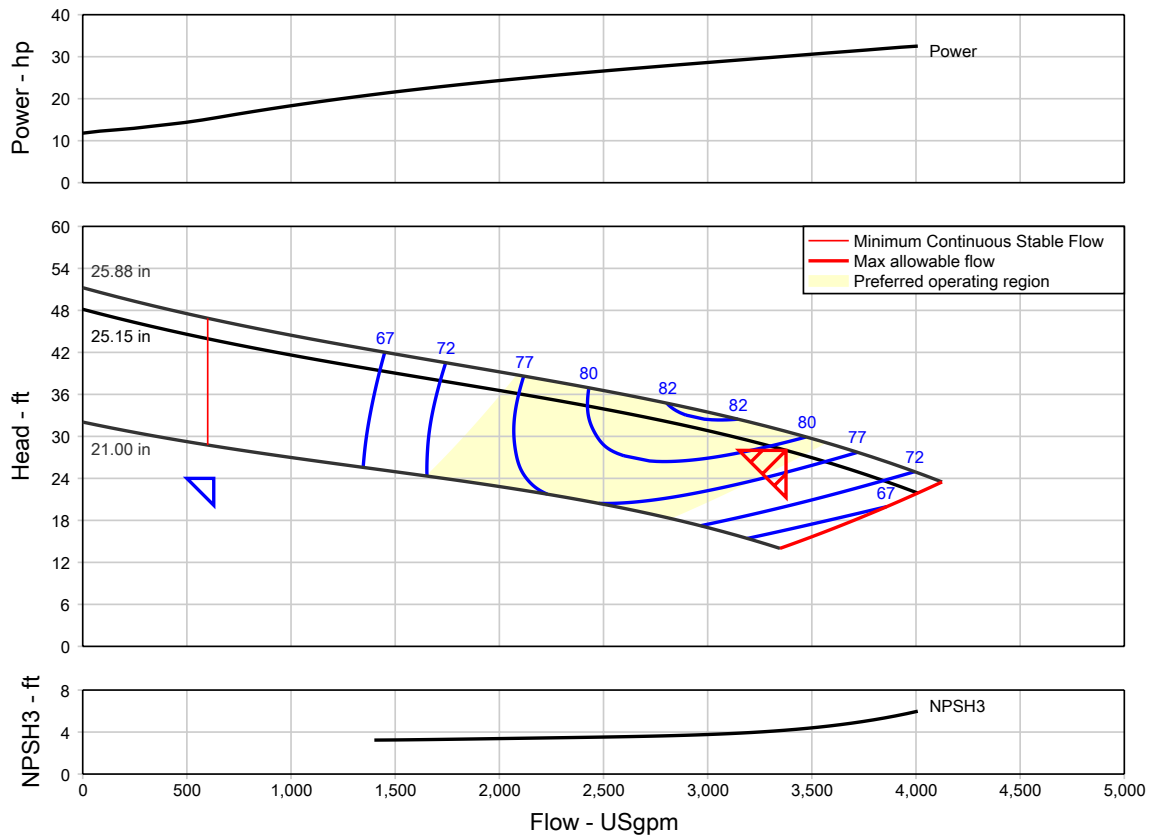
Material selected	: Cast Iron

Pressure Data

Maximum working pressure	: 20.84 psi.g
Maximum allowable working pressure	: 85.00 psi.g
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: 125.0 psi.g

Driver & Power Data (@Max density)

Driver sizing specification	: Max Power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 23.87 hp
Power, rated	: 30.10 hp
Power, maximum, rated diameter	: 32.52 hp
Minimum recommended motor rating	: 40.00 hp / 29.83 kW

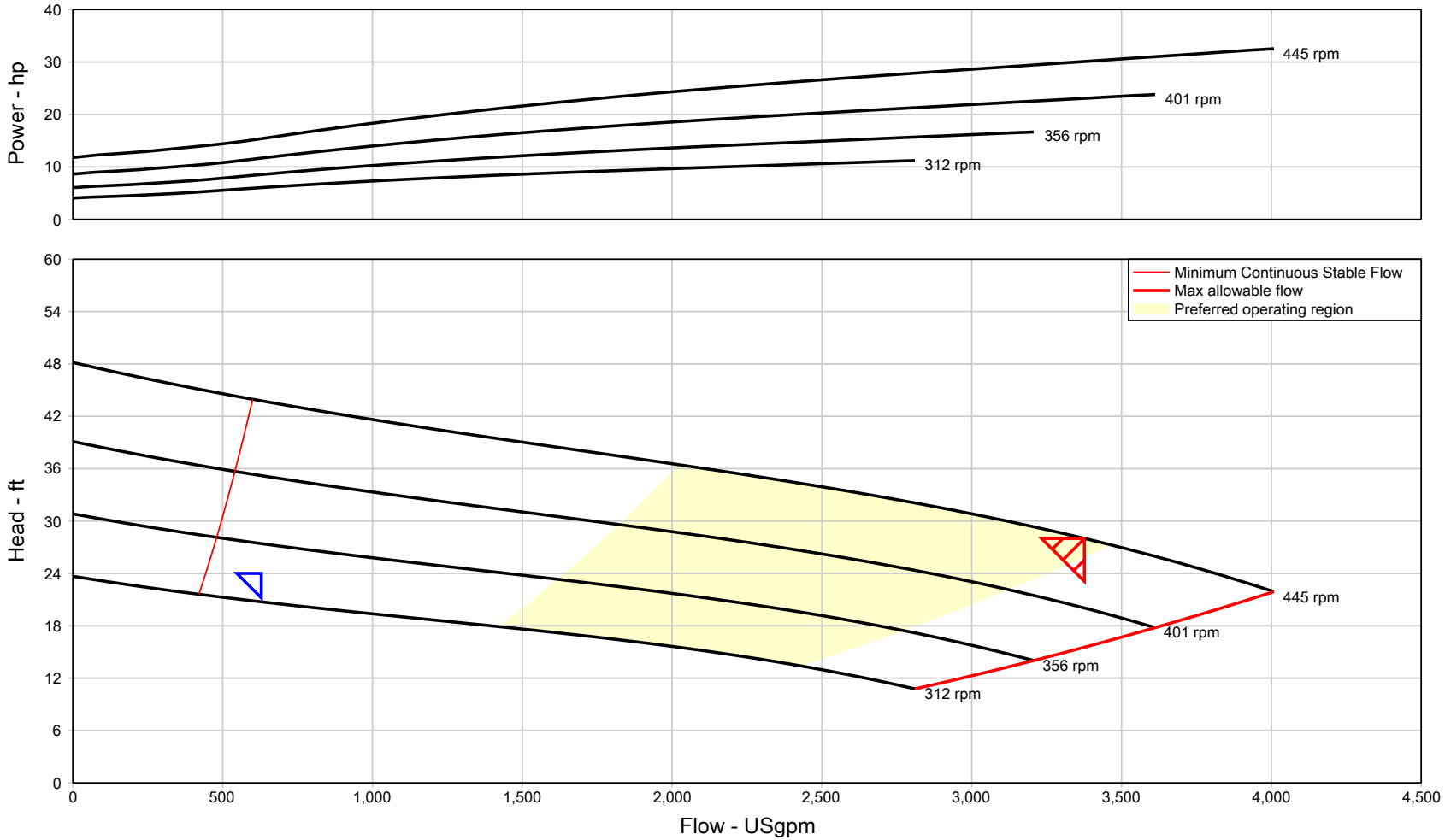


PENTAIR

Customer :
Project name :

Multi-Speed Performance Curve

Encompass 2.0 - 20.3.5



Item number	: Default	Size	: 10" 54X10	Flow, rated	: 3,376.0 USgpm
Service	:	Stages	: 1	Differential head / pressure, rated	: 28.00 ft
Quantity	: 1	Efficiency	: 79.31 %	Speed, rated	: 445 rpm
Quote number	:	Power, rated	: 30.10 hp	Impeller diameter, rated	: 25.15 in
Based on curve number	: 10-54x10-900-TPA256	NPSH required	: 4.18 ft	Fluid density, rated / max	: 1.000 / 1.000 SG
		Site Supply Frequency	: 60 Hz	Viscosity	: 1.00 cP
Date last saved	: 18 Sep 2020 1:34 AM	Nominal speed	: 445 rpm	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00

Pump Performance Datasheet

Customer	:	Quote number	:
Customer reference	:	Size	: SFF10-N Vertical
Item number	: Default	Stages	: 1
Service	:	Based on curve number	: P25-D124
Quantity	: 1	Date last saved	: 18 Sep 2020 1:15 AM

Operating Conditions

Flow, rated	: 3,376.0 USgpm
Differential head / pressure, rated (requested)	: 28.00 ft
Differential head / pressure, rated (actual)	: 27.86 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed, rated	: 1705 rpm
Speed, maximum	: 1800 rpm
Speed, minimum	: 800 rpm
Efficiency	: 65.56 %
NPSH required / margin required	: - / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 4,255 / - US Units
MCSF	: 1,139.3 USgpm
Head maximum, rated speed	: 110.5 ft
Head rise to shutoff	: 294.50 %
Flow, best eff. point	: 2,451.3 USgpm
Flow ratio, rated / BEP	: 137.72 %
Speed ratio (rated / max)	: 94.72 %
Head ratio (rated speed / max speed)	: 78.21 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: User defined
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.00 psi.a

Material

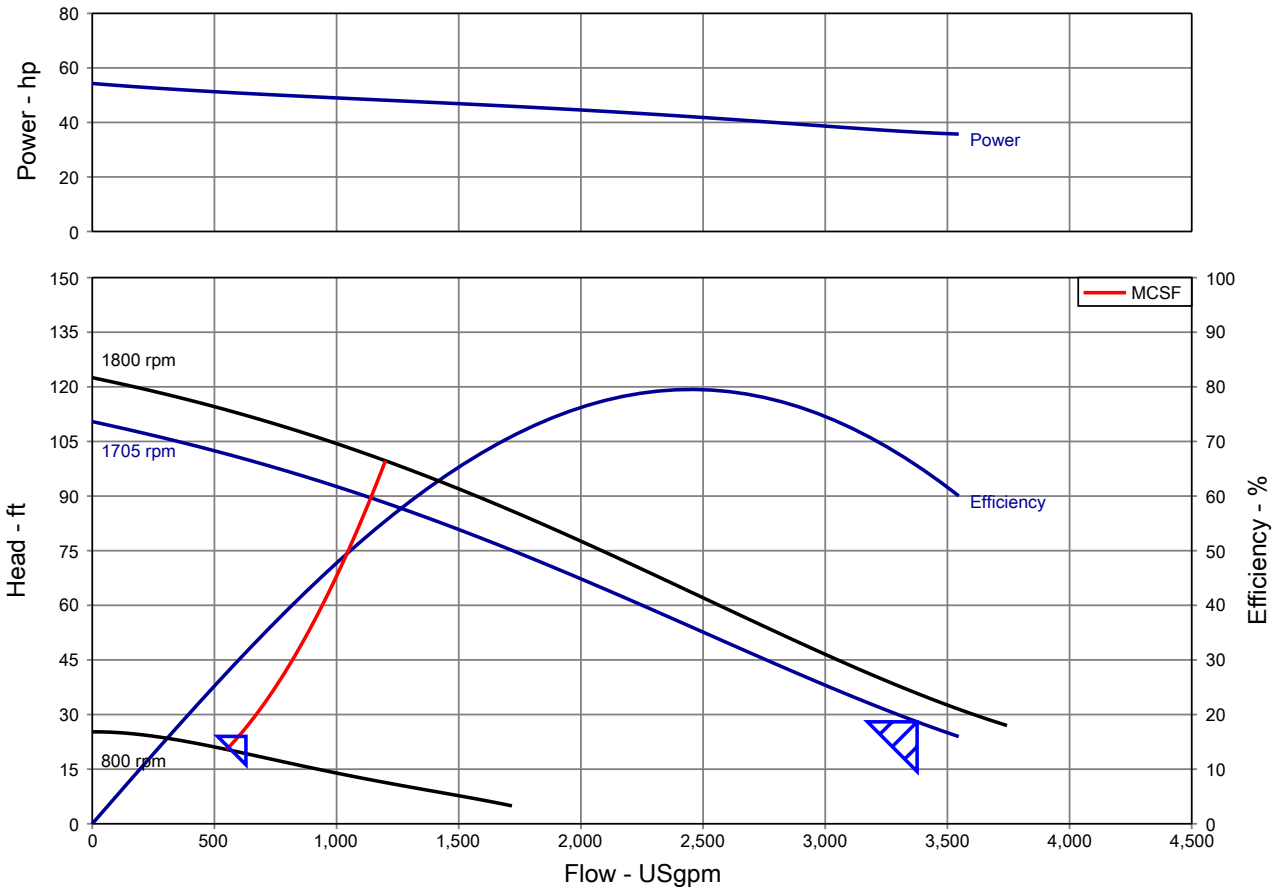
Material selected	: Standard

Pressure Data

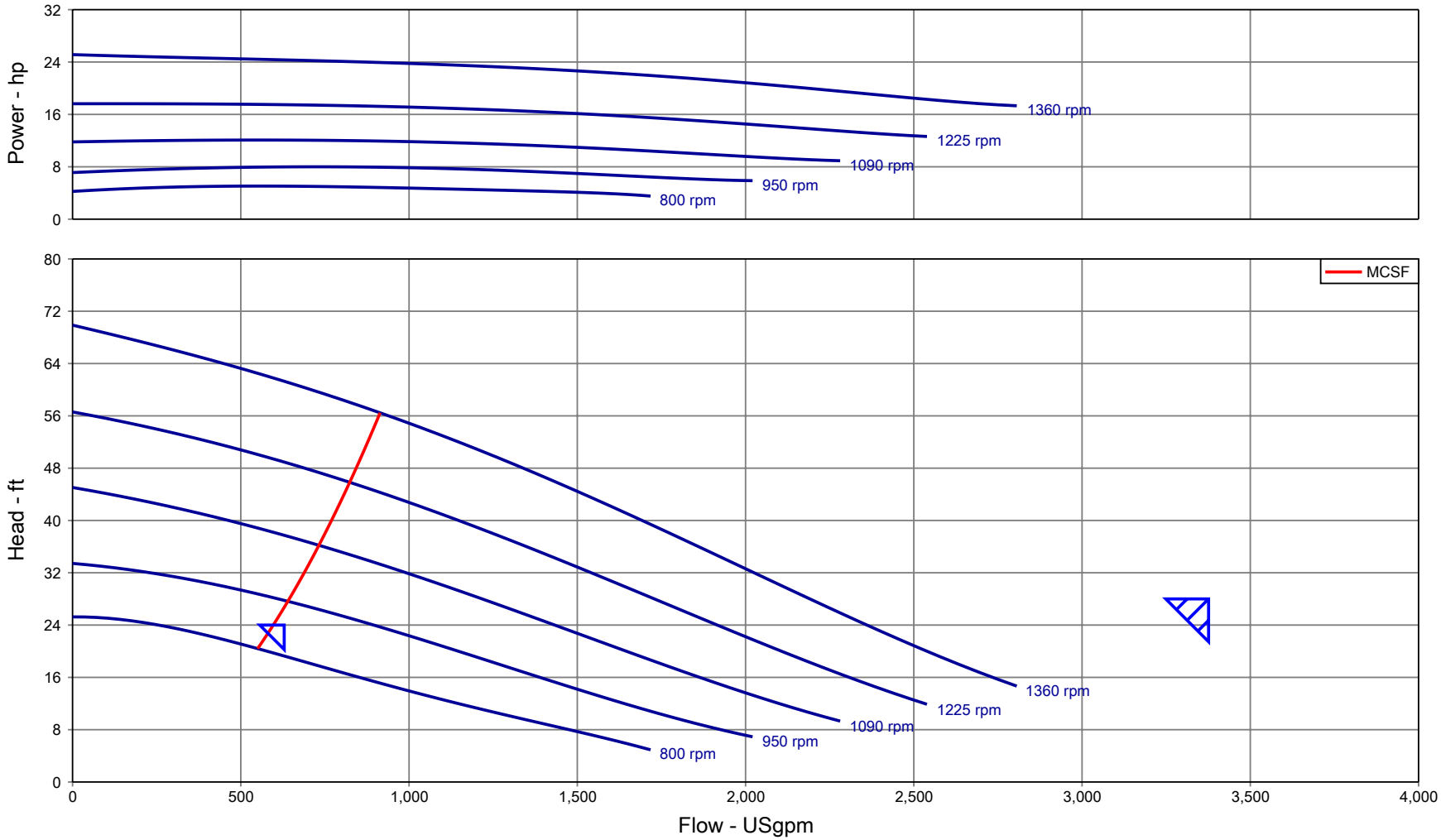
Maximum working pressure	: 12.12 psi.g
Maximum allowable working pressure	: 87.00 psi.g
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@Max density)

Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 23.87 hp
Power, rated	: 36.41 hp
Power, maximum, rated diameter	: 54.29 hp
Minimum recommended motor rating	: 40.00 hp / 29.83 kW



Multi-Speed Performance Curve



Customer	:	Stages	: 1	Nominal speed	: 1780 rpm
Customer reference	:	Based on curve number	: P25-D124	Flow, rated	: 3,376.0 USgpm
Item number	: Default	Efficiency	: 65.56 %	Differential head / pressure, rated	: 28.00 ft
Service	:	Power, rated	: 36.41 hp	Speed, rated	: 1705 rpm
Quantity	: 1	NPSH required	: -	Fluid density, rated / max	: 1.000 / 1.000 SG
Quote number	:	Site Supply Frequency	: 60 Hz	Viscosity, rated	: 1.00 cP
Date last saved	: 18 Sep 2020 1:15 AM			Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Size	: SFF10-N Vertical				

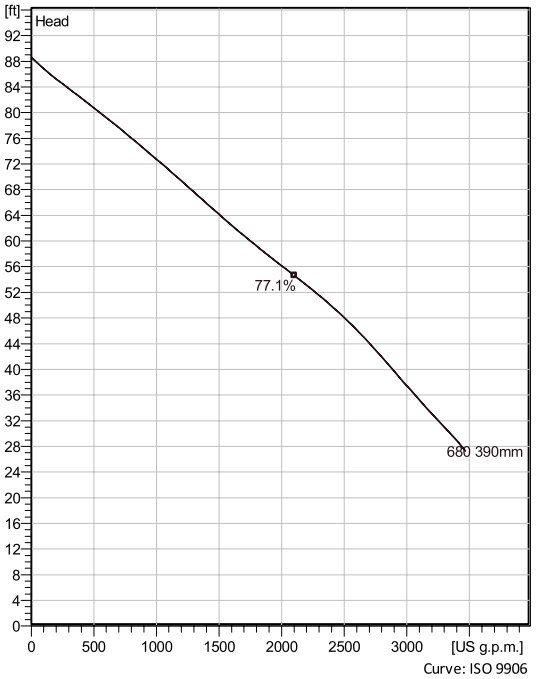
NP 3231/605 3~ 680

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Technical specification



Curves according to: Water, pure [100%],39.2 °F,62.43 lb/ft³,1.6888E-5 ft²/s



Curve: ISO 9906

Configuration

Motor number
N0605.000 35-29-6AA-W 58KW

Installation type
P - Semi permanent, Wet

Impeller diameter
390 mm

Discharge diameter
7 7/8 inch

Pump information

Impeller diameter
390 mm

Discharge diameter
7 7/8 inch

Inlet diameter
250 mm

Maximum operating speed
985 rpm

Number of blades
3

Max. fluid temperature
40 °C

Materials

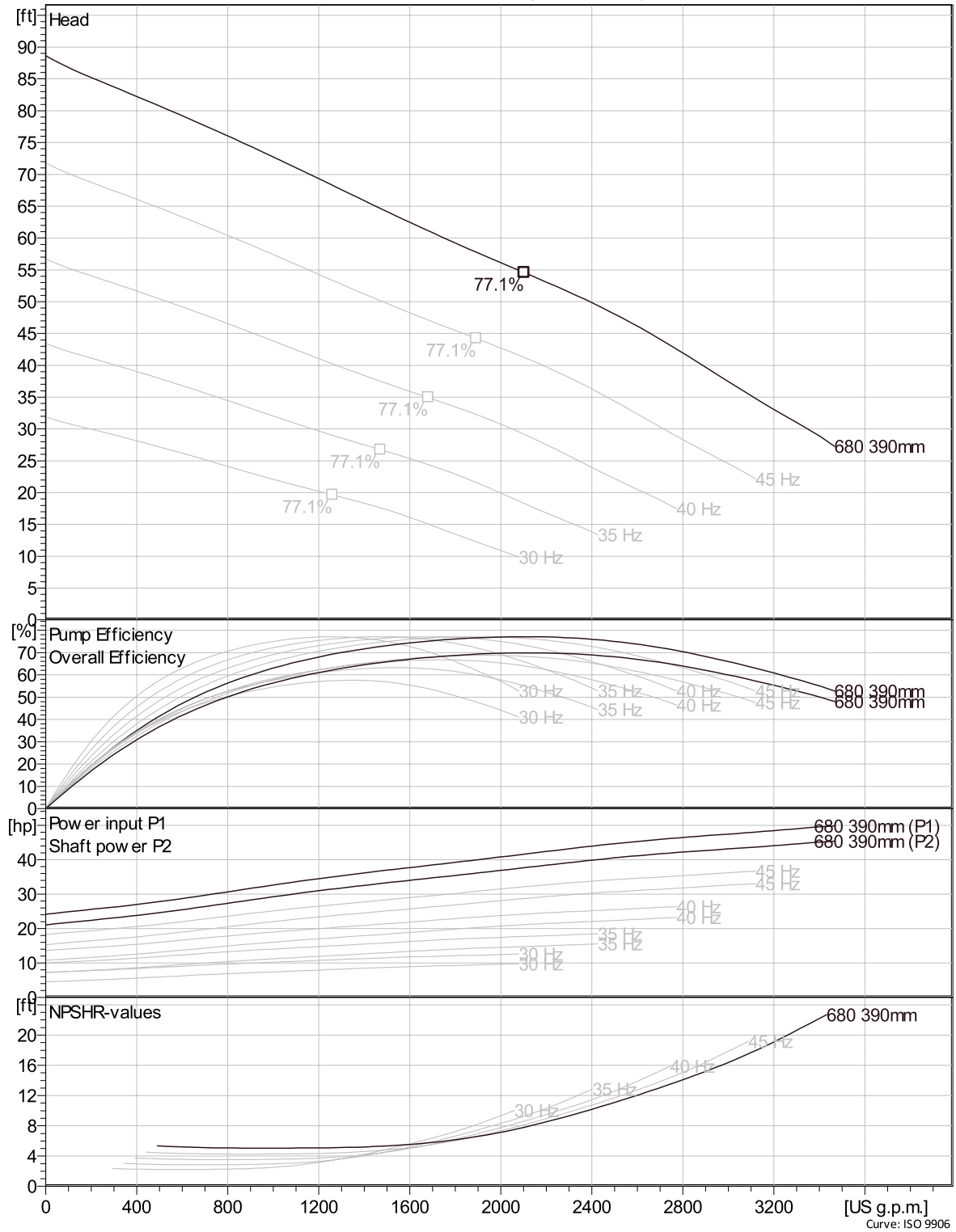
Impeller
Grey cast iron

Project		**Created by**	**Last update**
Block	0	**Created on**	9/18/2020

NP 3231/605 3~ 680

VFD Curve

Curves according to: Water, pure [100%],39.2 °F,62.43 lb/ft³,1.6888E-5 ft²/s

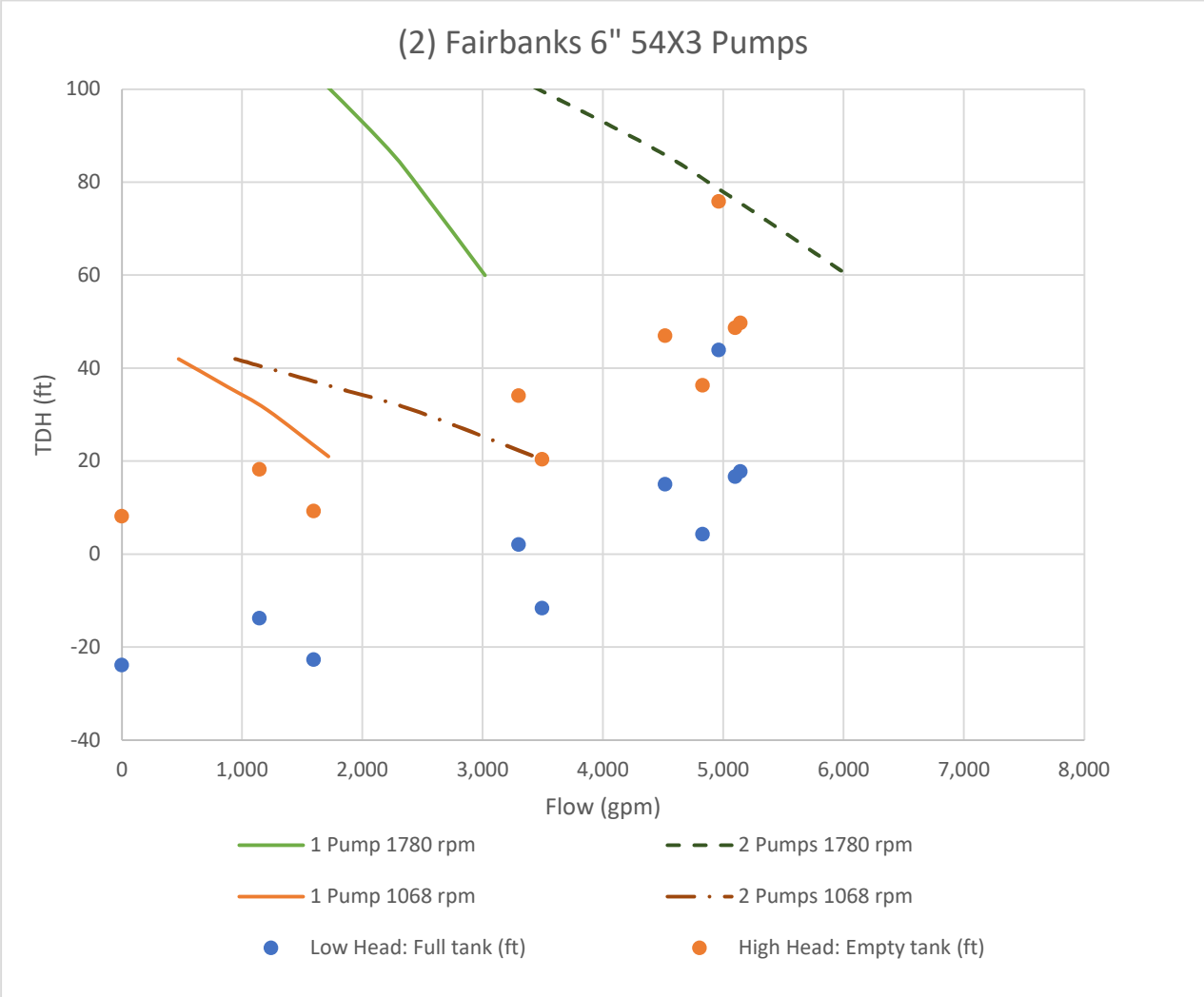


Curve: ISO 9906

Project		**Created by**		**Last update**	
Block	0	**Created on**	9/18/2020		

James River Pumps

Option 1



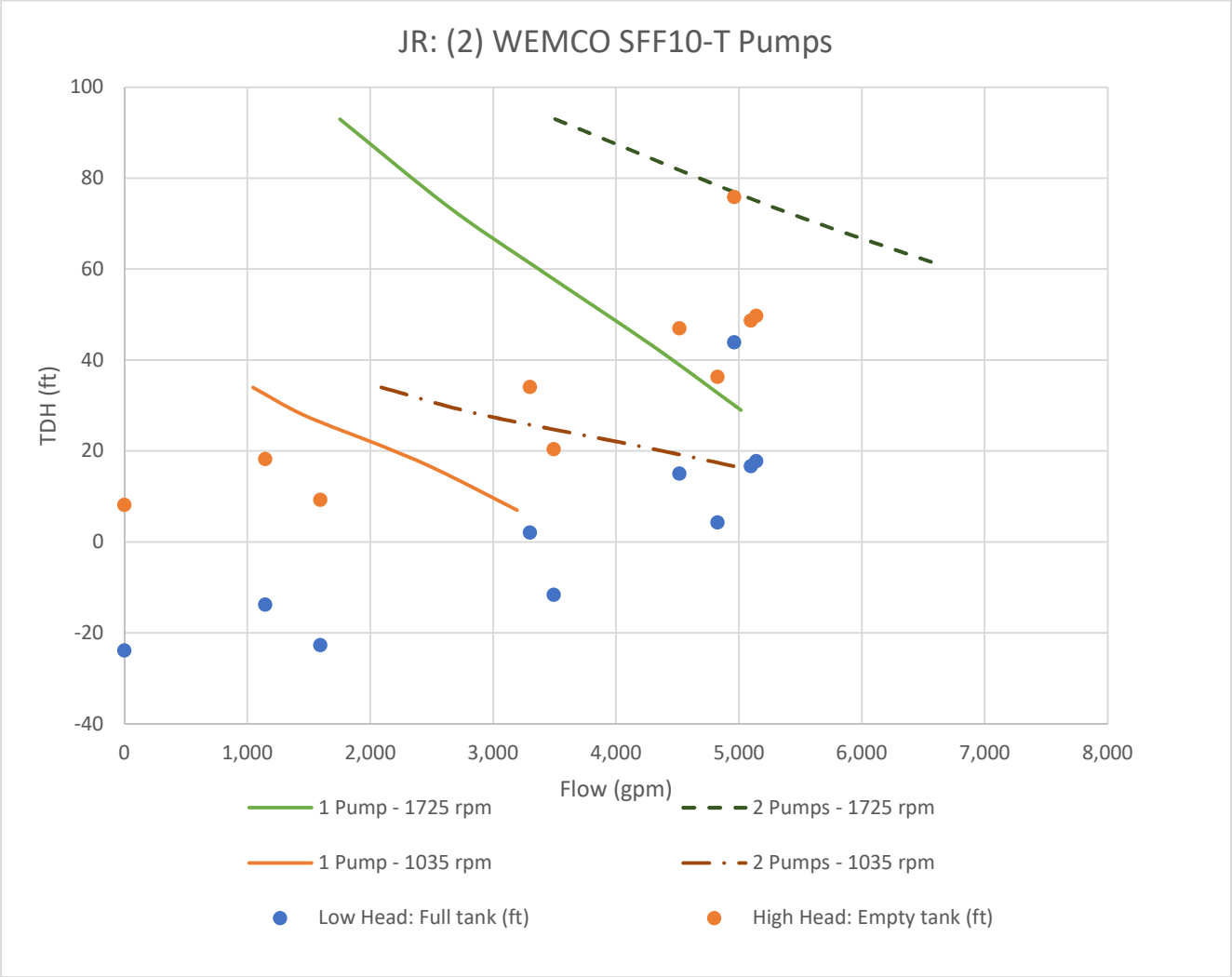
Fairbanks 6" 54X3 75 hp 60 Hz
11.36" Impeller 1780 rpm

1 Pump 1780 rpm	2 Pumps 1780 rpm	Head (ft)
819	1,638	123
1,262	2,524	112
2,148	**4,296**	**89**
2,497	4,994	78
3,018	6,036	60

1068 rpm

1 Pump 1068 rpm	2 Pumps 1068 rpm	Head (ft)
	0	
471	942	42
877	1,754	**36**
1,211	2,422	31
1,716	3,432	21

Option 2



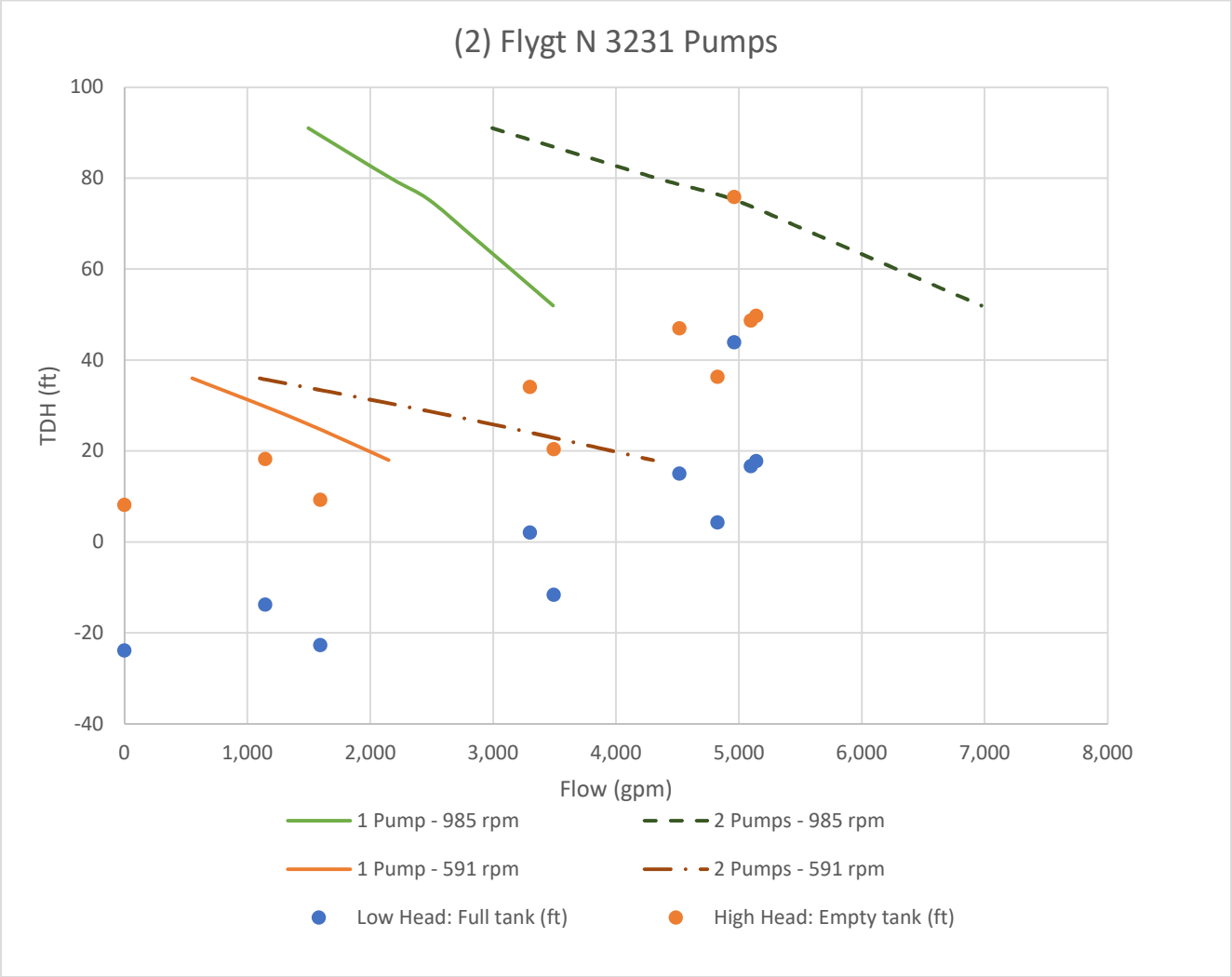
WEMCO SFF10-T 75 hp 60 Hz
Z Impeller 1725 rpm

1 Pump (gpm)	2 Pumps (gpm)	Head (ft)
1,752	3,504	93
2,621	5,242	74
3,315	**6,630**	**61**
4,304		43
5,016		29

1035 rpm

1 Pump (gpm)	2 Pumps (gpm)	Head (ft)
1,045	2,090	34
1,454	2,908	28
2,103	**4,206**	**21**
2,538	5,076	16
3,194		7

Option 3



Flygt NP 3231 78 hp 50 Hz 985 rpm

1 Pump (gpm)	2 Pumps (gpm)	Head (ft)
1,496	2,992	91
2,166	4,332	80
2,472	**4,944**	**75.4**
2,840	5,680	67
3,486	6,972	52

30 Hz 591 rpm

1 Pump (gpm)	2 Pumps (gpm)	Head (ft)
	0	
550	1,100	36
1,400	**2,800**	**27**
2,150	4,300	18

PENTAIR

Customer :
Project name :

Pump Performance Datasheet

Encompass 2.0 - 20.3.4-RC5

Item number	: Default	Size	: 6" 54X3
Service	:	Stages	: 1
Quantity	: 1	Based on curve number	: 6-54x3-1800-T6C1C
Quote number	:	Date last saved	: 16 Sep 2020 1:37 PM

Operating Conditions

Flow, rated	: 2,571.0 USgpm
Head, rated (requested)	: 68.50 ft
Head, rated (actual)	: 68.51 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed	: 1780 rpm
Impeller dia.	: 11.36 in
Impeller diameter, maximum	: 12.00 in
Impeller diameter, minimum	: 9.00 in
Efficiency	: 76.63 %
NPSH required / margin required	: 24.25 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 50 / 166 Metric units
Minimum Continuous Stable Flow	: 300.0 USgpm
Head max.	: 137.8 ft
Head rise to shutoff	: 101.10 %
Flow, best eff. point	: 1,975.2 USgpm
Flow ratio, rated / BEP	: 130.16 %
Diameter ratio (rated / max)	: 94.67 %
Head ratio (rated dia / max dia)	: 79.53 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids size limit	: 3.00 in
Solids concentration, by volume	: 0.00 %
Temperature	: 68.00 deg F
Fluid density	: 1.000 / 1.000 SG
Viscosity	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

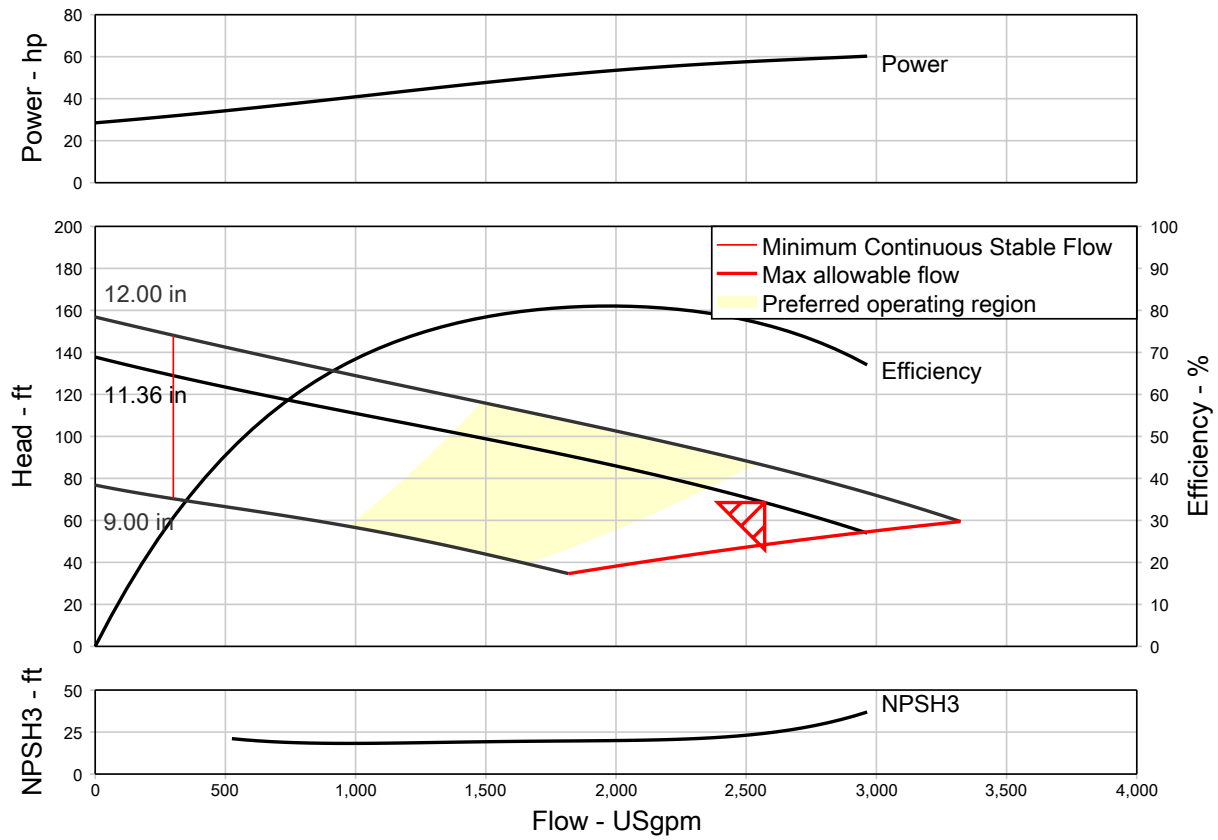
Material selected	: Cast Iron

Pressure Data

Maximum working pressure	: 59.63 psi.g
Maximum allowable working pressure	: 85.00 psi.g
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: 125.0 psi.g

Driver & Power Data (@Max density)

Driver sizing specification	: Max Power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 44.47 hp
Power, rated	: 58.03 hp
Power, maximum	: 60.25 hp
Motor rating	: 75.00 hp / 55.93 kW



PENTAIR

FAIRBANKS NIJHUIS
3501 FAIRBANKS AVENUE ·
KANSAS CITY, KANSAS 66106
WWW.FAIRBANKSNIJHUIS.COM

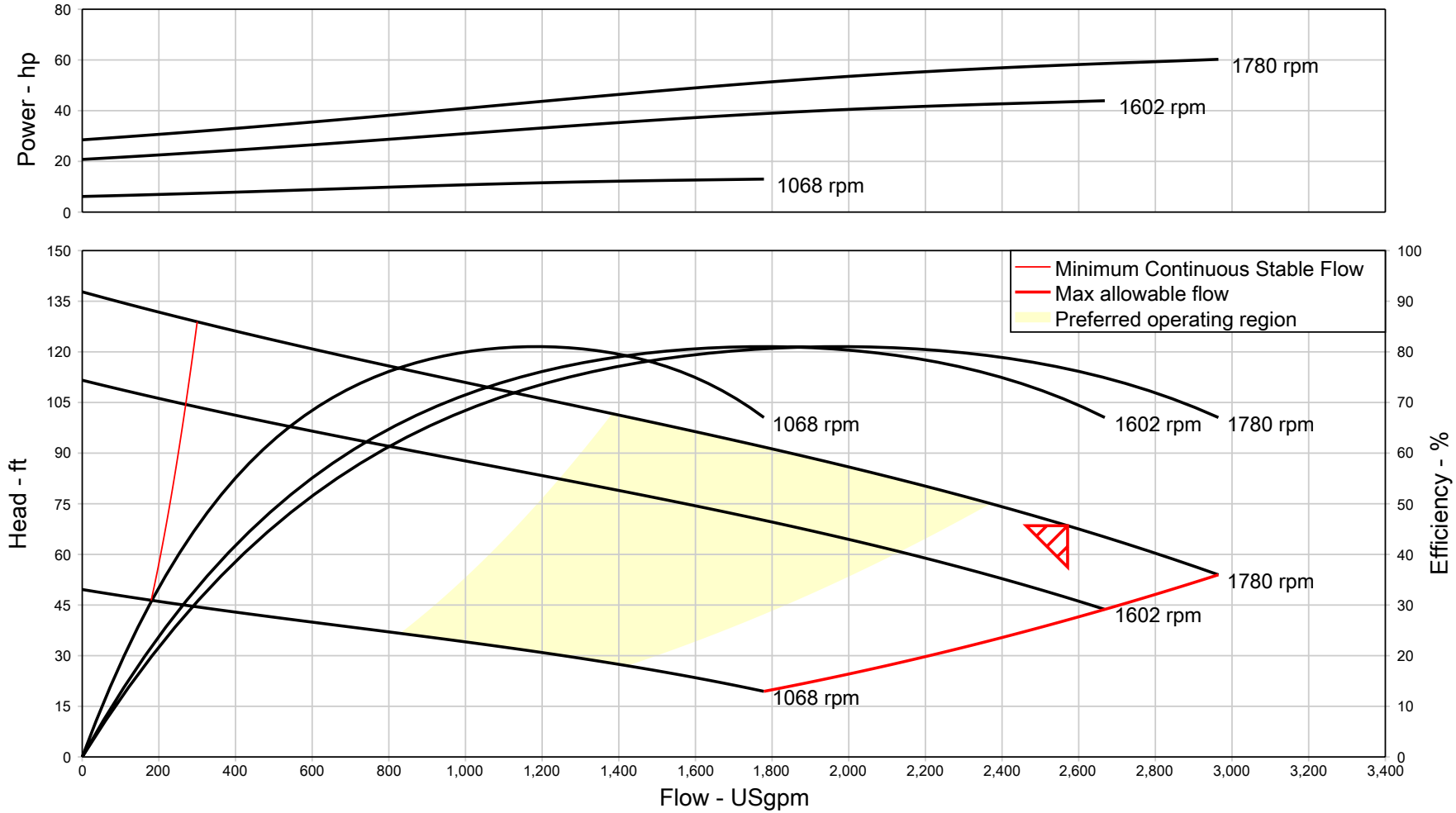
PHONE: +1-913-371-5000 · FAX:

PENTAIR

Customer :
Project name :

Multi-Speed Performance Curve

Encompass 2.0 - 20.3.4-RC5



Item number	: Default	Size	: 6" 54X3	Flow, rated	: 2,571.0 USgpm
Service	:	Stages	: 1	Head, rated	: 68.50 ft
Quantity	: 1	Efficiency	: 76.63 %	Speed	: 1780 rpm
Quote number	:	Power, rated	: 58.03 hp	Impeller dia.	: 11.36 in
Based on curve number	: 6-54x3-1800-T6C1C	NPSH required	: 24.25 ft	Fluid density	: 1.000 / 1.000 SG
		Site Supply Frequency	: 60 Hz	Viscosity	: 1.00 cP
Date last saved	: 16 Sep 2020 1:37 PM	Nominal speed	: 1780 rpm	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00

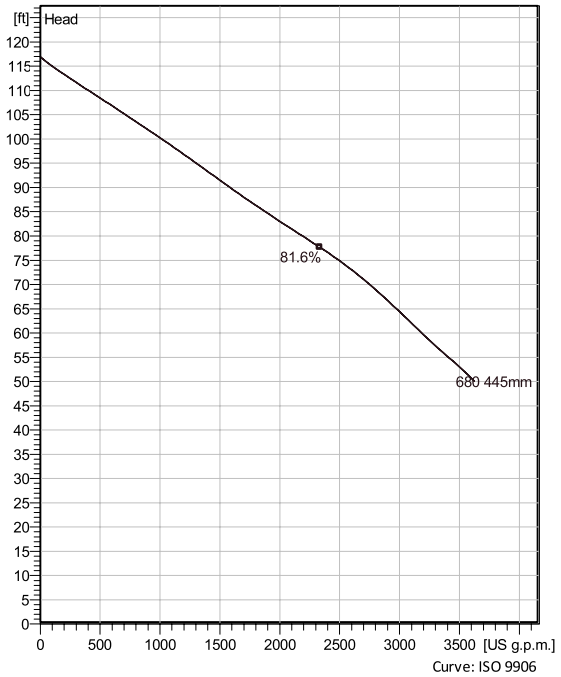
NP 3231/605 3~ 680

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Technical specification



Curves according to: Water, pure [100%],39.2 °F,62.43 lb/ft³,1.6888E-5 ft²/s



Curve: ISO 9906

Configuration

Motor number
N0605.000 35-29-6AA-W 58KW

Installation type
P - Semi permanent, Wet

Impeller diameter
445 mm

Discharge diameter
7 7/8 inch

Pump information

Impeller diameter
445 mm

Discharge diameter
7 7/8 inch

Inlet diameter
250 mm

Maximum operating speed
985 rpm

Number of blades
3

Max. fluid temperature
40 °C

Materials

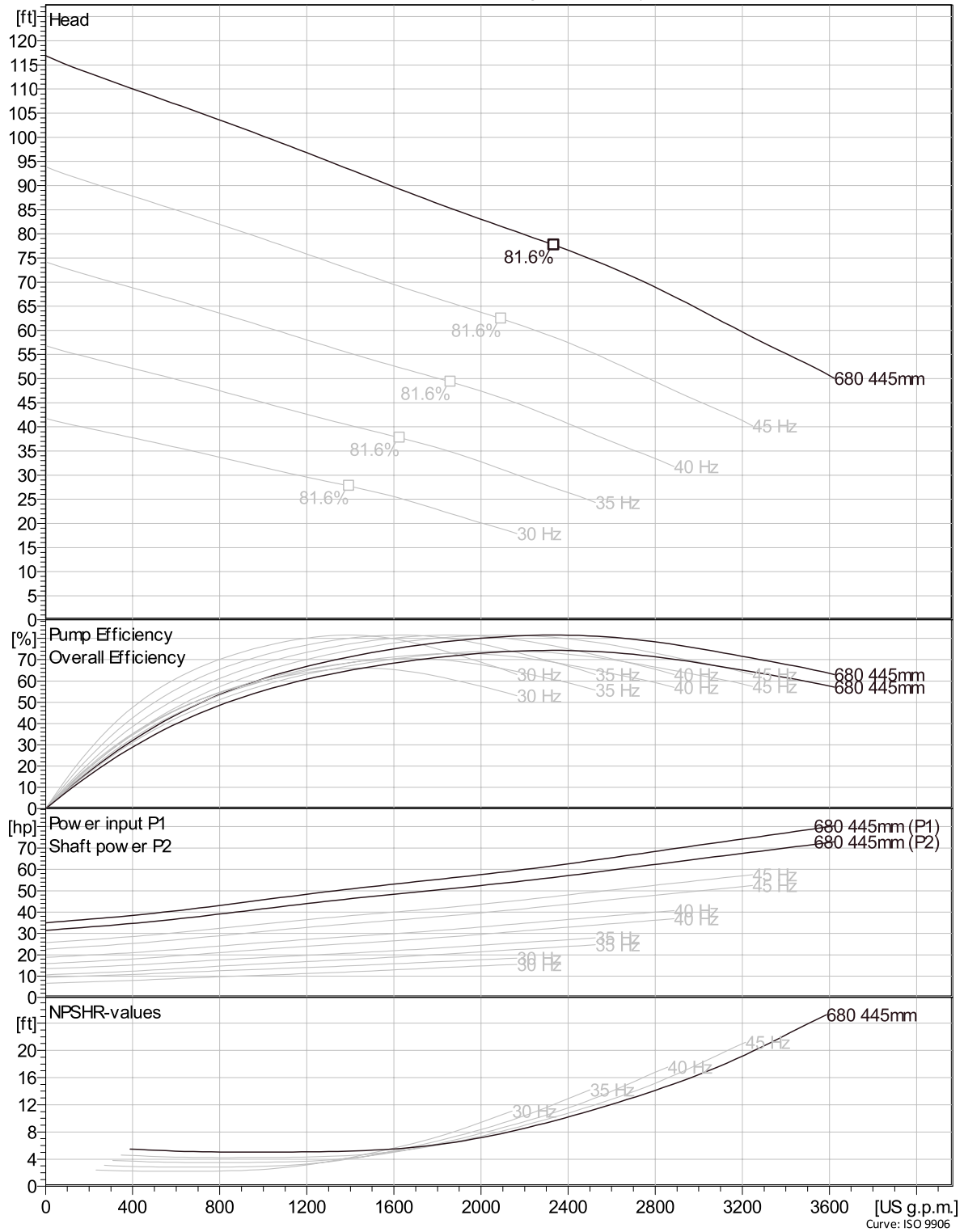
Impeller
Grey cast iron

Project		**Created by**	**Last update**
Block	0	**Created on**	9/18/2020

NP 3231/605 3~ 680

VFD Curve

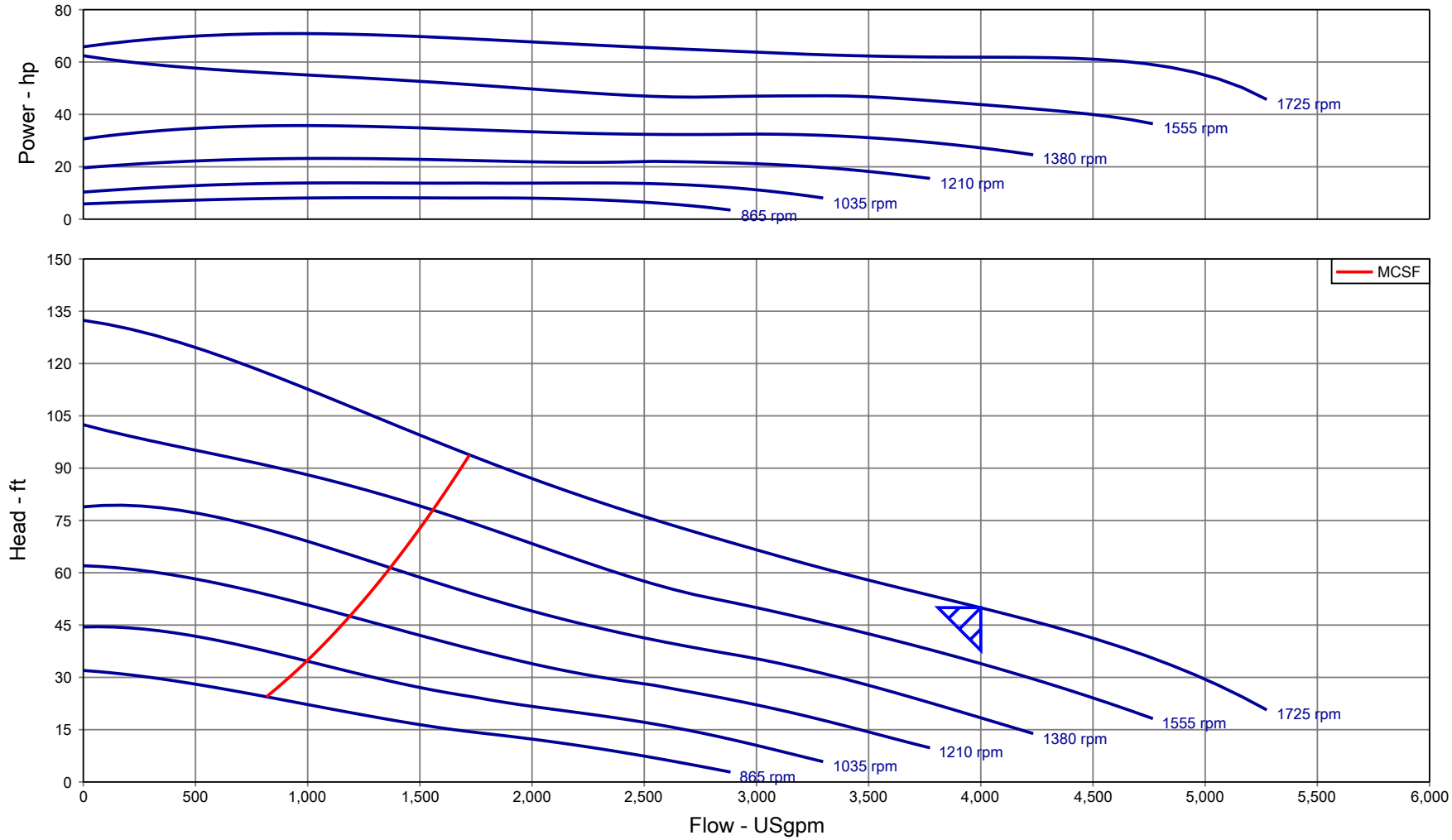
Curves according to: Water, pure [100%],39.2 °F,62.43 lb/ft³,1.6888E-5 ft²/s



Curve: ISO 9906

Project		**Created by**		**Last update**	
Block	0	**Created on**	9/18/2020		

Multi-Speed Performance Curve



Customer	:	Stages	: 1	Nominal speed	: 1780 rpm
Customer reference	:	Based on curve number	: P25-D125	Flow, rated	: 4,000.0 USgpm
Item number	: Default	Efficiency	: 81.57 %	Differential head / pressure, rated	: 50.00 ft
Service	:	Power, rated	: 61.69 hp	Speed, rated	: 1725 rpm
Quantity	: 1	NPSH required	: -	Fluid density, rated / max	: 1.000 / 1.000 SG
Quote number	:	Site Supply Frequency	: 60 Hz	Viscosity, rated	: 1.00 cP
Date last saved	: 09 Sep 2020 1:49 PM			Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Size	: SFF10-T Horizontal				

Pump Performance Datasheet

Customer	:	Quote number	:
Customer reference	:	Size	: SFF10-T Horizontal
Item number	: Default	Stages	: 1
Service	:	Based on curve number	: P25-D125
Quantity	: 1	Date last saved	: 09 Sep 2020 1:49 PM

Operating Conditions

Flow, rated	: 4,000.0 USgpm
Differential head / pressure, rated (requested)	: 50.00 ft
Differential head / pressure, rated (actual)	: 49.96 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed, rated	: 1725 rpm
Speed, maximum	: 1800 rpm
Speed, minimum	: 800 rpm
Efficiency	: 81.57 %
NPSH required / margin required	: - / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 5,175 / - US Units
MCSF	: 1,719.6 USgpm
Head maximum, rated speed	: 132.1 ft
Head rise to shutoff	: 165.11 %
Flow, best eff. point	: 3,705.4 USgpm
Flow ratio, rated / BEP	: 107.95 %
Speed ratio (rated / max)	: 95.83 %
Head ratio (rated speed / max speed)	: 87.01 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: User defined
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.00 psi.a

Material

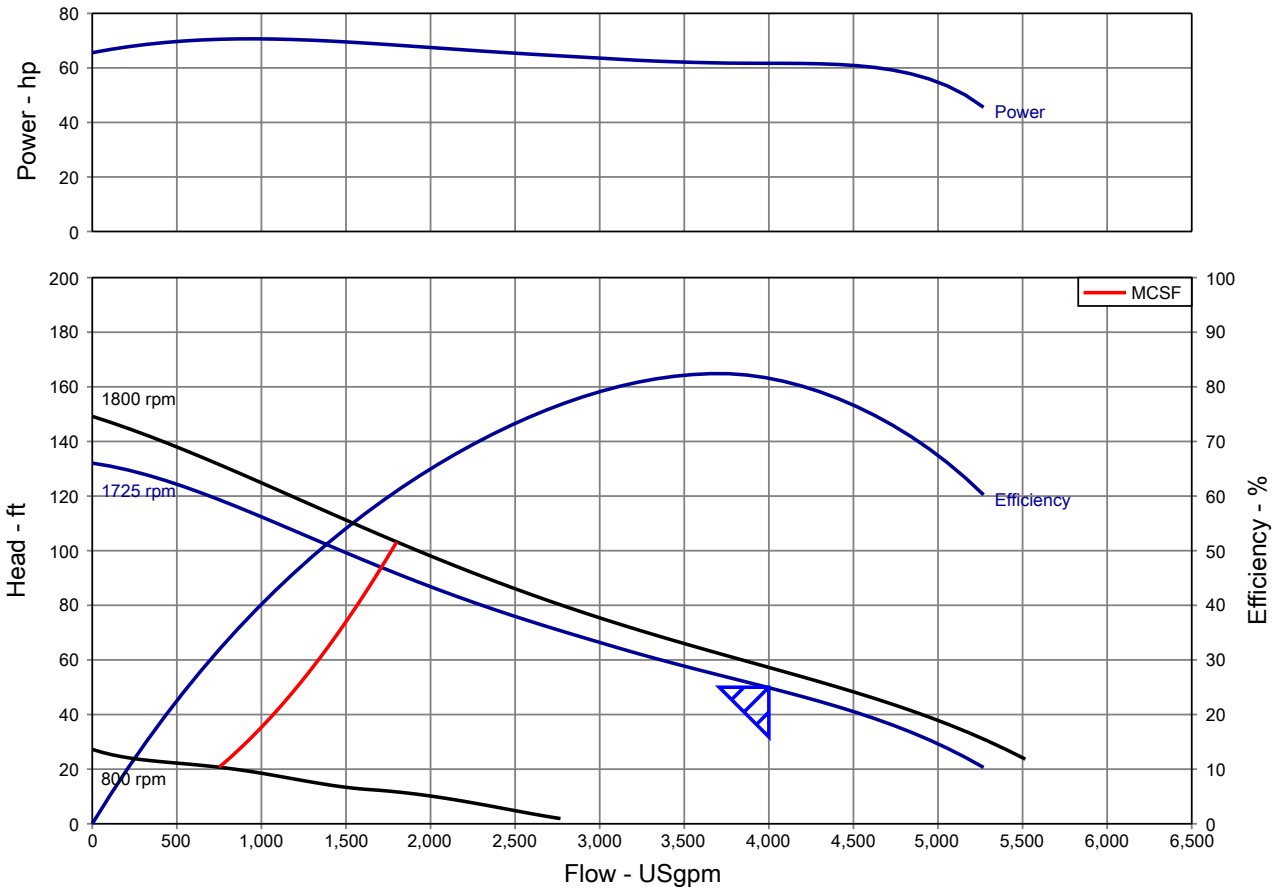
Material selected	: Standard

Pressure Data

Maximum working pressure	: 21.57 psi.g
Maximum allowable working pressure	: 87.00 psi.g
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

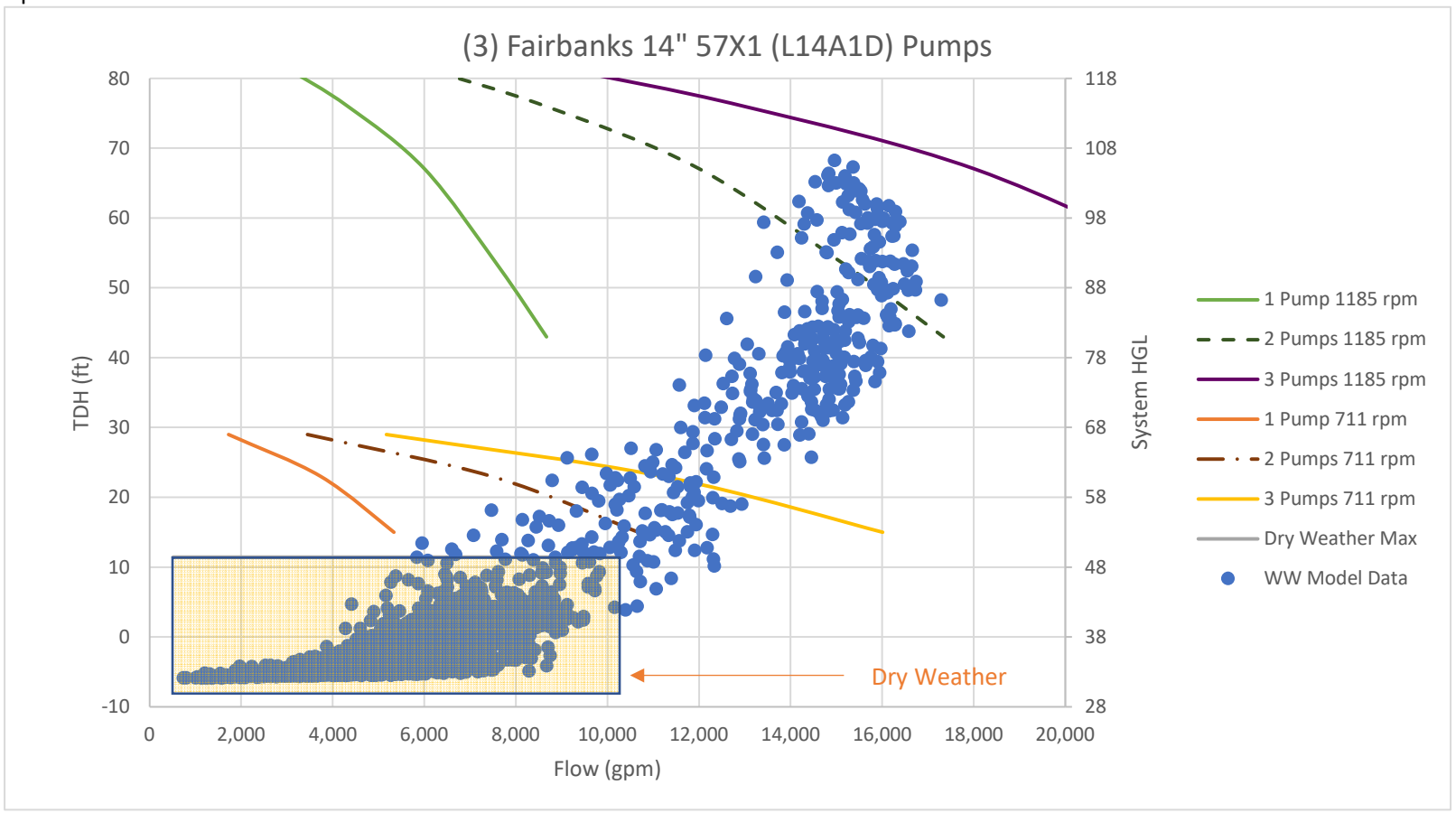
Driver & Power Data (@Max density)

Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 50.32 hp
Power, rated	: 61.69 hp
Power, maximum, rated diameter	: 70.66 hp
Minimum recommended motor rating	: 75.00 hp / 55.93 kW



Pressure Reducing Pumps

Option 1



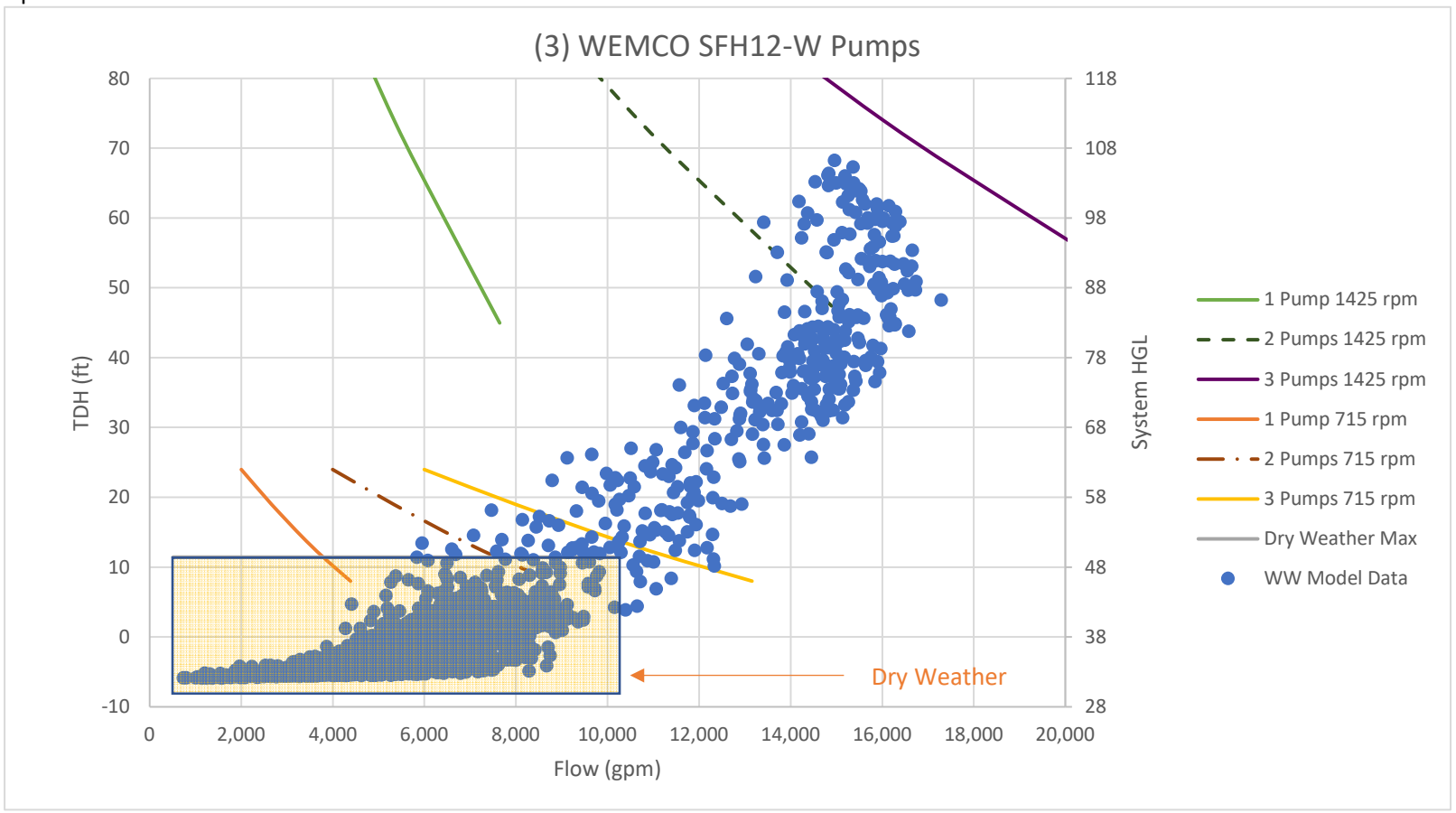
Fairbanks 14" 57X1 (L14A1D) 150 hp 60 Hz
33.96" Impeller 1185 rpm

1 Pump 1185 rpm	2 Pumps 1185 rpm	3 Pumps 1185 rpm	Head (ft)
2,865	5,730	8,595	82
4,331	8,662	12,993	76
6,010	**12,020**	**18,030**	**67**
7,625	15,250	22,875	53
8,666	17,332	25,998	43

711 rpm

1 Pump 711 rpm	2 Pumps 711 rpm	3 Pumps 711 rpm	Head (ft)
1,723	3,446	5,169	29
3,737	7,474	11,211	23
5,337	**10,674**	**16,011**	**15**
	0	0	
	0	0	

Option 2



WEMCO SFH12-W 150 hp 60 Hz

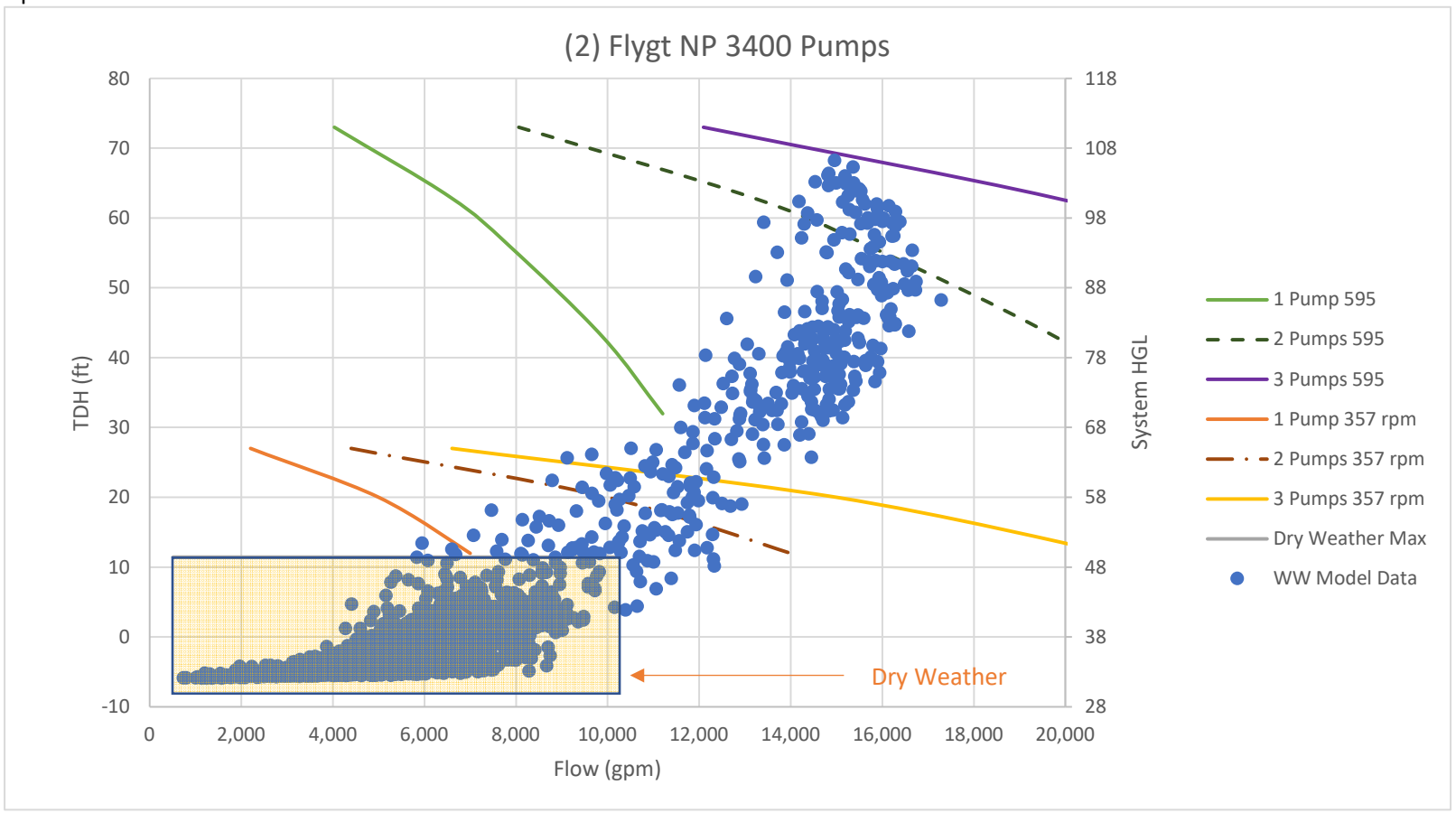
1425 rpm

1 Pump 1425 rpm	2 Pumps 1425 rpm	3 Pumps 1425 rpm	Head (ft)
3,265	6,530	9,795	105
4,118	8,236	12,354	92
5,341	**10,682**	**16,023**	**74**
6,351	12,702	19,053	61
7,645	15,290	22,935	45

715 rpm

1 Pump 715 rpm	2 Pumps 715 rpm	3 Pumps 715 rpm	Head (ft)
1,998	3,996	5,994	24
2,666	5,332	7,998	19
3,533	**7,066**	**10,599**	**13**
4,386	8,772	13,158	8

Option 3



Flygt NP3400 168 hp 50 Hz
575 mm 595 rpm

1 Pump	2 Pumps	3 Pumps	
595	595	595	Head (ft)
4,032	8,064	12,096	73
6,568	13,136	19,704	63
7,857	**15,714**	**23,571**	**56**
9,893	19,786	29,679	43
11,203	22,406	33,609	32

30 Hz
357 rpm

1 Pump	2 Pumps	3 Pumps	
357 rpm	357 rpm	357 rpm	Head (ft)
2,200	4,400	6,600	27
5,000	10,000	15,000	20
7,000	**14,000**	**21,000**	**12**
	0	0	
	0	0	

Appendix G: Conceptual Drawings

HAMPTON ROADS SANITATION DISTRICT

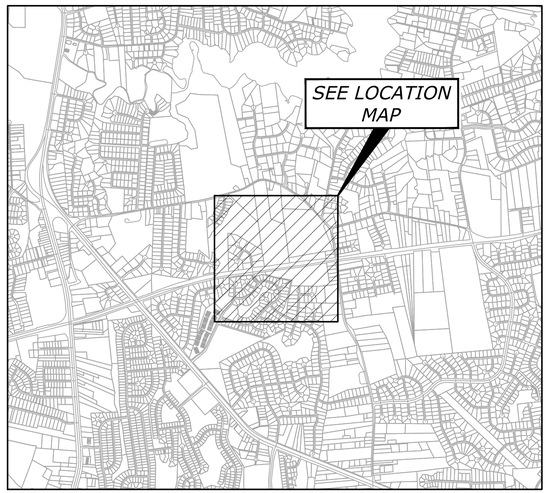
TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

VOLUME 2 OF 2

COUNTY OF YORK, VIRGINIA

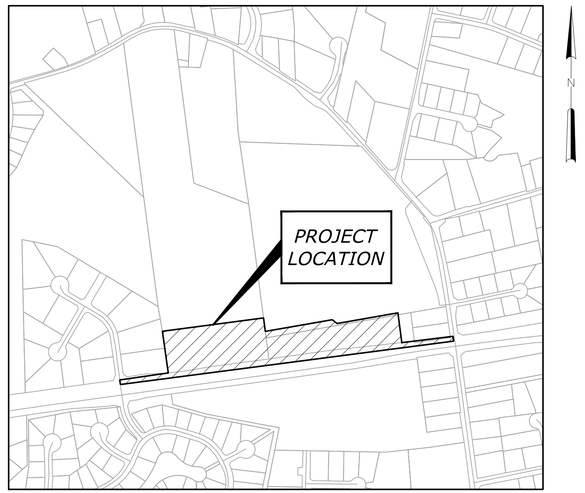
PER SUBMITTAL - SEPTEMBER 2020

CIP PROJECT No. XXXXX



VICINITY MAP

SCALE: 1" = 2000'



LOCATION MAP

SCALE: 1:500

SITE INFORMATION

OWNER:

HAMPTON ROADS SANITATION DISTRICT
1434 AIR RAIL AVENUE
VIRGINIA BEACH, VA 23455
PHONE: 757 460-226

SITE ADDRESS:

NEW PRESSURE REDUCING STATION AND OFFLINE
STORAGE FACILITY:
900 YORKTOWN ROAD
YORKTOWN, VIRGINIA

VERTICAL DATUM:

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
AND ESTABLISHED FROM RTK GPS

CONCEPTUAL DRAWINGS - DO NOT USE FOR CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757 497-0490

811 Know what's **below.** **Call** before you dig.

SHEET NUMBER	DRAWING NUMBER	DESCRIPTION
1		COVER
	GENERAL	
2	G1	INDEX OF DRAWINGS
3	G2	ABBREVIATION AND LEGENDS
4	G3	TOPOGRAPHIC SURVEY
5	G4	TOPOGRAPHIC SURVEY
6	G5	TOPOGRAPHIC SURVEY
7	G6	TOPOGRAPHIC SURVEY
8	G7	TOPOGRAPHIC SURVEY
9	G8	TOPOGRAPHIC SURVEY
10	G9	TOPOGRAPHIC SURVEY
11	G10	TOPOGRAPHIC SURVEY
	CIVIL	
12	C1	OVERALL SITE AND KEY PLAN PLAN
13	C2	AREA 1 SITE PLAN
14	C3	AREA 2 SITE PLAN
15	C4	AREA 3 SITE PLAN
	MECHANICAL	
16	M100	PRS ISOMETRIC OVERALL PLAN
17	M101	TOP PLAN
18	M102	BOTTOM PLAN
19	M103	SECTIONS
20	M104	SECTIONS
21	M200	OLSF ISOMETRIC OVERALL PLAN
22	M201	STORAGE TANK PLAN
23	M202	SECTIONS
	ARCHITECTURAL	
24	A1	LIFE SAFETY AND CODE ANALYSIS
25	A2	TOP PLAN
26	A3	BOTTOM PLAN
27	A4	ROOF PLAN
28	A5	BUILDING ELEVATION
29	A6	BUILDING SECTIONS
30	A7	SCHEDULES AND DETAILS
	ELECTRICAL	
31	E100	SINGLE LINE DIAGRAM
32	E101	CONTROL ROOM PLAN
33	E102	GENERATOR ROOM PLAN
	TOTAL SHEETS	
33		

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: T. McPHERSON
DESIGNED BY: R. SMITH
DRAWN BY: E. PAGSANJAN
CHECKED BY: B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

GENERAL

INDEX OF DRAWINGS

DATE: SEPTEMBER 2020
HAZEN NO.: 32452-001
CONTRACT NO.: VP015400
DRAWING NUMBER: G1
SHEET #### OF #

File: O:\32562-HRD\32562.000\CAD_BIM\GENERAL\G01 Saved by EPAGSANJAN Save date: 10/1/2020 3:09 PM
PLOT DATE: 10/1/2020 3:10 PM BY: EPAGSANJAN

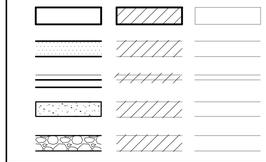
ABBREVIATIONS

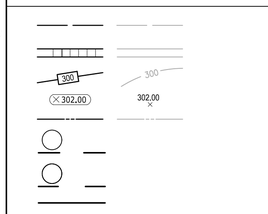
A/C	AIR CONDITIONER	DWG(S)	DRAWING(S)		GROUNDING	OHE	OVERHEAD ELECTRIC		(LOG)
AB	ANCHOR BOLT	DWL	DOWEL	HUM	HUMIDIFIER	OML	OIL MIST LUBRICATOR	STIR	STIRRUP
AC	ASBESTOS CEMENT			HVAC	HEATING, VENTILATION	OPER	OPERATOR	STL	STEEL
ACP	AIR COMPRESSOR	EA	EACH		AND AIR CONDITIONING	OPNG	OPENING	STRU	STRUCTURAL
AD	AREA DRAIN	ECC	ECCENTRIC	HW	HEADWALL	OPP	OPPOSITE	SUB	SUBSTITUTE
ADH	ADHESIVE	ECH	ELECTRIC CABINET	HWB	HEATING WATER BOILER	ORF	OIL REMOVAL FILTER	SUCT	SUCTION
ADJ	ADJUSTABLE		HEATER	HWCH	HEATING WATER	ORIG	ORIGINAL	SUR	SURFACE
AFF	ABOVE FINISHED FLOOR	ED	EQUIPMENT DRAIN		CABINET HEATER			SUSP	SUSPENDED
AGGR	AGGREGATE	EDH	ELECTRIC DUCT HEATER	HWL	HIGH WATER LEVEL	PAC	PACKAGED AIR	SWD	SIDE WATER DEPTH
AH	AIR HEATER	EDP	EMERGENCY	HWY	HIGHWAY		CONDITIONING UNIT	SYM	SYMMETRICAL
AHU	AIR HANDLING UNIT		DISTRIBUTION PANEL	HYD	HYDRAULIC	PAR	PARALLEL		
AL, ALUM	ALUMINUM	EE	EACH END			PC	POINT OF CURVE OR	T&B	TOP AND BOTTOM
ALLOW	ALLOWANCE/ALLOWABLE	EEW	EMERGENCY EYE WASH	I	IRON		PIECE	T&G	TONGUE AND GROOVE
ALT	ALTERNATE	EF	EACH FACE OR EXHAUST	ID	INSIDE DIAMETER	PCC	POINT OF COMPOUND	TAN	TANGENT
APPROX	APPROXIMATE		FAN	IF	INSIDE FACE		CURVE	TBA	TO BE ABANDONED
AR	AIR RECEIVER	EFF	EFFLUENT	IN	INCH	PCF	POUNDS PER CUBIC	TBM	TEMPORARY BENCH
ARCH	ARCHITECTURAL	EHH	ELECTRICAL HANDHOLE	INCL	INCLUDED		FOOT		MARK
ASPH	ASPHALT	EL	ELEVATION	INF	INFLUENT	PE	PLAIN END	TC	TOP OF CURB
ATF	AIR TERMINAL UNIT (FAN	ELEC	ELECTRICAL	INSUL	INSULATION	PERF	PERFORATED	TCP	TEMPERATURE CONTROL
	POWERED)	ELP	EMERGENCY LIGHTING	INT	INTERIOR	PERP	PERPENDICULAR		PANEL
ATS	AUTOMATIC TRANSFER		PANEL	INV	INVERT	PF	PROPELLER FAN	TCV	TEMPERATURE CONTROL
	SWITCH	EMH	ELECTRICAL MANHOLE	IPP	INSTRUMENT POWER	PI	POINT OF INTERSECTION		VALVE
ATU	AIR TERMINAL UNIT	ENGR	ENGINEER		PANEL	PL	PROPERTY LINE OR	TDH	TOTAL DYNAMIC HEAD
		ENT	ENTRANCE				PLATE	TECH	TECHNICAL
B	BORING	EOG	EDGE OF GRAVEL	JB	JUNCTION BOX	PLC	PROGRAMMABLE LOGIC	TEL	TELEPHONE
BD	BOARD	EOP	EDGE OF PAVEMENT	JCT	JUNCTION		CONTROLLER	TEMP	TEMPERATURE
BDD	BACKDRAFT DAMPER	EPP	EMERGENCY POWER	JT	JOINT	PNL	PANEL	TG	TEMPERED GLASS
BF	BLIND FLANGE		PANEL			PP	POWER PANEL OR	THD	THREADED
BFE	BOTTOM OF FITTING	EPX	EPOXY	L	LENGTH/ANGLE		POWER POLE	THK	THICK
	ELEV	EQ	EQUAL	LA	LINE AHEAD	PREFAB	PREFABRICATED	THRU	THROUGH
BFV	BUTTERFLY VALVE	EQPT	EQUIPMENT	LAM	LAMINATED	PRV	PRESSURE RELIEF	TOC	TOP OF CONCRETE
BH	BASEBOARD HEATER	ERH	ELECTRIC WIRE ROPE	LAT	LATERAL		VALVE	TOD	TOP OF DECK
BITUM	BITUMINOUS		HOIST	LAV	LAVATORY	PROP	PROPOSED	TOF	TOP OF FOOTING
B	BASELINE	ES	EMERGENCY SHOWER	LB	POUND OR LINE BACK	PRVN	POWER ROOF	TOM	TOP OF
BL	BUILDING LINE	ES/EEW	EMERGENCY SHOWER	LD	COMBINATION		VENTILATOR		MASONRY/MANHOLE
BLDG	BUILDING		AND EYEWASH		LOUVER/DAMPER	PSF	POUNDS PER SQUARE	TOS	TOP OF SLAB/ TOP OF
BLK	BLOCK	ET	EXPANSION TANK	LF	LINEAR FEET		FOOT		STEEL
BM	BENCH MARK	EUH	ELECTRIC UNIT HEATER	LG	LONG	PSI	POUNDS PER SQUARE	TOW	TOP OF WALL
BOC	BACK OF CURB	EW	EACH WAY	LI	LEVEL INDICATOR		INCH	TOL	TOLERANCE
BOM	BOTTOM OF MASONRY	EWC	ELECTRIC WATER	LIP	LIGHTING INDICATING	PSU	POWER SUPPLY UNIT	TYP	TYPICAL
BOT	BOTTOM		COOLER		PANEL	PV	PLUG VALVE		
BRC	BRIDGE CRANE	EWH	ELECTRIC WATER	LL	LIVE LOAD	PVC	POLYVINYLCHLORIDE	UG	UNDERGROUND
BRK	BRICK		HEATER	LLH	LONG LEG HORIZONTAL	PVMT	PAVEMENT	UGE	UNDERGROUND
BRL	BUILDING RESTRICTION	EXIST/EX	EXISTING	LLV	LONG LEG VERTICAL				ELECTRIC
	LINE	EXC	EXCAVATE	LP	LIGHTING PANEL	QTY	QUANTITY	UGG	UNDERGROUND GAS
BRZ	BRONZE	EXH	EXHAUST	LPT	LOW POINT			UH	UNIT HEATER
BT	BOLT	EXP	EXPANSION	LRG	LOW RESISTANCE	RAD	RADIUS	UNFIN	UNFINISHED
BV	BALL VALVE	EXT	EXTERIOR		GROUNDING	RECIR	RECIRCULATION	UNO	UNLESS NOTED
				LS	LEVEL SWITCH	RECT	RECTANGULAR		OTHERWISE
CB	CATCH BASIN	F	FAN	LTG	LIGHTING	RED	REDUCER	UPS	UNINTERRUPTIBLE
CBD	COUNTERBALANCE	FAB	FABRICATE	LVR	LOUVER	REF	REFERENCE		POWER SUPPLY
	BACKDRAFT DAMPER	F&C	FRAME AND COVER	LWL	LOW WATER LEVEL	REG	REGISTER	U/S	UPSTREAM
CC	COOLING COIL	F&G	FRAME AND GRATE			REINF	REINFORCING	UTIL	UTILITY
C/C	CENTER TO CENTER	FC	FLUSHING CONNECTION	MAINT	MAINTENANCE	REM	REMOVE		
CD	CONTROL DAMPER	FCO	FLOOR CLEANOUT	MANUF	MANUFACTURER	REQD	REQUIRED	VAP	VAPORIZER
CE	CONSTRUCTION	FCU	FAN COIL UNIT	MATL	MATERIAL	REST	RESTRAINED	VAV	VARIABLE AIR VOLUME
	EASEMENT	FD	FLOOR DRAIN	MAU	MAKE UP AIR HANDLING	REV	REVISE		UNIT
CEM	CEMENT	FDN	FOUNDATION		UNIT	RFD	REFRIGERANT AIR	VCD	VOLUME CONTROL
CER	CERAMIC	FE	FIRE	MAX	MAXIMUM		DRYER		DAMPER
CF	CUBIC FEET		EXTINGUISHER/FLOW	MCC	MOTOR CONTROL	RH	ROOF HOOD	VEL	VELOCITY
CIP	CAST IRON PIPE		ELEMENT		CENTER	RIO	REMOTE INPUT/OUTPUT	VENT	VENTILATING OR
CL	CENTERLINE	FEF	FUME EXHAUST FAN	MCLU	MOTOR CONTROL	RJ	RESTRAINED JOINT		VENTILATION
CLKG	CAULKING	FH	FIRE HYDRANT		LINE-UP	RM	ROOM	VERT	VERTICAL
CLR	CLEAR	FIG	FIGURE	MECH	MECHANICAL	RND	ROUND	VF	VANE AXIAL FAN
CMU	CONCRETE MASONRY	FIN	FINISH	MET	METAL	RO	ROUGH OPENING	VOL	VOLUME
	UNIT	FIX	FIXTURE	MFR	MANUFACTURER	RPM	REVOLUTIONS PER	VTR	VENT THROUGH ROOF
CO	CLEANOUT	FL	FLOOR	MFM	MAGNETIC FLOWMETER		MINUTE		
COL	COLUMN	FLG	FLANGE	MG	MILLION GALLONS	RPZ	REDUCED PRESSURE	W	WEST OR WIDTH
CONC	CONCRETE	FLXC	FLEXIBLE CONNECTION	MGD	MILLION GALLONS PER		ZONE ASSEMBLY	W/	WITH
CONST	CONSTRUCTION	FOC	FIBER OPTICS CABLE		DAY	RR	RAILROAD	WF	WALL FAN
CONT	CONTINUOUS	FPRF	FIREPROOF	MH	MANHOLE	RT	RIGHT	WG	WIRE GLASS
	CONTINUATION	FS	FLOW SWITCH	MIN	MINIMUM	RTU	REMOTE TERMINAL UNIT	WH	WALL HYDRANT OR WALL
CONTR	CONTRACTOR	FSD	FIRE/SMOKE DAMPER	MISC	MISCELLANEOUS	R/W OR ROW	RIGHT OF WAY		HEATER
CORP	CORPORATION	FT	FEET OR FIN TUBE	MJ	MECHANICAL JOINT			WL	WATER LEVEL
CP	CONCRETE PLANK OR		HEATER	MLDG	MOLDING	S	SOUTH OR SLOPE	WM	WATER METER
	CONTROL PANEL, OR	FTG	FOOTING	MO	MASONRY OPENING	SAV	SURGE ANTICIPATOR	W/O	WITHOUT
	CONTROL POINT	FURR	FURRING OR FURRED	MOD	MODIFY OR MODIFIED		VALVE	WP	WATERPROOF
CPLG	COUPLING			MON	MONUMENT	SB	SOIL BORING	WPFG	WATER PROOFING
CPT	CONTROL POWER	GA	GAUGE	MOV	MOTOR OPERATED	SBL	SURVEY BASELINE	WSE	WATER SURFACE
	TRANSFORMER	GAL	GALLON		VALVE	SCH	SCHEDULE		ELEVATION
CR	CONTROL RELAY	GALV	GALVANIZED	MTD	MOUNTED	SCR	SELECTIVE CATALYTIC	WSP	WEATHER STRIP
CRS	COURSE	GC	GENERAL CONTRACTOR	MTG	MOUNTING		REDUCTION	WT	WEIGHT
CTJ	CONTROL JOINT	GEN	GENERATOR	MULT	MULTIPLE	SDG	SLIDE GATE	WTR	WATER MAIN
CU	COPPER OR	GLV	GLOBE HEATER			SECT	SECTION	WV	WATER VALVE
	CONDENSING UNIT	GPM	GALLONS PER MINUTE	N	NORTH	SERV	SERVICE	WWF	WELDED WIRE FABRIC
CW	COLD WATER	GR	GRADE	NA	NOT APPLICABLE	SF	SQUARE FEET		
CY	CUBIC YARD	GRTG	GRATING	NAD '83	NORTH AMERICAN	SG	SWITCH GEAR	XFMR	TRANSFORMER
		GUH	GAS UNIT HEATER		DATUM OF 1983	SHT	SHEET	XMH	EXISTING MANHOLE
DEH	DEHUMIDIFIER	GV	GATE VALVE	NAVD '88	NORTH AMERICAN	SI	SQUARE INCH		
DEM	DEMISTER	GW	GUY WIRE		VERTICAL DATUM OF	SIL	SILENCER	YH	YARD HYDRANT
DET	DETAIL	GWH	GAS WATER HEATER		1988	SIM	SIMILAR	YI	YARD INLET
DF	DUCT FAN	GYP	GYPSUM	NC	NORMALLY CLOSED	SMH	STORM MANHOLE	YD	YARD
DIA OR Ø	DIAMETER			NF	NEAR FACE	SOV	SOLENOID OPERATED	YR	YEAR
DIAG	DIAGONAL	HC	HEATING COIL	NG	NATURAL GAS		VALVE		
DIM	DIMENSION	HDPE	HIGH DENSITY	NGVD '29	NATIONAL GEODETIC	SP	SUMP PUMP		
DIP	DUCTILE IRON PIPE		POLYETHYLENE		VERTICAL DATUM OF	SPEC	SPECIFICATION		
DISC	DISCONNECT	HDW	HARDWARE		1929	SQ	SQUARE		
DISCH	DISCHARGE	HE	HEAT EXCHANGER	NIC	NOT IN CONTRACT	SS	SANITARY SEWER		
DIST	DISTRIBUTION	HEX	HEXAGONAL	No.	NUMBER	SS FM	SANITARY SEWER FORCE		
DKC	DOOR OPERATOR	HHRG	HYBRID HIGH	NO	NORMALLY OPEN		MAIN		
(ELECTRIC)			RESISTANCE	NOM	NOMINAL	SSMH	SANITARY SEWER		
DL	DEAD LOAD		GROUNDING	NPT	NATIONAL PIPE THREAD		MANHOLE		
DN	DOWN	HORIZ	HORIZONTAL	NTS	NOT TO SCALE	SSP	SUBMERSIBLE SUMP		
DOZ	DOZEN	HP	HORSEPOWER OR HEAT				PUMP		
DP	DISTRIBUTION PANEL		PUMP	OC	ON CENTER	SST	STAINLESS STEEL		
DS	DISCONNECT SWITCH	HPT	HIGH POINT	OD	OUTSIDE DIAMETER OR	STA	STATION OR STACK		
D/S	DOWNSTREAM	HRU	HEAT RECOVERY UNIT		OVERHEAD DOOR	STD	STANDARD		
DT	DAY TANK	HRG	HIGH RESISTANCE	OF	OUTSIDE FACE	STG	STORAGE OR STOP GATE		

LEGEND

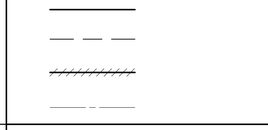
SYMBOLS

- BALL VALVE
- BALL CHECK VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- CONTROL VALVE
- DIAPHRAGM VALVE
- FLUSHING CONNECTION
- GATE VALVE
- GLOBE VALVE (GL)
- MOTOR OPERATED VALVE (M)
- PINCH VALVE
- PLUG VALVE
- PRESSURE REDUCING VALVE
- PRESSURE RELIEF VALVE
- PRESSURE RELIEF/VACUUM BREAKER VALVE (VB)
- QUICK CONNECT COUPLING
- SOLENOID VALVE (S)
- STRAINER
- UNION
- HOSE BIBB
- REDUCER
- WALL PENETRATION
- FLEXIBLE HOSE
- SINGLE LINE DRAWINGS
- DOUBLE LINE DRAWINGS
- MECHANICAL COUPLING
- WELDED JOINT
- FLANGED JOINT
- MECHANICAL, PUSH-ON OR RESTRAINED JOINT
- HARNESSED FLANGED ADAPTER
- SLEEVE TYPE COUPLING
- HARNESSED SLEEVE TYPE COUPLING
- DISMANTLING JOINT
- EXPANSION JOINT
- FE FIRE EXTINGUISHER
- ES/EEW



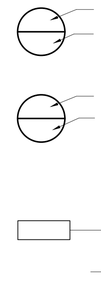






MATERIALS

- GRADE OR EARTH
- GRATING
- BRICK
- INSULATION
- CONCRETE FILL OR GROUT
- CAST IRON
- GLASS
- CONCRETE
- WATER SURFACE
- CONCRETE MASONRY UNIT
- STEEL
- WOOD BLOCKING
- ASPHALT PAVING
- CHECKERED PLATE
- GRAVEL
- LIMITS OF SOIL COMPOST AMENDMENT INSTALLATION 3" DEPTH



REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE — 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

GENERAL

ABBREVIATION AND LEGENDS

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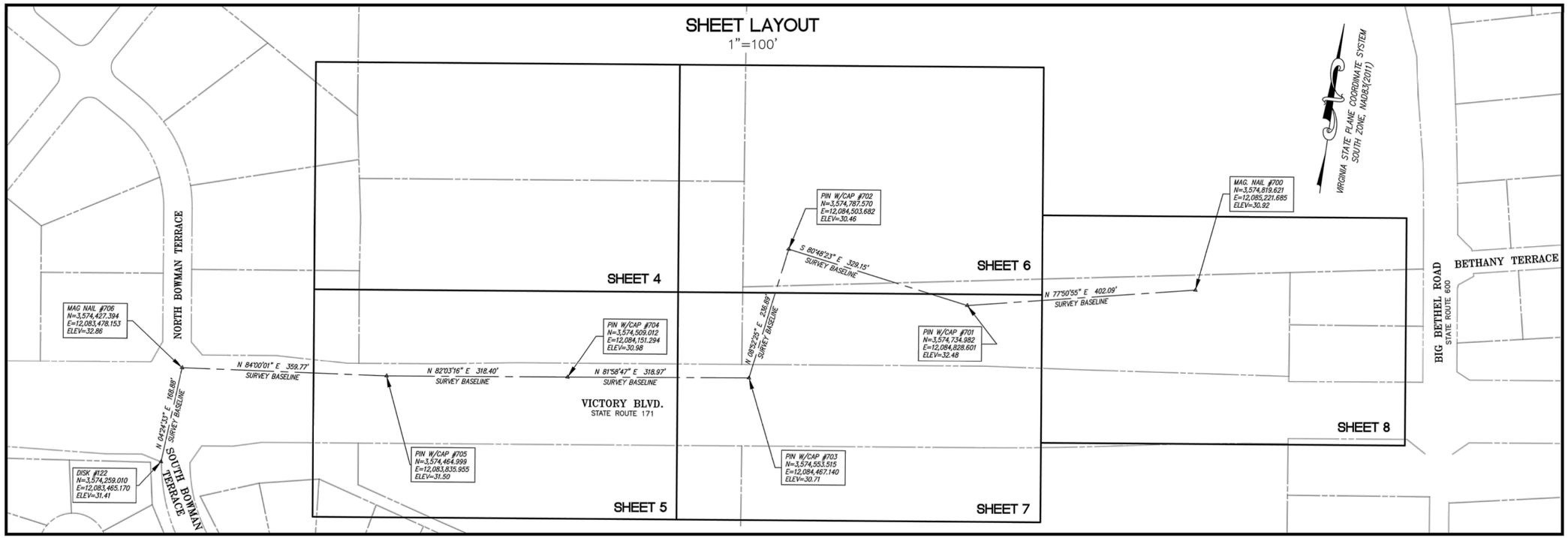


SURVEY & UTILITY NOTES

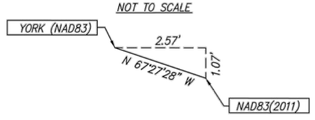
1. THE MERIDIAN SOURCE OF THIS TOPOGRAPHIC SURVEY IS BASED ON THE COUNTY OF YORK GEODETIC CONTROL NETWORK, VIRGINIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NORTH AMERICAN DATUM 1983(2011) (US SURVEY FEET).
2. ELEVATIONS REFER TO NAVD88 AND WERE ESTABLISHED FROM RTK GPS.
3. THIS SURVEY WAS PREPARED TO SHOW EXISTING FEATURES AS OF 08/15/2020 AND DOES NOT CERTIFY TO CHANGES TO SITE CONDITIONS WHICH OCCUR SUBSEQUENT TO THIS DATE AND OR TO PROPOSED IMPROVEMENTS.
4. THIS SURVEY DOES NOT CONSTITUTE A BOUNDARY SURVEY NOR A SUBDIVISION OF LAND.
5. PROPERTY AND R/W LINES WERE ESTABLISHED USING A COMPILATION OF DEEDS OF RECORD, PLATS OF RECORD AND EXISTING FIELD MEASUREMENTS.
6. THIS SURVEY DOES NOT INTEND TO DEPICT ANY WETLANDS, HAZARDOUS WASTE AND ENVIRONMENTAL FEATURES THAT MAY AFFECT SAID PROPERTY EXCEPT AS SHOWN.
7. PIPE MATERIAL TYPES ARE DETERMINED BY FIELD OBSERVATIONS TO THE BEST OF OUR ABILITY. PMI DOES NOT WARRANT THE MATERIAL TYPE OF PIPES LOCATED IN CONFINED OR INACCESSIBLE SPACES.
8. THE UNDERGROUND UTILITIES SHOWN, IF ANY, HAVE BEEN DESIGNATED BY ACCUMARK, INC. UTILIZING QL-B METHODS AND STANDARDS AND THE PAINT DESIGNATION LINES HAVE BEEN LOCATED IN THE FIELD. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED, ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES' THE SURVEYOR FURTHER NOTIFIES ALL PARTIES THAT VIRGINIA LAW REQUIRES VA811 TO BE CONTACTED PRIOR TO ANY EXCAVATION. SIZE AND MATERIAL INFORMATION IS BASED ON PLAN OR GIS DATA AND HAS NOT BEEN FIELD VERIFIED.
9. THIS TOPOGRAPHIC SURVEY WAS COMPLETED UNDER THE DIRECT AND RESPONSIBLE CHARGE OF IVAN LINEBERRY FROM AN ACTUAL ☐ GROUND OR ☐ AIRBORNE SURVEY MADE UNDER MY SUPERVISION; THAT THE IMAGERY AND/OR ORIGINAL DATA WAS OBTAINED BETWEEN 7-20-2020 & 8-12-2020; AND THAT THIS PLAT, MAP, OR DIGITAL GEOSPATIAL DATA INCLUDING METADATA MEETS MINIMUM ACCURACY STANDARDS UNLESS OTHERWISE NOTED.

COORDINATE SYSTEM CONVERSION DIAGRAM

VIRGINIA STATE PLANE COORDINATE SYSTEM NAD83(2011) TO COUNTY OF YORK HORIZONTAL CONTROL (NAD83)

1. INCREASE THE NORTHING U.S. SURVEY FEET VALUE BY 1.07'
2. REDUCE THE EASTING U.S. SURVEY FEET VALUE BY 2.57'

NOT TO SCALE



NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) TO NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)

1. INCREASE THE U.S. SURVEY FEET ELEVATION VALUE BY 1.08'

EXAMPLE: DISK 122 NAVD88 ELEVATION = 31.41 + 1.08 = DISK 122 NGVD29 ELEVATION = 32.49

LEGEND

	TEST BORING
DI	DRAINAGE INLET
CHH	CABLE HAND HOLE
EHH	ELECTRIC HAND HOLE
FM	FORCE MAIN WITNESS POST
L/P	LIGHT POLE W/MAST
CO	SANITARY CLEAN OUT
SCO	SANITARY MANHOLE
	SHRUB
	SIGN
SDMH	STORM MANHOLE
SFMV	SANITARY FORCEMAIN VALVE
TBM	TEMPORARY BENCHMARK
TCAB	TELEPHONE CABINET
THH	TELEPHONE HAND HOLE
TPED	TELEPHONE PEDESTAL
	CONTROL POINT
30128	TREE & IDENTIFIER
WV	WATER VALVE
	DITCH
	FENCE
	GUARDRAIL
OHE	OVERHEAD ELECTRIC
UGC	UNDERGROUND COMMUNICATION LINE
UGE	UNDERGROUND ELECTRIC
W	UNDERGROUND WATER
	UNDERGROUND FORCE MAIN
CONC.	CONCRETE
ETRANS	ELECTRIC TRANSFORMER
FES	FLARED END SECTION
HW	HEADWALL
TOB	TOP OF BANK
TOS	TOE OF SLOPE
CLF	CHAINLINK FENCE
WF	WIRE FENCE

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS
OF
TABB PUMPING REDUCING STATION
YORK COUNTY, VIRGINIA
SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.
SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
www.precisionmeasurements.com
VIRGINIA BEACH – NEWPORT NEWS – RICHMOND – CHANTILLY, VIRGINIA
BALTIMORE, MARYLAND

TREE SPECIES IDENTIFIER TABLE

30019 15"PINE
30020 15"PINE
30021 15"PINE
30040 8"HOLLY
30041 8"HOLLY
30042 8"HOLLY
30043 8"SPLIT HOLLY
30061 24"PINE
30203 8"CEDAR
30204 8"CEDAR
30205 8"CEDAR
30214 8"CEDAR
30215 8"CEDAR
30216 8"CEDAR
30217 8"CEDAR
30218 8"CEDAR
30219 8"CEDAR
30254 8"TRIPLE OAK
30270 10"ASH
30271 8"CEDAR
30273 8"CEDAR
30274 8"CEDAR
30275 8"CEDAR
30276 8"CEDAR
30277 8"CEDAR
30278 8"CEDAR
30281 10"GUM
30282 24"PINE
30283 12"GUM
30284 6"GUM
30285 6"GUM
30286 12"PINE
30287 15"PINE
30288 15"PINE
30289 15"PINE
30290 8"PINE
30291 10"GUM
30292 10"GUM
30293 8"GUM
30294 8"GUM
30295 24"PINE
30296 24"PINE
30297 8"OAK
30298 15"MAPLE
30299 30"PINE
30300 8"OAK
30301 15"GUM
30302 15"TWIN DEAD PINE
30303 12"GUM
30304 12"PINE
30305 12"PINE
30306 8"PINE
30307 8"OAK
30308 8"PINE
30309 8"PINE
30310 6"OAK
30311 6"GUM
30312 6"OAK
30313 18"PINE
30314 15"PINE
30315 6"TRIPLE GUM
30316 18"PINE
30317 10"OAK
30318 10"OAK
30319 10"GUM
30375 30"MAPLE
30376 30"OAK
30388 36"OAK
30389 18"CREPE MYRTLE CLUSTER
30390 8"OAK
30391 15"OAK
30392 6"MAPLE
30446 18"GUM
30447 12"GUM
30448 12"GUM
30449 8"GUM
30450 6"GUM
30451 8"MAPLE
30456 8"MAPLE
30457 6"TWIN BIRCH
30458 10"TWIN GUM
30459 24"PINE
30460 8"GUM
30479 24"PINE
30482 12"GUM
30483 24"PINE
30484 6"MAPLE
30485 6"MAPLE
30496 18"PINE
30497 18"PINE
30502 15"PINE
30503 15"PINE
30504 15"PINE
30505 15"PINE
30506 15"PINE
30507 18"PINE
30508 18"PINE
30509 8"GUM
30510 6"POPLAR
30511 6"GUM
30512 6"GUM
30513 6"GUM
30514 6"GUM
30515 6"GUM
30516 8"GUM
30517 10"GUM
30518 12"GUM
30519 15"GUM
30520 8"MAPLE
30521 18"GUM
30522 6"MAPLE
30523 6"MAPLE
30524 24"PINE
30525 12"DEAD GUM
30526 18"MAPLE
30527 8"GUM
30528 8"GUM
30529 8"BIRCH
30530 12"MAPLE
30531 30"PINE
30532 8"MAGNOLIA
30533 6"GUM
30534 12"POPLAR
30546 12"GUM
30547 12"MAPLE
30548 30"GUM
30549 18"GUM
30550 10"GUM
30560 18"PINE
30562 18"TWIN PINE
30563 6"GUM
30564 15"GUM
30565 10"DEAD HARDWOOD
30566 6"DEAD BEECH
30567 18"ASH

30568 6"BIRCH
30569 24"PINE
30570 18"GUM
30571 8"GUM
30572 18"GUM
30573 15"ASH
30574 12"BIRCH
30575 8"GUM
30576 30"PINE
30577 30"PINE
30578 12"GUM
30579 8"BIRCH
30580 8"MAPLE
30581 24"PINE
30582 15"GUM
30583 15"PINE
30584 18"PINE
30588 30"PINE
30589 6"TWIN GUM
30590 6"GUM
30591 6"GUM
30592 6"CEDAR
30594 24"PINE
30610 24"GUM
30611 8"MAPLE
30612 30"PINE
30613 15"TWIN GUM
30614 18"GUM
30615 18"GUM
30616 10"GUM
30617 10"PINE
30618 12"GUM
30619 18"GUM
30620 18"PINE
30629 18"GUM
30638 30"PINE
30639 15"GUM
30640 15"GUM
30641 8"GUM
30643 18"GUM
30644 24"GUM
30645 12"GUM
30646 15"GUM
30647 15"GUM
30648 6"PINE
30649 6"OAK
30650 15"GUM
30651 24"PINE
30652 15"GUM
30653 8"PINE
30654 6"GUM
30655 10"GUM
30660 18"GUM
30662 12"PINE
30663 6"CEDAR
30664 8"BIRCH
30665 18"GUM
30666 15"GUM
30732 12"GUM
30744 12"GUM
30755 6"MAPLE
30756 6"MAPLE
30757 6"PINE
30758 12"MAPLE
30759 8"MAPLE
30760 8"TWIN OAK
30761 12"GUM
30762 24"PINE
30763 6"PINE
30764 6"PINE
30765 6"PINE
30766 8"OAK
30771 24"GUM
30772 30"PINE
30773 10"GUM
30774 10"GUM
30775 15"GUM
30776 18"GUM
30785 18"GUM
30786 18"GUM
31169 18"DEAD HARDWOOD
31170 30"PINE
31406 8"GUM
31407 15"GUM
31408 8"MAG
31409 8"MAG
31410 8"PINE
31411 6"GUM
31412 6"GUM
31413 18"PINE
31414 18"GUM
31415 8"PINE
31416 15"PINE
31417 15"GUM
31418 12"OAK
31419 18"PINE
31421 8"TRIPLE BIRCH
31422 6"GUM
31423 24"PINE
31656 15"PINE
31657 15"PINE
31658 15"PINE
31659 24"PINE
31660 18"PINE
31672 8"GUM
31673 8"GUM
31674 8"GUM
31675 8"MAP
31676 10"GUM
31677 6"TRIPLE MAPLE
31678 6"TWIN GUM
31679 15"GUM
31680 12"GUM
31681 12"GUM
31682 18"GUM
31683 15"GUM
31684 18"GUM
31685 12"MAPLE
31686 12"MAPLE
31687 8"HOLLY
31688 15"MAP
31689 8"MAGNOLIA
31690 15"GUM
31691 18"GUM
31692 15"OAK
31693 6"OAK
31694 8"MAPLE
31695 15"MAPLE
31696 15"LM
31697 24"GUM
31698 10"ELM
31699 18"GUM
31700 18"GUM
31701 15"TWIN MAPLE
31702 8"PINE
31703 15"MAPLE

31704 15"MAPLE
31705 18"BEECH
31706 24"PINE
31707 30"PINE
31708 15"MAPLE
31709 8"BEECH
31710 12"TWIN MAPLE
31711 8"GUM
31712 36"OAK
31713 24"OKA
31714 18"GUM
31715 6"GUM
31716 8"BEECH
31717 8"BEECH
31718 8"BEECH
31719 6"MAP
31720 15"PINE
31721 15"GUM
31722 8"MAP
31723 18"GUM
31724 8"MAGNOLIA
31725 6"GUM
31726 12"GUM
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31728 15"MAPLE
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31731 15"GUM
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31819 12"DEAD HARDWOOD
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71278 15"OAK
71279 24"BEECH
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71282 30"PINE
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71287 15"BEECH
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71289 10"BEECH
71290 30"TWIN BEECH
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71292 18"OAK
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71296 12"PINE
71297 6"BIRCH
71298 15"GUM
71299 10"PINE
71300 18"PINE
71301 10"PINE
71302 18"GUM
71303 6"MAPLE
71304 6"BEECH
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71306 18"OAK
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71348 8"GUM
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71354 6"MAPLE
71355 6"GUM
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71442 24"PINE
71443 15"PINE
71444 8"DEAD PINE
71445 6"GUM
71446 6"BIRCH
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71458 24"BIRCH
71459 15"GUM
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71471 12"PINE
71472 8"BEECH
71473 15"PINE
71474 6"MAPLE
71475 6"MAPLE
71476 8"BEECH
71477 12"GUM
71478 10"MAPLE
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71480 15"PINE
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71484 18"PINE
71485 10"PINE
71486 12"PINE
71487 12"BIRCH
71488 10"MAPLE
71489 10"PINE
71490 8"GUM
71491 12"MAPLE
71492 15"BIRCH
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71494 6"BEECH
71495 18"PINE
71496 18"PINE
71497 12"PINE
71498 6"HOLY
71499 15"STUMP
71500 24"PINE
71501 8"MAPLE
71502 15"OAK
71503 18"OAK
71504 6"BEECH
71505 18"PINE
71506 36"BEECH
71507 12"PINE
71508 10"OAK
71509 15"OAK
71510 10"OAK
71511 18"PINE
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71513 12"GUM
71514 6"MAPLE
71515 6"BEECH
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71518 10"MAPLE
71519 6"BEECH
71520 6"MAPLE
71521 24"PINE
71522 15"PINE
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71545 15"OAK
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71550 8"TWIN HOLLY
71551 12"GUM
71552 8"GUM
71553 24"TWIN BIRCH
71554 15"PINE
71555 18"PINE
71556 6"HOLY
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71571 15"GUM

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71606 24"TWIN MAPLE
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71669 8"DEAD PINE
71670 6"MAPLE
71673 18"PINE
71674 15"BIRCH
71675 6"BEECH
71676 15"PINE
71677 15"PINE
71678 15"PINE
71680 6"STUMP

0 20 40 60
GRAPHIC SCALE
1"=20'

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No

CONTROL RECOVERY SKETCHES

CONTROL ID: 700
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

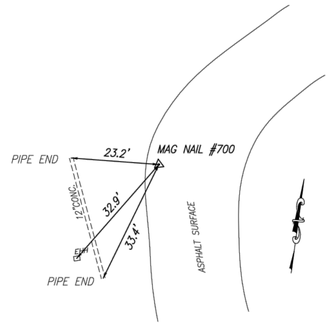
HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,819.621
X(EAST): 12,085,221.685

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 30.92

DETAILED DESCRIPTION:

CONTROL POINT IS A MAG NAIL SET IN ASPHALT.



NOT TO SCALE

CONTROL ID: 701
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

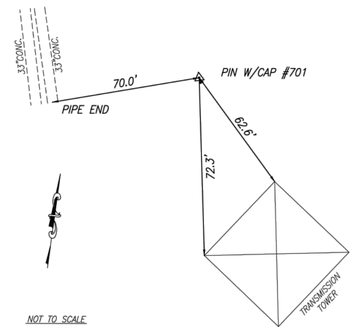
HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,734.982
X(EAST): 12,084,828.601

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 32.48

DETAILED DESCRIPTION:

CONTROL POINT IS A IRON PIN WITH PLASTIC CAP SET LEVEL WITH THE GROUND SURFACE.



NOT TO SCALE

CONTROL ID: 702
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

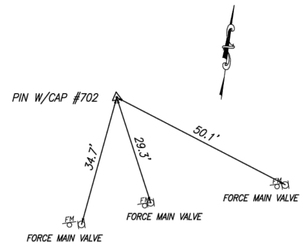
HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,787.570
X(EAST): 12,084,503.682

VERTICAL DATUM BASED ON NAVD88
ELEVATION = 30.46

DETAILED DESCRIPTION:

CONTROL POINT IS A IRON PIN WITH PLASTIC CAP SET LEVEL WITH THE GROUND SURFACE.



NOT TO SCALE

CONTROL ID: 703
ROUTE: VICTORY BOULEVARD
CITY: YORK COUNTY
ESTABLISHED BY: PRECISION MEASUREMENTS, INC.

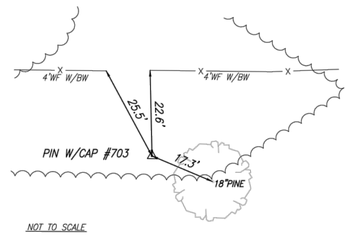
HORIZONTAL DATUM BASED ON VIRGINIA STATE PLANE
COORDINATE SYSTEM, SOUTH ZONE (NAD83(2011)

U.S. SURVEY FEET VALUES
Y(NORTH): 3,574,553.515
X(EAST): 12,084,467.140

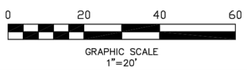
VERTICAL DATUM BASED ON NAVD88
ELEVATION = 30.71

DETAILED DESCRIPTION:

CONTROL POINT IS A IRON PIN WITH PLASTIC CAP SET LEVEL WITH THE GROUND SURFACE.



NOT TO SCALE





EXISTING CONDITIONS
OF
TABB PUMPING REDUCING STATION
YORK COUNTY, VIRGINIA
SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.
SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
www.precisionmeasurements.com
VIRGINIA BEACH – NEWPORT NEWS – RICHMOND – CHANTILLY, VIRGINIA
BALTIMORE, MARYLAND

PROPERTY LINE SHOWN PER SUBDIVISION PLAT PROVIDED BY HAMPTON ROADS SANITATION DISTRICT. THIS PLAT HAS NOT BEEN RECORDED AS OF 08-12-2020.

NOW OR FORMERLY
HARRY RICHARD ASHE
D.B. 1103, PG. 312
(P.B. 10, PG. 530)
GPIN# T04D-3932-0449

SMALL PINES & SAPLINGS

PIPE(F)

DITCH

TOS

TOB

MATCHLINE SEE SHEET 5

MATCHLINE SEE SHEET 6

VIRGINIA STATE PLANE COORDINATE SYSTEM
SOUTH ZONE, NAD83(2011)

0 20 40 60
GRAPHIC SCALE
1"=20'

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

PRECISION MEASUREMENTS, INC.

SURVEYORS – GPS – UAS – HYDROGRAPHIC – 3-D LASER SCANNING
629 PHOENIX DRIVE, SUITE 100
VIRGINIA BEACH, VA. 23452
TEL.: (757) 368-0945
FAX: (757 368-9375
www.precisionmeasurements.com
VIRGINIA BEACH – NEWPORT NEWS – RICHMOND – CHANTILLY, VIRGINIA
BALTIMORE, MARYLAND

MATCHLINE SEE SHEET 4

MATCHLINE SEE SHEET 7

EXISTING 40' DRAINAGE & UTILITY EASEMENT (P.B. 10, Pg. 331)

DITCH TOS

SMALL PINES & SAPLINGS

PIPE(F)

4'WF W/BW

MON(F)

B-1

PIN W/CAP #704
N=3,574,509.012
E=12,084,151.294
ELEV=30.98

EXISTING R/W

4'WF W/BW

30'DI HRSD EM

N 82°03'16" E 318.40'
SURVEY BASELINE

PIN W/CAP #705
N=3,574,464.999
E=12,083,835.955
ELEV=31.50

N 81°58'47" E 318.97'
SURVEY BASELINE

TOB

TOS

DITCH

SIGN

ASPHALT SURFACE

VICTORY BOULEVARD
(VARIABLE WIDTH R/W)
STATE ROUTE 171

VIRGINIA STATE PLANE COORDINATE SYSTEM
SOUTH ZONE, NAD83(2011)

0 20 40 60
GRAPHIC SCALE
1"=20'

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

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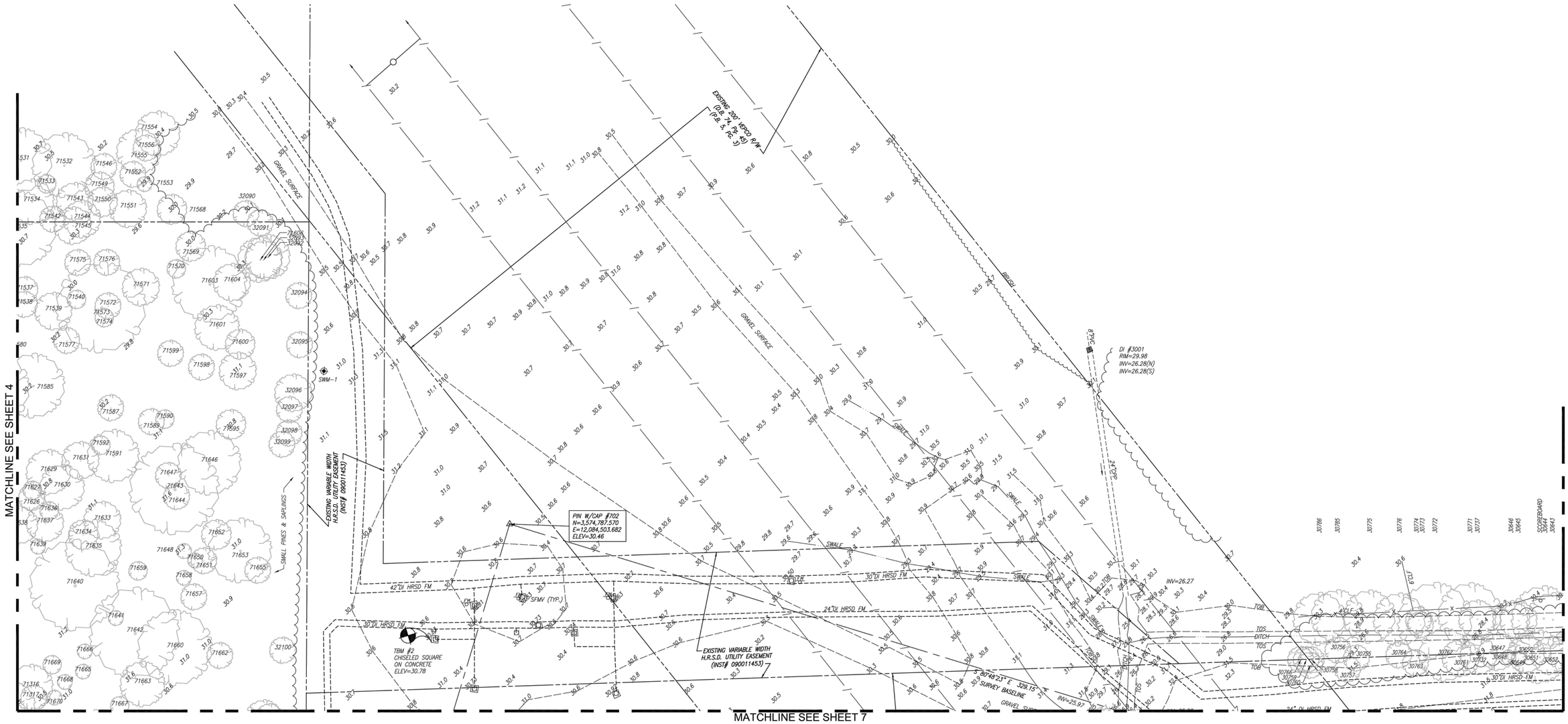

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
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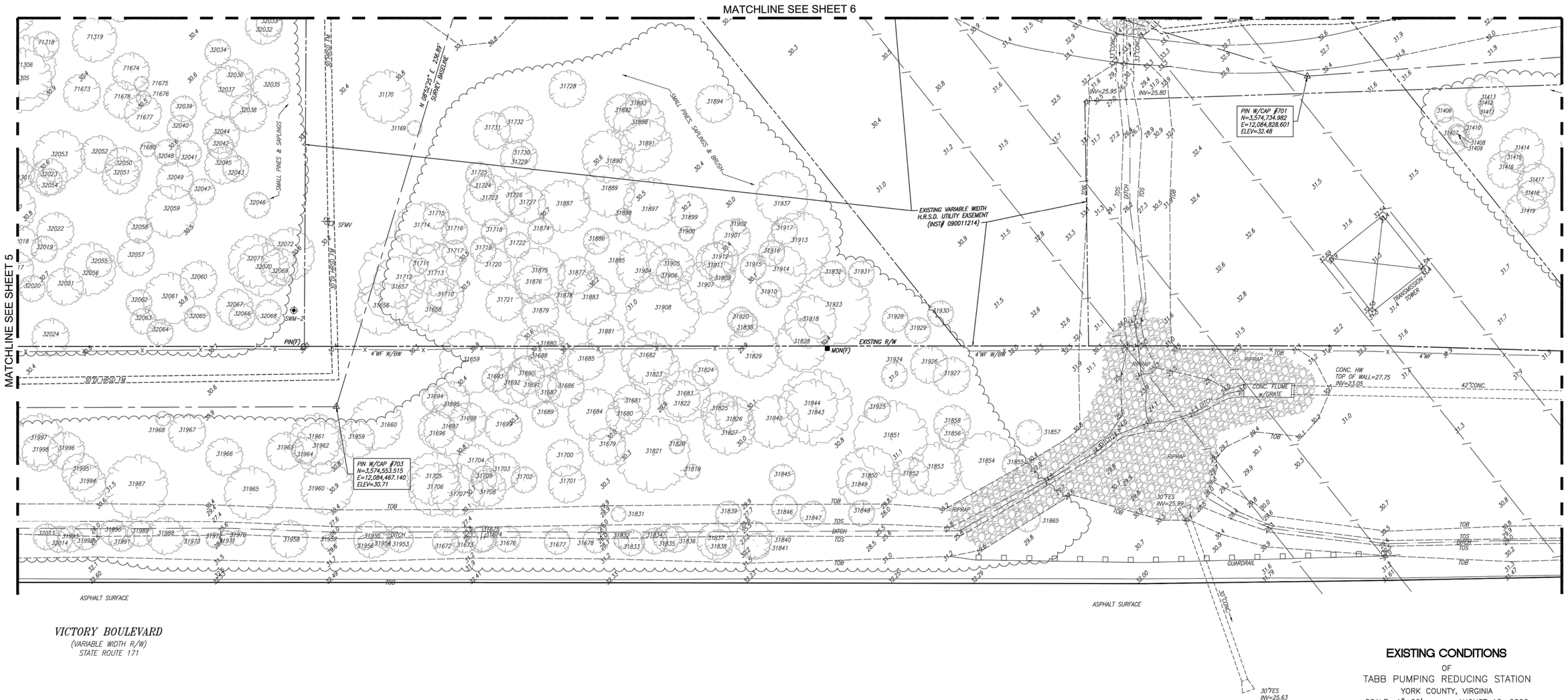

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN R. LINEBERRY
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8/12/2020
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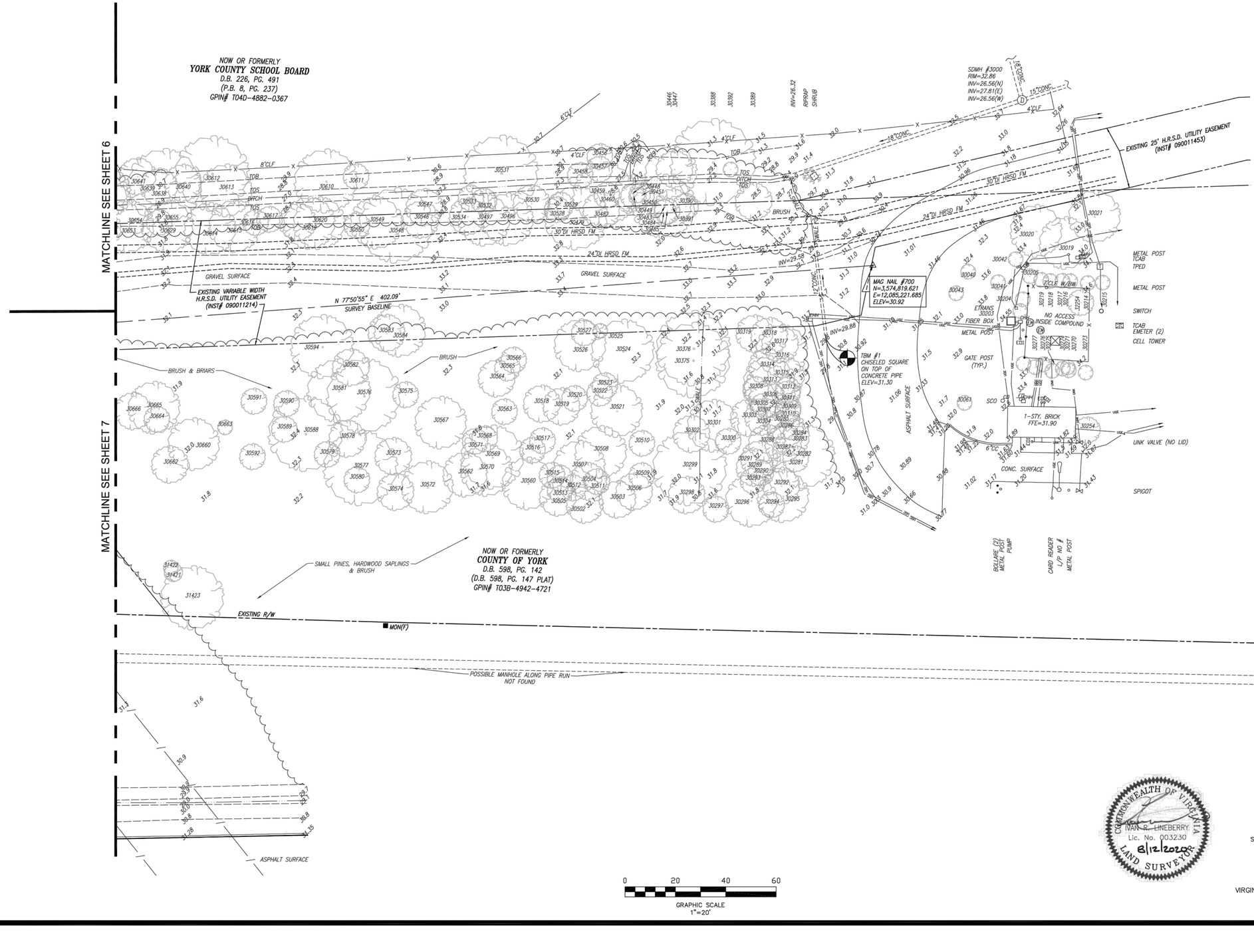

EXISTING CONDITIONS

OF

TABB PUMPING REDUCING STATION

YORK COUNTY, VIRGINIA

SCALE: 1"=20' AUGUST 12, 2020

COMMONWEALTH OF VIRGINIA
IVAN E. LINEBERRY
Lic. No. 003230
8/12/2020
LAND SURVEYOR

PRECISION MEASUREMENTS, INC.

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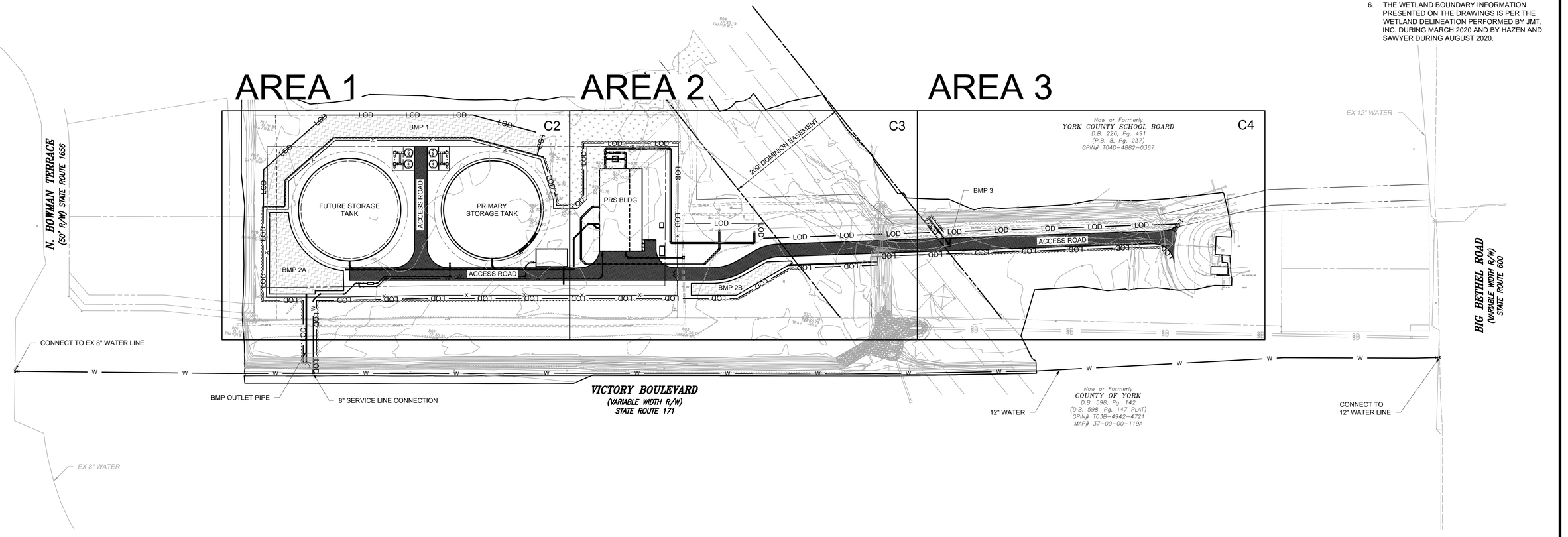
BALTIMORE, MARYLAND

NOTES:

1. THIS SURVEY WAS PREPARED TO SHOW EXISTING FEATURES AS OF 08/15/2020 BY PRECISIONS MEASUREMENTS INC.
2. THE MERIDIAN SOURCE OF THIS TOPOGRAPHIC SURVEY IS BASED ON THE COUNTY OF YORK GEODETIC CONTROL NETWORK, VIRGINIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NORTH AMERICAN DATUM 1983 (2011) (US SURVEY FEET).
3. ELEVATIONS REFER TO NAVD88 AND WERE ESTABLISHED FROM RTK GPS.
4. THE PROJECT RESIDES ENTIRELY WITH IN ZONE X (UNSHADED), AN AREA OF MINIMAL FLOOD HAZARD AS SHOWN ON THE FEMA NFIP FIRM FOR YORK COUNTY COMMUNITY - PANEL NUMBERS 51199C0152D AND 51199C0156D, DATED JANUARY 16, 2015.
5. FOR SOIL BORING INFORMATION, REFER TO THE "PRELIMINARY REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING SERVICES, HRSD TABB PRESSURE REDUCING STATION AND OFFLINE STORAGE FACILITY" BY GET SOLUTIONS, INC. DATED AUGUST 14, 2020.
6. THE WETLAND BOUNDARY INFORMATION PRESENTED ON THE DRAWINGS IS PER THE WETLAND DELINEATION PERFORMED BY JMT, INC. DURING MARCH 2020 AND BY HAZEN AND SAWYER DURING AUGUST 2020.



SCALE: 1" = 80'

80 40 0 80'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

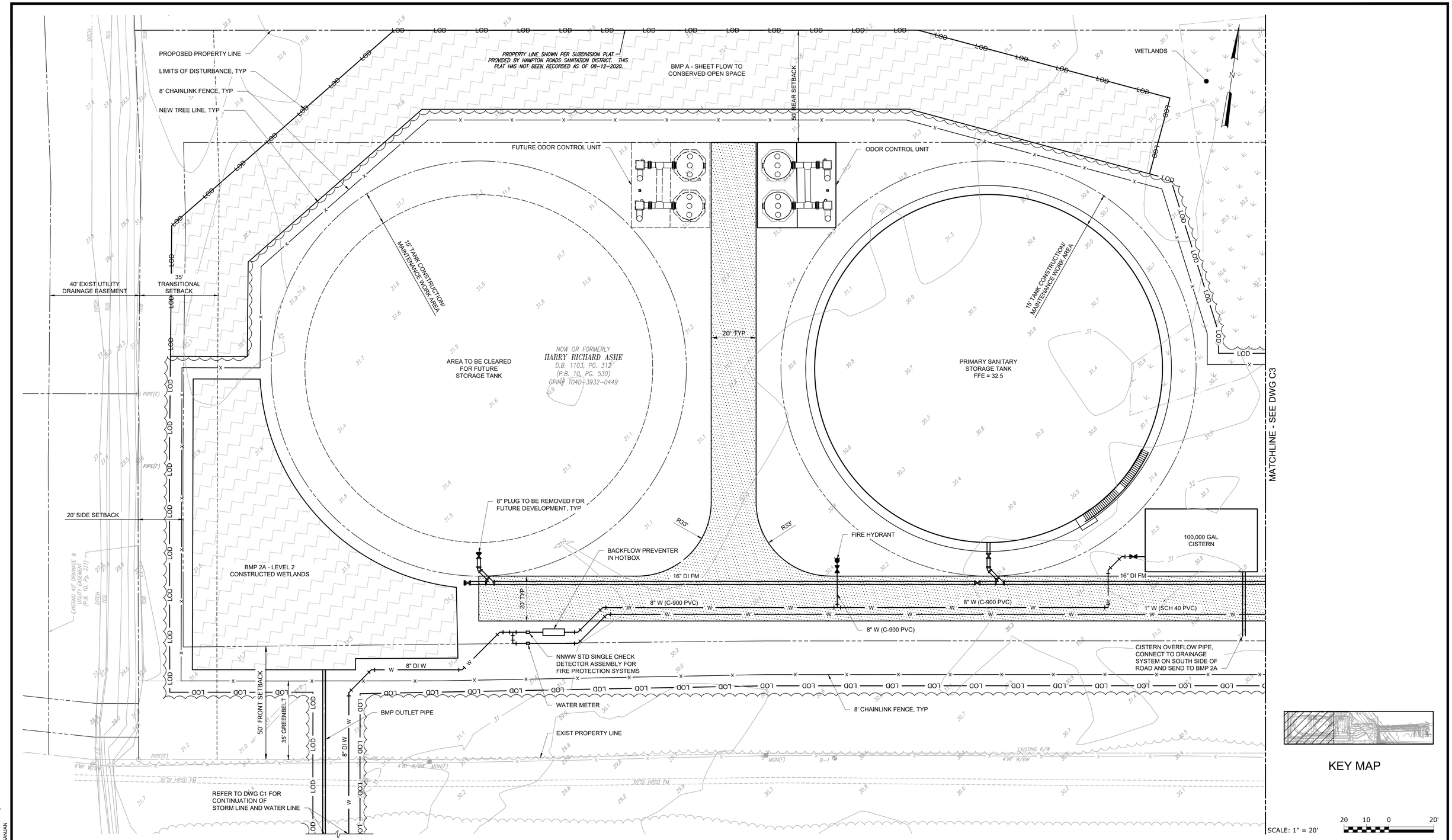
TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

CIVIL

OVERALL SITE AND KEY PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32452-001
CONTRACT NO.:	VP015400
DRAWING NUMBER:	C1
SHEET	- OF #

File: O:\32562+HRD\32562-000\CAD_BIM\CIVIL\C01 Saved by EPAGSANJAN Save date: 10/2/2020 10:19 AM
PLOT DATE: 10/2/2020 10:22 AM BY: EPAGSANJAN



REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS DO NOT USE FOR CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

CIVIL

AREA 1 SITE PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32452-001
CONTRACT NO.:	VP015400
DRAWING NUMBER:	C2
SHEET	- OF #

File: O:\32562-HRD\32562-000\CAD_BIM\CIVIL\C02 Saved by EPAGSANJAN Save date: 9/24/2020 4:23 PM
PLOT DATE: 10/2/2020 10:28 AM BY: EPAGSANJAN

MATCHLINE - SEE DWG C2

MATCHLINE - SEE DWG C4

PROPOSED PROPERTY LINE

LIMITS OF DISTURBANCE, TYP

8' CHAINLINK FENCE, TYP

50' REAR SETBACK

WETLANDS

NEW TREE LINE, TYP

LOD

24" DI FM

VALVE BOX

20' SIDE SETBACK

STAIRS (EXTERIOR PEDESTRIAN ACCESS)

10' LANDSCAPE OPEN SPACE TRIP

PRS BUILDING FFE = 32.5

CONTROL ROOM

DOMINION TX

4' SIDEWALK

18'

GENERATOR 18'

FUEL TANK

16" DI FM

R60'

1" W (SCH 40 PVC)

46.5'

W

24' GATE

50' FRONT SETBACK

35' GREENBELT

8' CHAINLINK FENCE, TYP

BMP 2B - LEVEL 2 CONSTRUCTED WETLANDS

NEW TREE LINE, TYP

BMP OUTLET PIPE

LIMITS OF DISTURBANCE, TYP

EXTEND CULVERT

EXISTING VARIABLE WIDTH H.R.S.D. UTILITY EASEMENT (INST# 090011453)

EXISTING 200' VERSO R/W (D.B. 74, PG. 43)

GRAVEL SURFACE

SWALE

DI #3001
RIM=29.98
INV=26.28(N)
INV=26.28(S)

42"DI HRSD FM

30"DI HRSD FM

24"DI HRSD FM

SFMV (TYP.)

TBM #2
CHISEL SQUARE ON CONCRETE
ELEV=30.78

SWM-1

SWM-2

PIN(F)

MON(F)

EXISTING R/W

4'WF W/BW

INV=26.27

INV=25.82

INV=25.40

INV=25.40

TOB

TOS

DITCH

27

KEY MAP

SCALE: 1" = 20'

20 10 0 20'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

CIVIL

AREA 2 SITE PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32452-001
CONTRACT NO.:	VP015400
DRAWING NUMBER:	C3
SHEET	- OF #

File: O:\32562-HRD\32562-000\CAD_BIM\CIVIL\C003 Saved by EPAGSANJAN Save date: 9/25/2020 5:14 PM
PLOT DATE: 10/2/2020 10:33 AM BY: EPAGSANJAN

MATCHLINE - SEE DWG C3

NOW OR FORMERLY
YORK COUNTY SCHOOL BOARD
D.B. 226, PG. 491
(P.B. 8, PG. 237)
GPIN# T04D-4882-0367

NOW OR FORMERLY
COUNTY OF YORK
D.B. 598, PG. 142
(D.B. 598, PG. 147 PLAT)
GPIN# T03B-4942-4721

BMP OUTLET PIPE

ASPHALT PAVEMENT

BMP 3 - HYDRODYNAMIC SEPARATOR DEVICE

NEW TREE LINE, TYP

LIMITS OF DISTURBANCE, TYP

EXISTING 25' H.R.S.D. UTILITY EASEME (INST# 090011453)

SDMH #3000
RIM=32.86
INV=26.56(N)
INV=27.81(E)
INV=26.56(W)

INV=26.32
RIPRAP
SHRUB

METAL POST
TCAB
TPED

METAL POST

SWITCH

TCAB
EMETER (2)
CELL TOWER

NO ACCESS
INSIDE COMPOUND

GATE POST (TYP.)

1-STY. BRICK
FFE=31.90

UNK VALVE (NO LID)

SPIGOT

BOLLARE (2)
METAL POST
PUMP

CARD READER
L/P NO #
METAL POST

CONC. HW
TOP OF WALL=27.75
INV=23.05

POSSIBLE MANHOLE ALONG PIPE RUN NOT FOUND

KEY MAP

SCALE: 1" = 20'

20 10 0 20'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

CIVIL

AREA 3 SITE PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32452-001
CONTRACT NO.:	VP015400
DRAWING NUMBER:	C4
SHEET	- OF #

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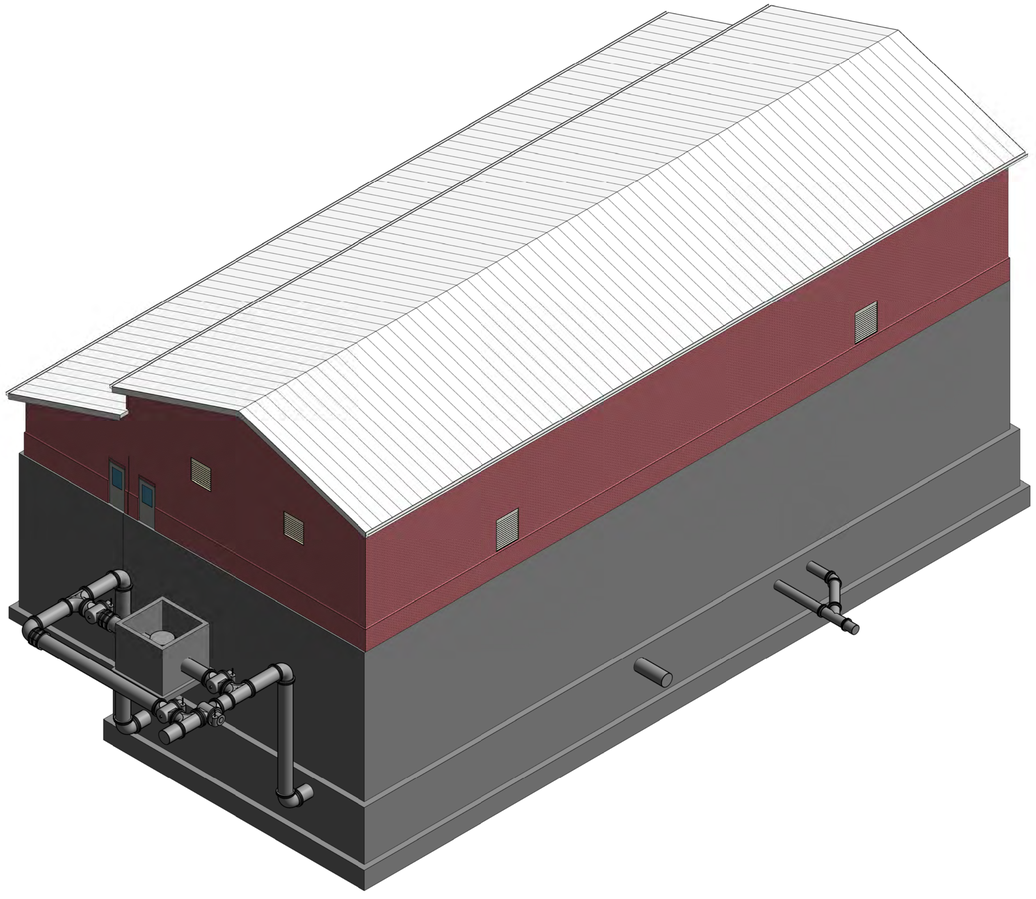

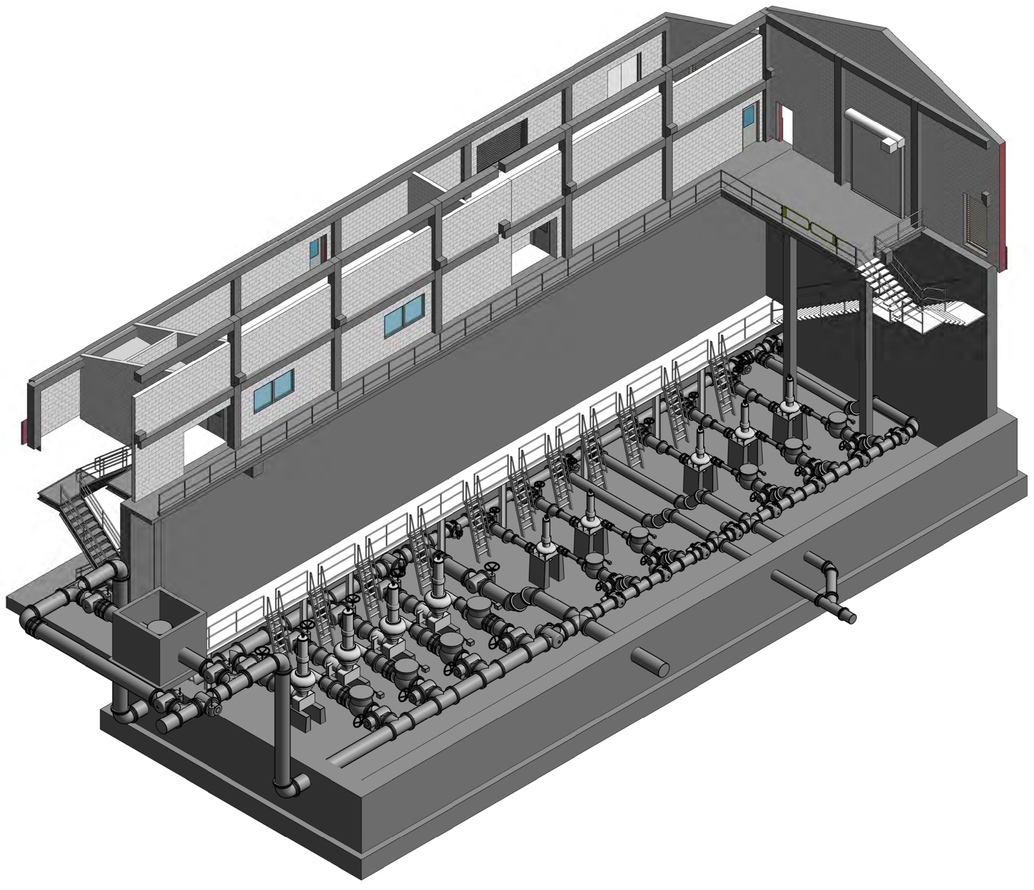

3/32" = 1' 0" 10 8 6 4 2 0 11'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	T. McPHERSON

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

MECHANICAL

PRS ISOMETRIC OVERALL PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M100
SHEET:	OF #

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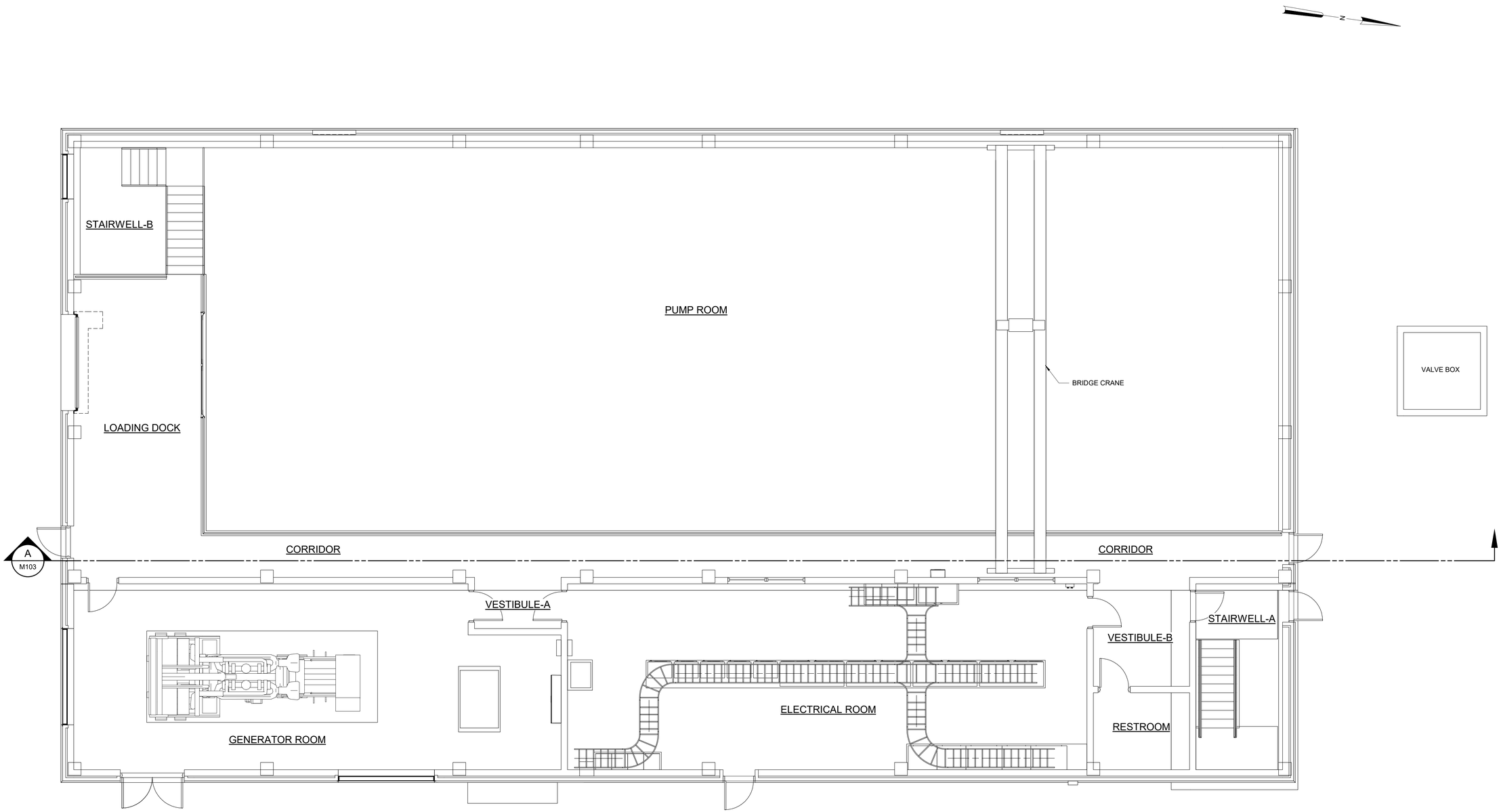

TOP PLAN
3/16" = 1'-0"

3/16" = 1'-0" 6 4 2 0 5'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	T. McPHERSON

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

MECHANICAL

TOP PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M101
SHEET:	OF #

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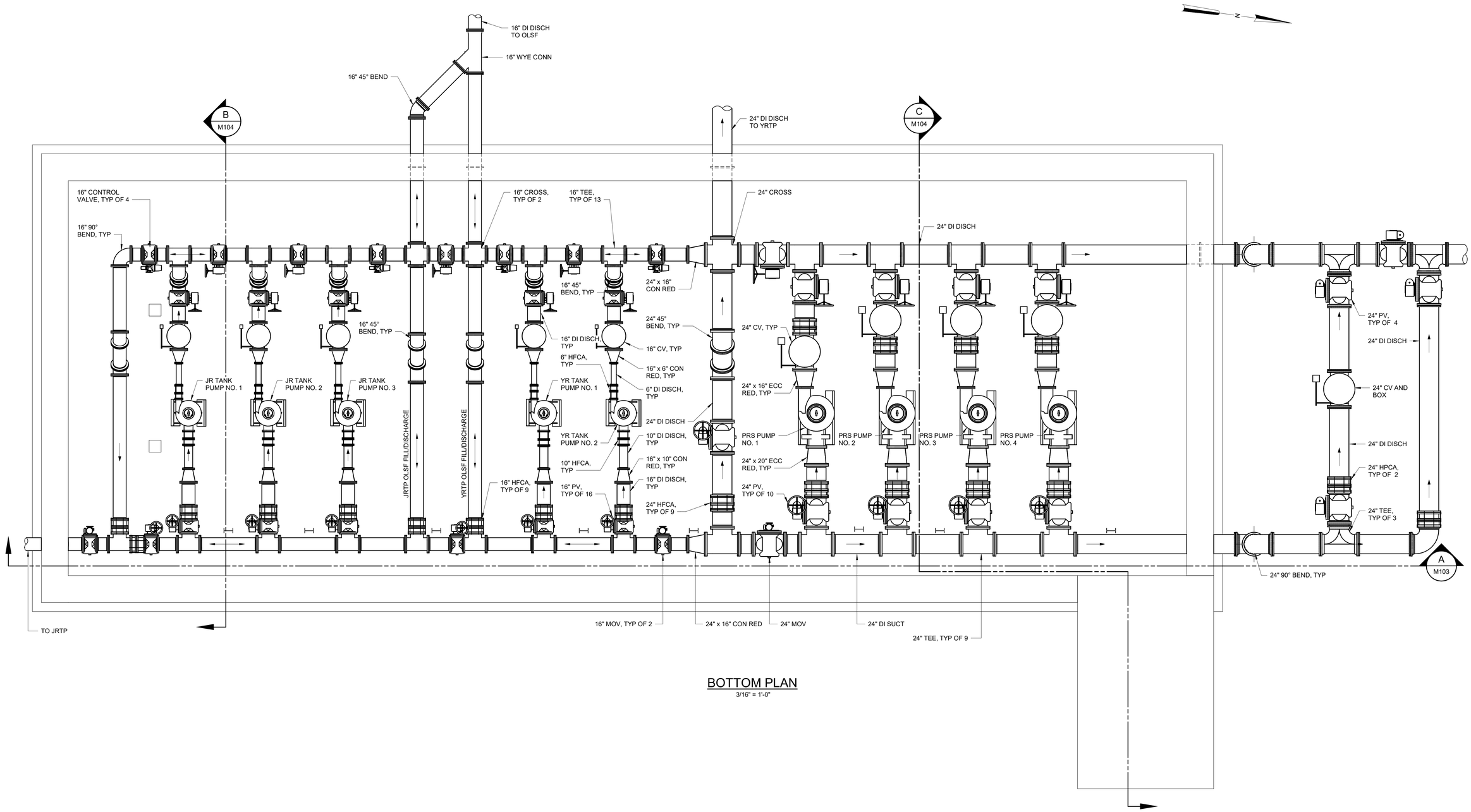

BOTTOM PLAN

3/16" = 1'-0"

3/16" = 1'-0" 6 4 2 0 5'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	T. McPHERSON

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

MECHANICAL

BOTTOM PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M102
SHEET:	OF #

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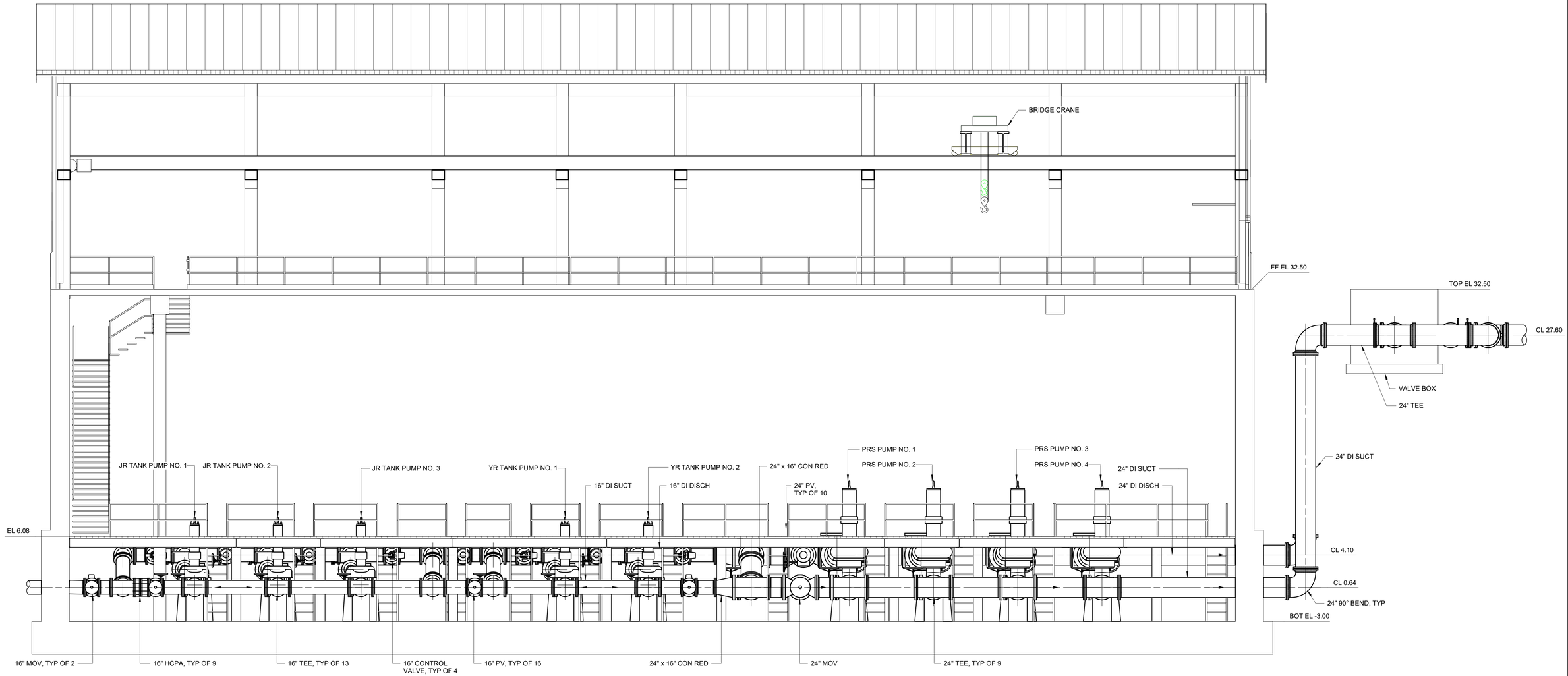

SECTION A
3/16" = 1'-0"
M101

3/16" = 1'-0" 6 4 2 0 5'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	T. McPHERSON

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

MECHANICAL

SECTIONS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M103
SHEET:	OF #

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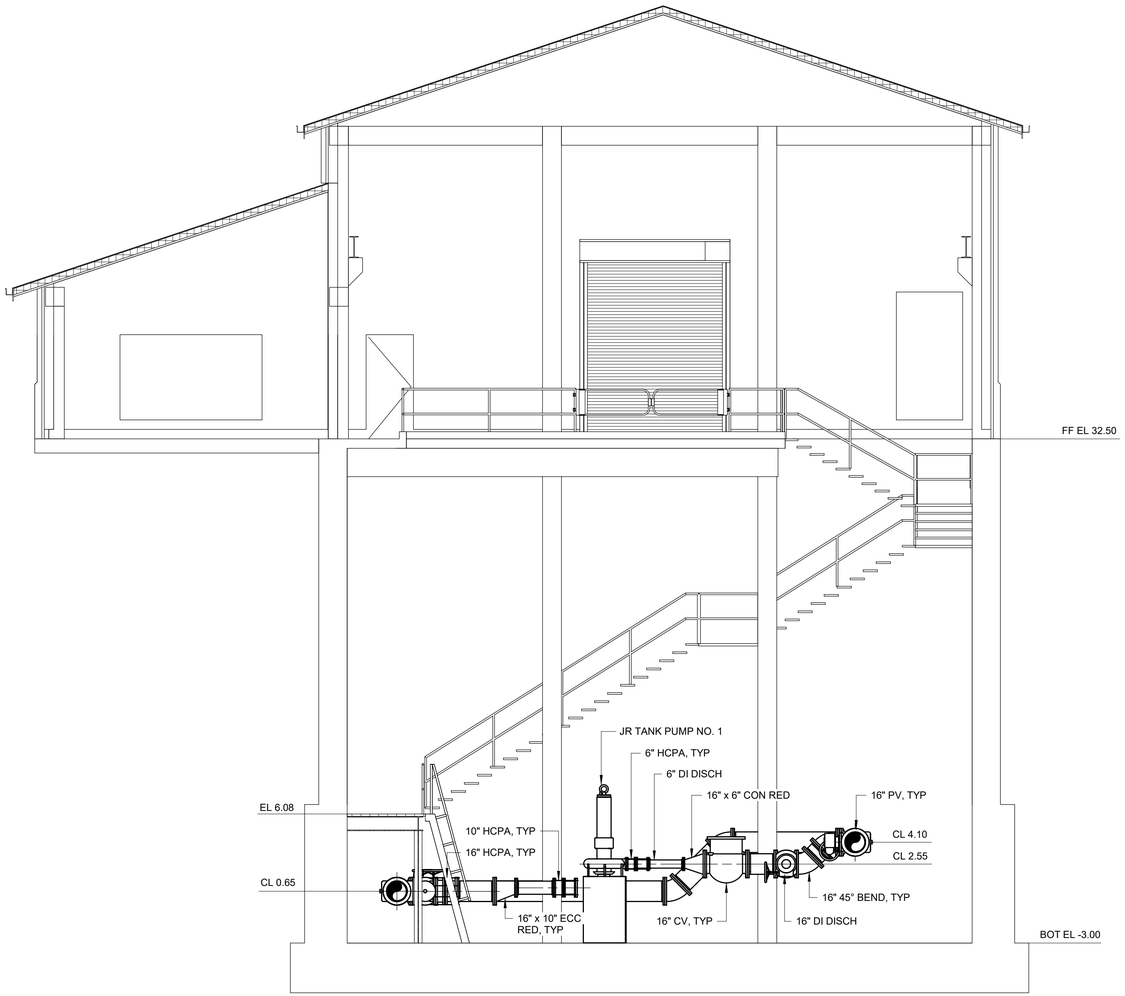
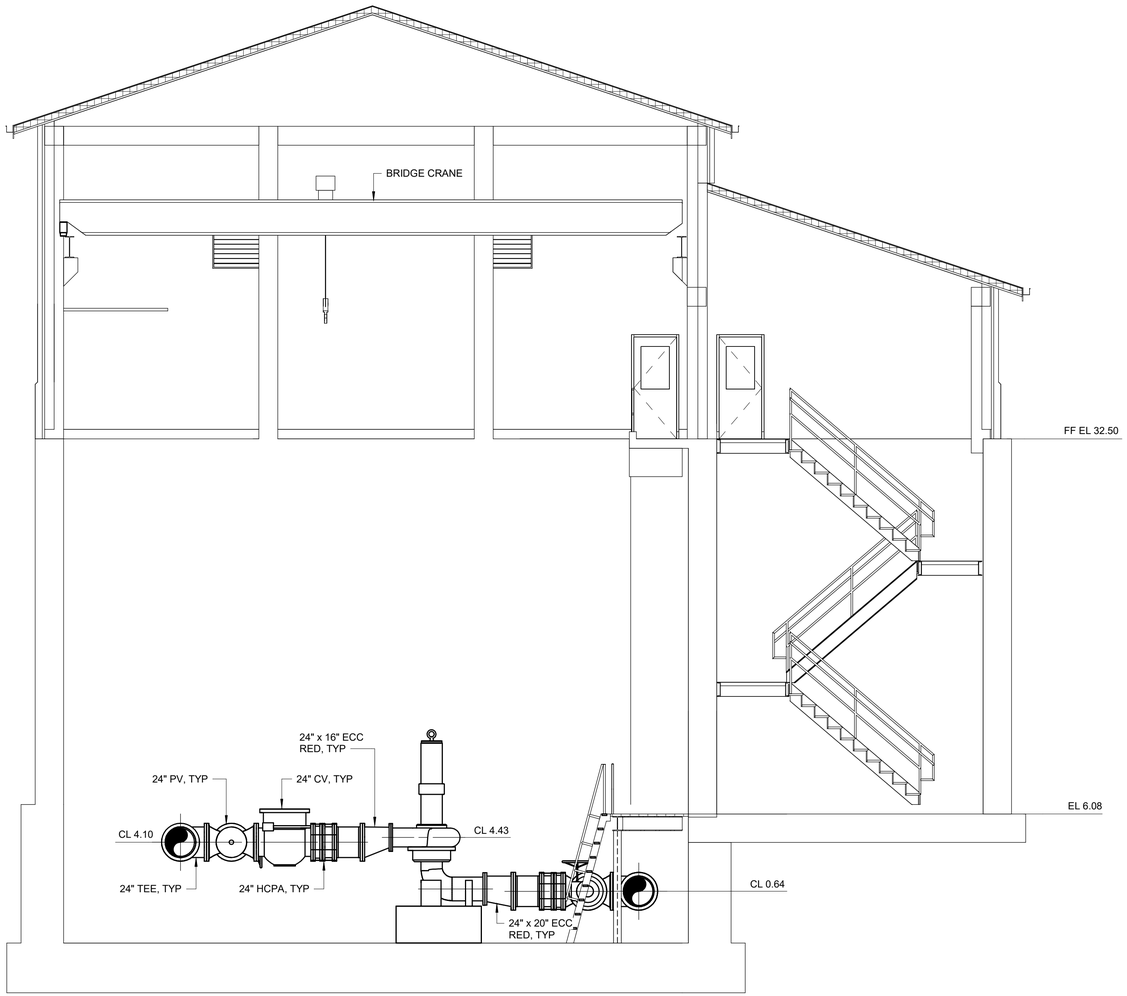


SECTION B
3/16" = 1'-0"
M102



SECTION C
3/16" = 1'-0"
M102

3/16" = 1'-0" 6 4 2 0 5'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	T. McPHERSON

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

MECHANICAL

SECTIONS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M104
SHEET:	OF #

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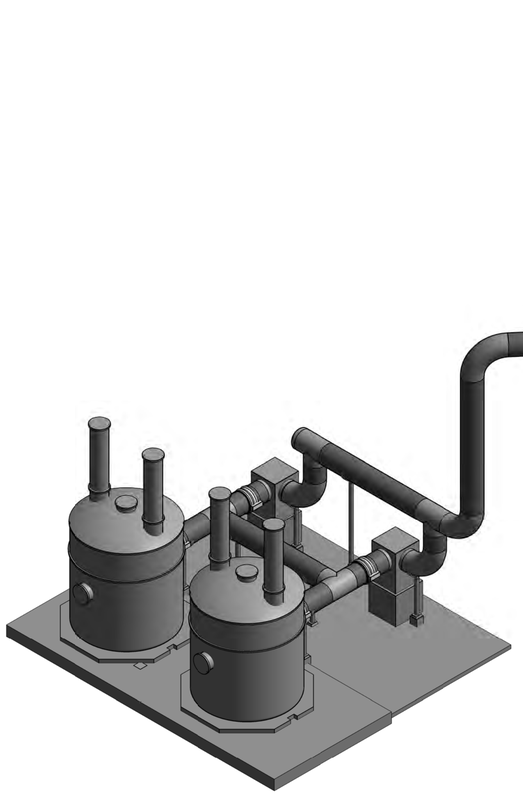

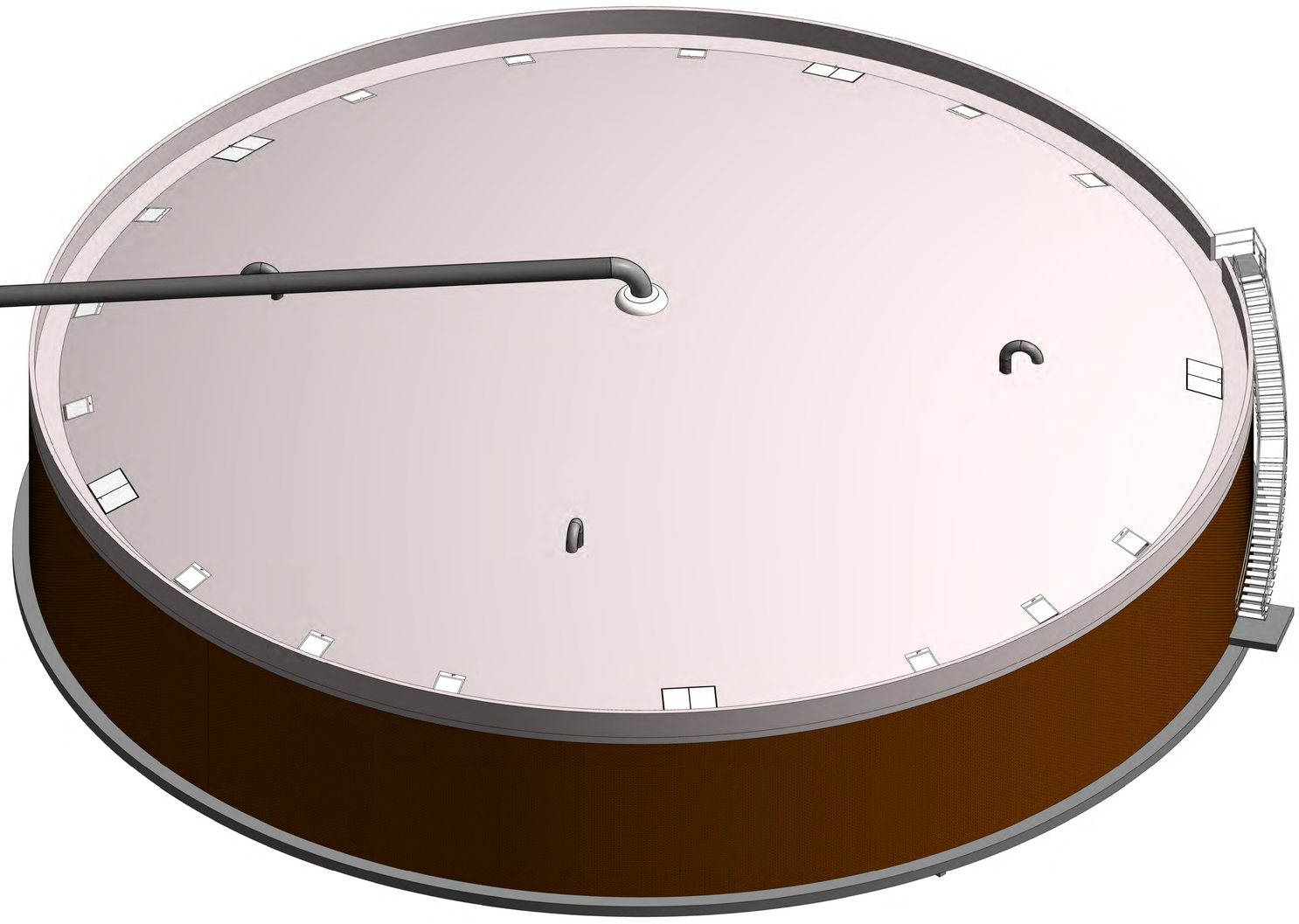

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	Author
CHECKED BY:	Checker
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

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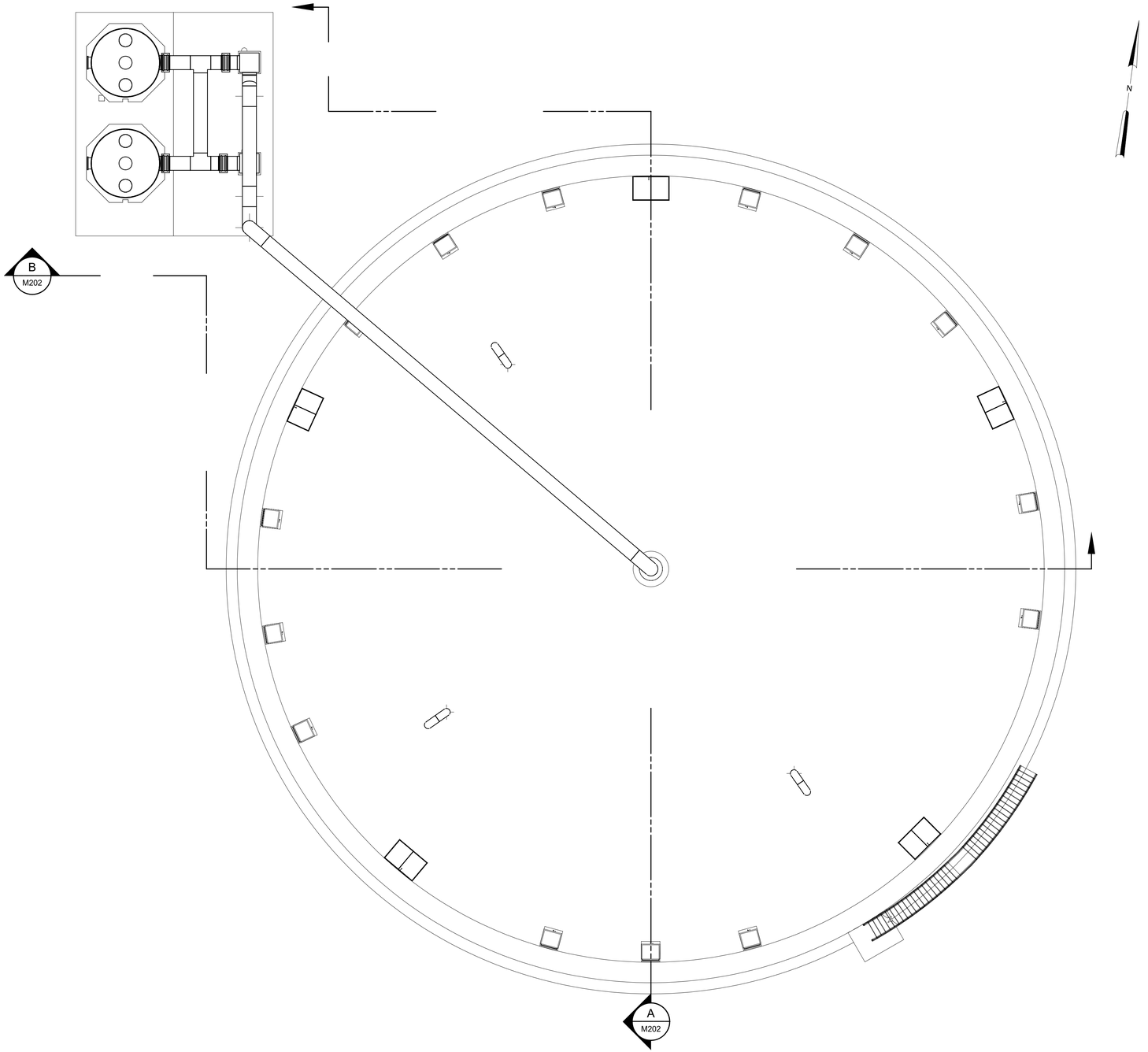
TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

MECHANICAL

OLSF ISOMETRIC OVERALL PLAN

DATE:	SEPTEI
HAZEN NO.:	
CONTRACT NO.:	
DRAWING NUMBER:	
SHEET:	



OVERALL PLAN
3/32" = 1'-0"

3/32" = 1'-0"
10 8 6 4 2 0 11'

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	Checker
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

MECHANICAL

STORAGE TANK PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M201
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-200-OLSF-M.rvt
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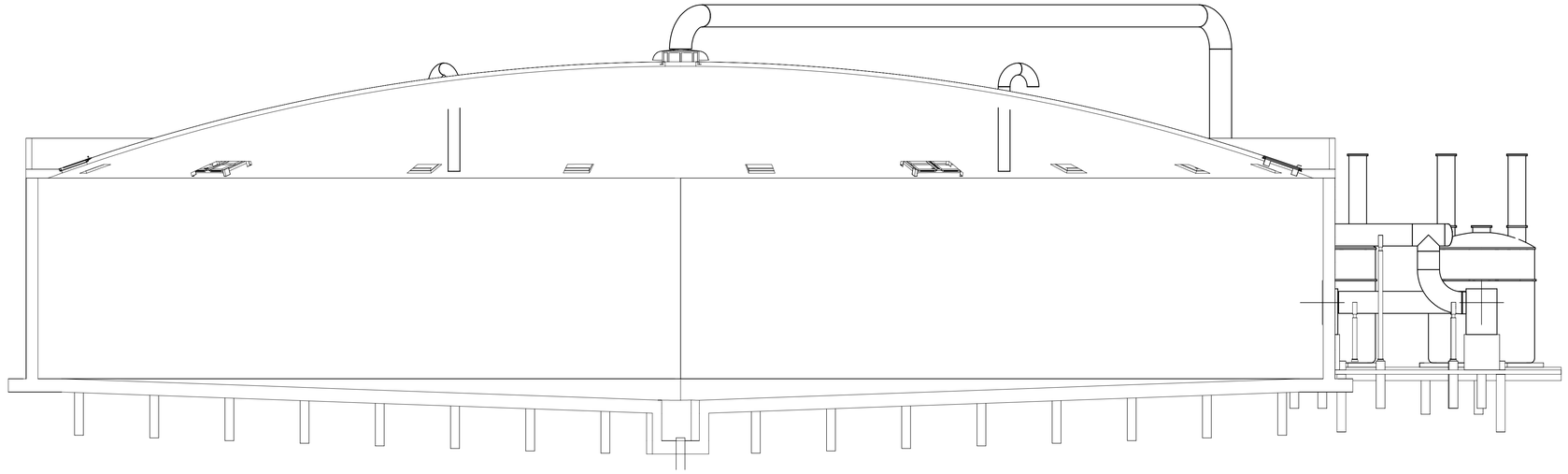
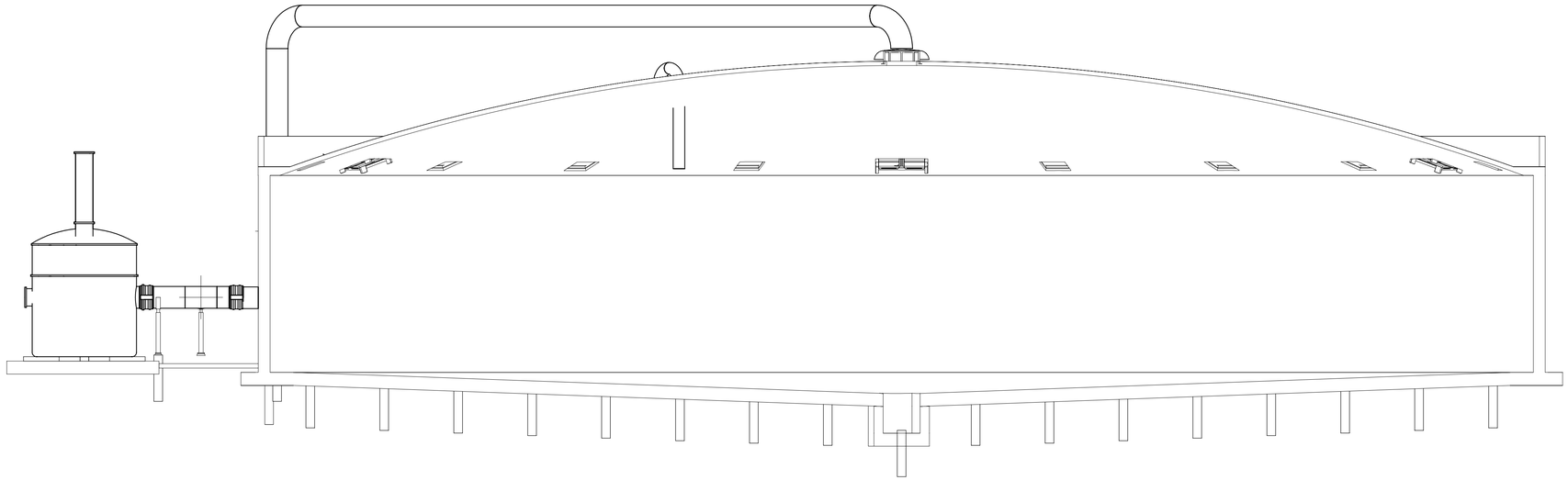


SECTION A
1/8" = 1'-0"
M201



SECTION B
1/8" = 1'-0"
M201

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	R. SMITH
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	Checker
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

MECHANICAL

SECTIONS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	M202
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-200-OLSF-M.rvt
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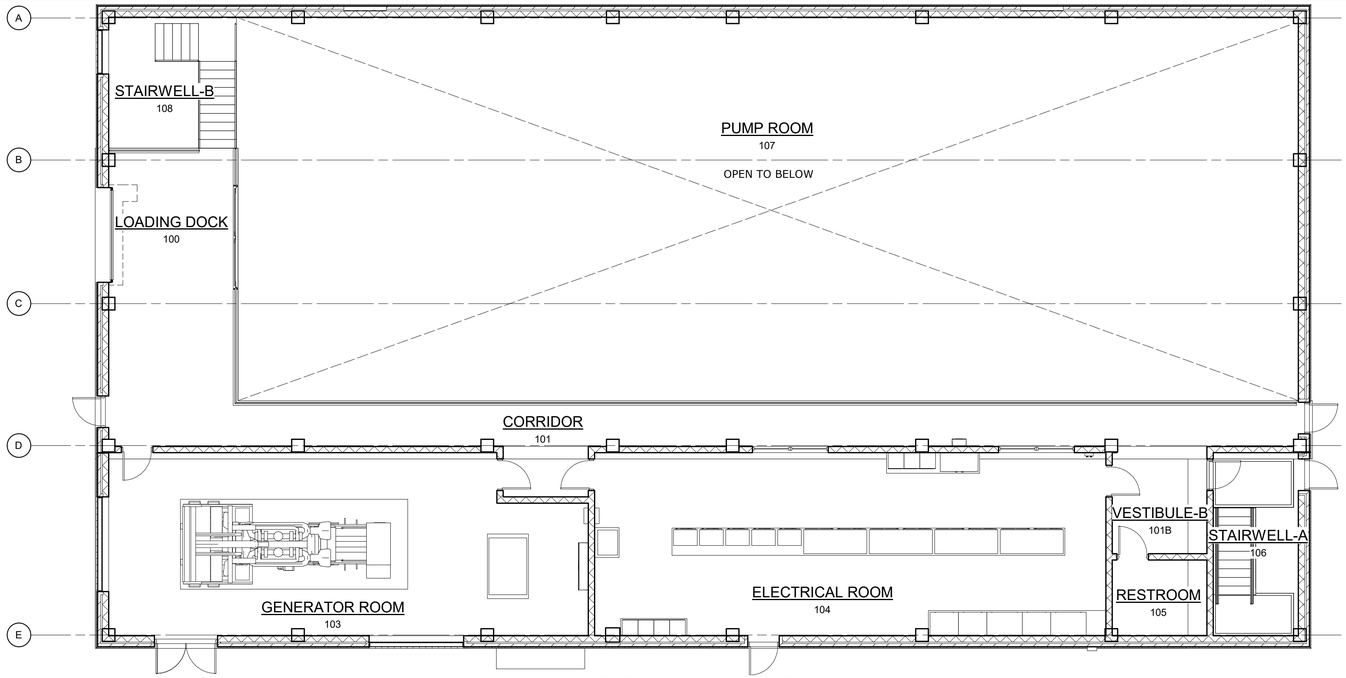
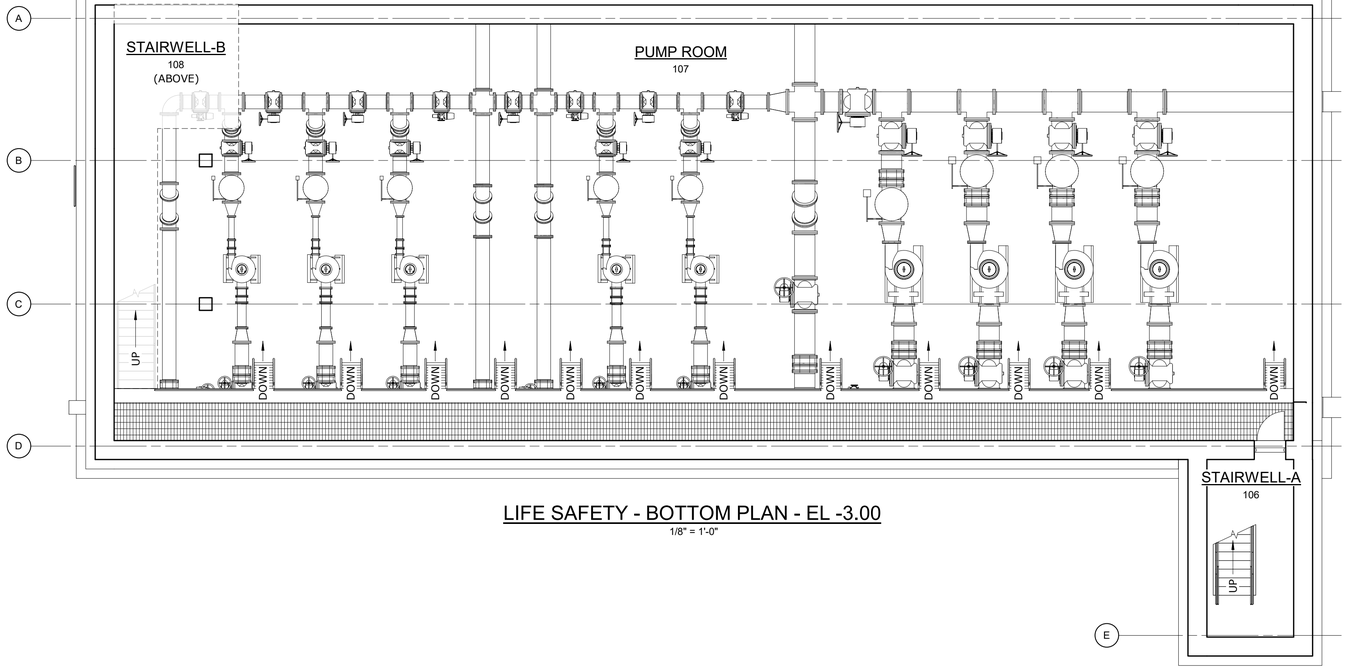


LIFE SAFETY - TOP PLAN - EL 32.50

1/8" = 1'-0"



LIFE SAFETY - BOTTOM PLAN - EL -3.00

1/8" = 1'-0"

BUILDING CODE ANALYSIS
2015 VIRGINIA CONSTRUCTION CODE

CODE ITEM	CODE REFERENCE	PRESSURE REDUCING STATION
OCCUPANCY CLASSIFICATION	CHAPTER 3	H-3 AND F-2
CONSTRUCTION CLASSIFICATION	CHAPTER 6	IIB
TABULAR HEIGHT ALLOWED	CHAPTER 5 - TABLE 503	55'
ACTUAL HEIGHT AS DESIGNED		28'-6"
TABULAR AREA ALLOWED	CHAPTER 5 - TABLE 503	14,000 S.F. PER FLOOR
ACTUAL GROSS AREA AS DESIGNED		H-3 (EXT) 3,624.60 S.F. H-3 (INT) 1,138.60 S.F. F-2 1,551.80 S.F. TOTAL 6,315 S.F.
STORIES ALLOWED	CHAPTER 5 - TABLE 503	2
ACTUAL STORIES		1
FIRE RESISTANCE RATING REQUIREMENTS		
STRUCTURAL FRAME	CHAPTER 6 - TABLE 601	0
EXTERIOR BEARING WALLS	CHAPTER 6 TABLE 601 & 602	0
INTERIOR BEARING WALLS	CHAPTER 6 - TABLE 601	0
EXTERIOR NON-BEARING WALLS AND PARTITIONS	CHAPTER 6 - TABLE 602	NR
INTERIOR NON-BEARING WALLS AND PARTITIONS	CHAPTER 6 - TABLE 601	2, 3 HR
FLOOR CONSTRUCTION	CHAPTER 6 - TABLE 601	0
ROOF CONSTRUCTION	CHAPTER 6 - TABLE 601	0
SHAFT ENCLOSURES - EXIT	CHAPTER 7 - SECTION 708.4	NR
OPENING PROTECTIVES	CHAPTER 7 - SECTION 715	NR
EGRESS WIDTH PER OCCUPANT SERVED		
STAIRWAYS	NR	NR
OTHER EGRESS COMPONENTS	SECTION 1005.3.2	0.2" PER OCCUPANT
OCCUPANT LOAD	TABLE 1004.1.1	22 OCCUPANTS
ALLOWABLE COMMON PATH OF TRAVEL DISTANCE	TABLE 1006.2.1	75'-0"
ACTUAL MAX COMMON PATH OF TRAVEL DISTANCE		31'-0"
ALLOWABLE TRAVEL DISTANCE	TABLE 1017.2	300'-0"
ACTUAL TRAVEL DISITANCE		160'-0"
LIFE SAFETY SYSTEM REQUIREMENTS		
EMERGENCY LIGHTING	SECTION 1006.1	YES
EXIT SIGNS	SECTION 1011	YES
AUTOMATIC SPRINKLERS	SECTION 903.3.1.1	YES
FIRE ALARM	SECTION 907	YES
SMOKE DETECTION SYSTEMS	SECTION 907.2.5	YES
PANIC HARDWARE	SECTION 1008.1.10	YES (AS NOTED ON PLANS)
STRUCTURAL AND SEISMIC DESIGN LOADS - SEE STRUCTURAL DRAWINGS		

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

ARCHITECTURAL

LIFE SAFETY AND CODE ANALYSIS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A1
SHEET:	OF #

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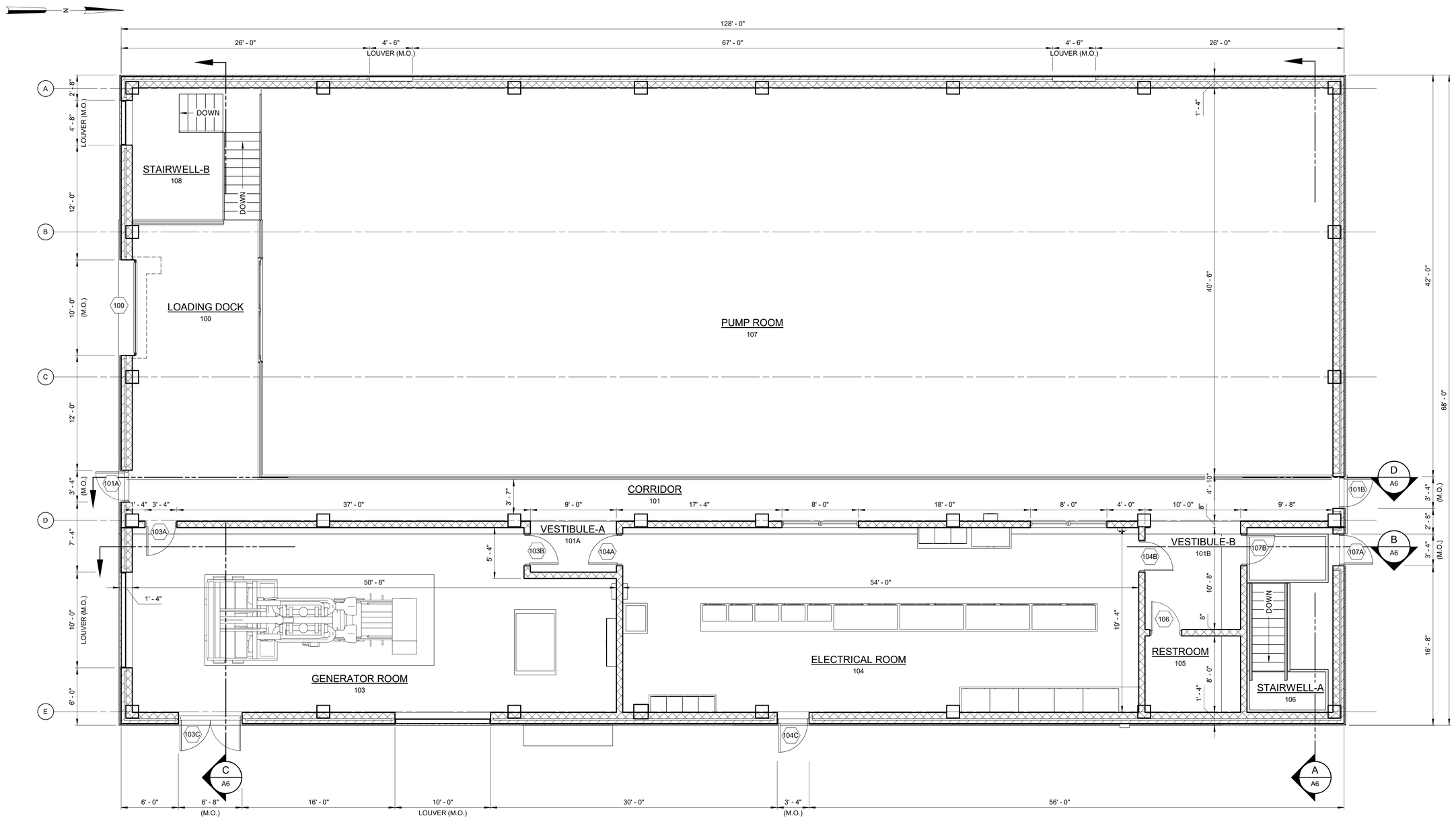

TOP PLAN - EL 32.50

3/16" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

TOP PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A2
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-A.rvt
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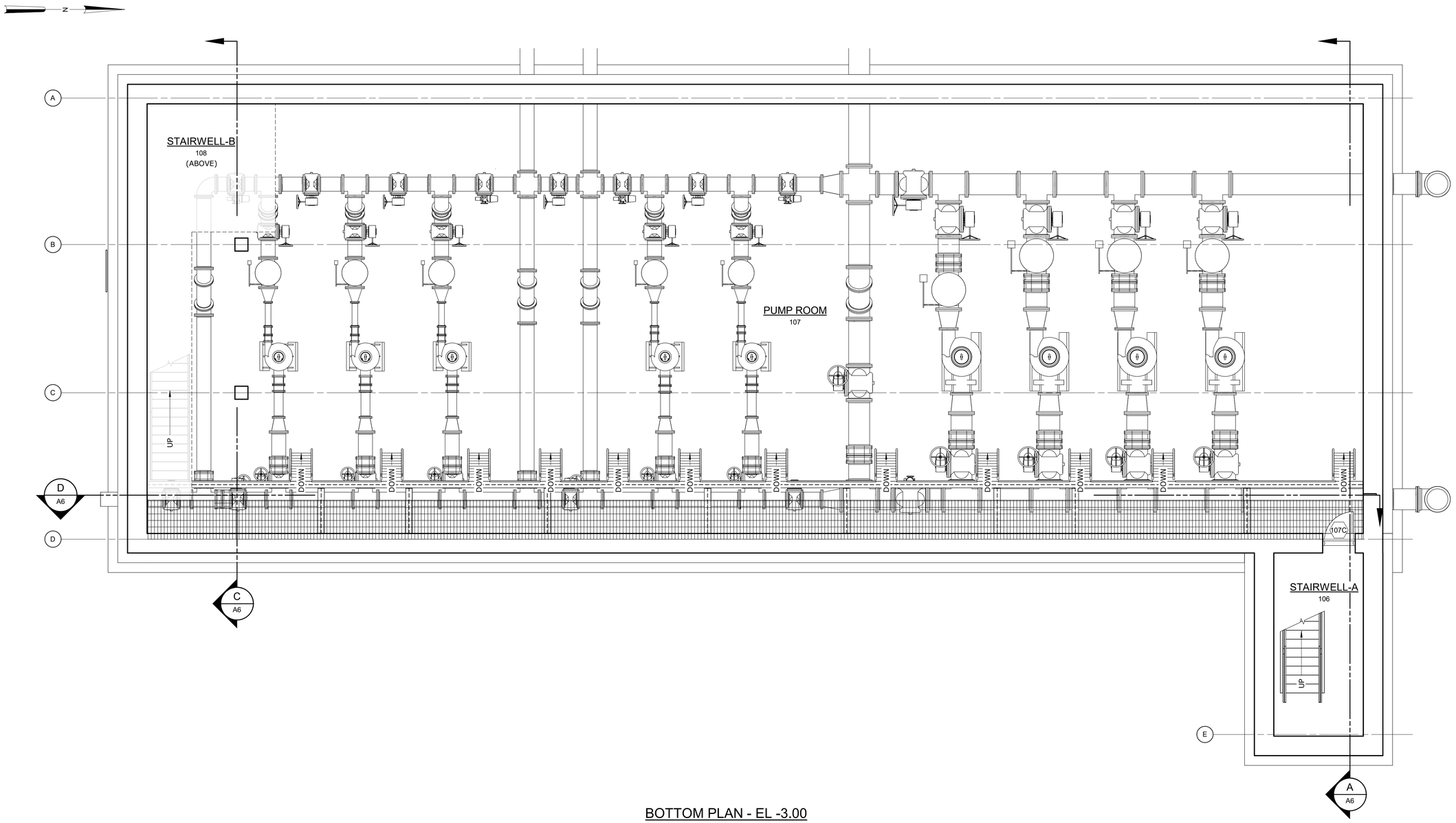

BOTTOM PLAN - EL -3.00

3/16" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

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VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

BOTTOM PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A3
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-A.rvt
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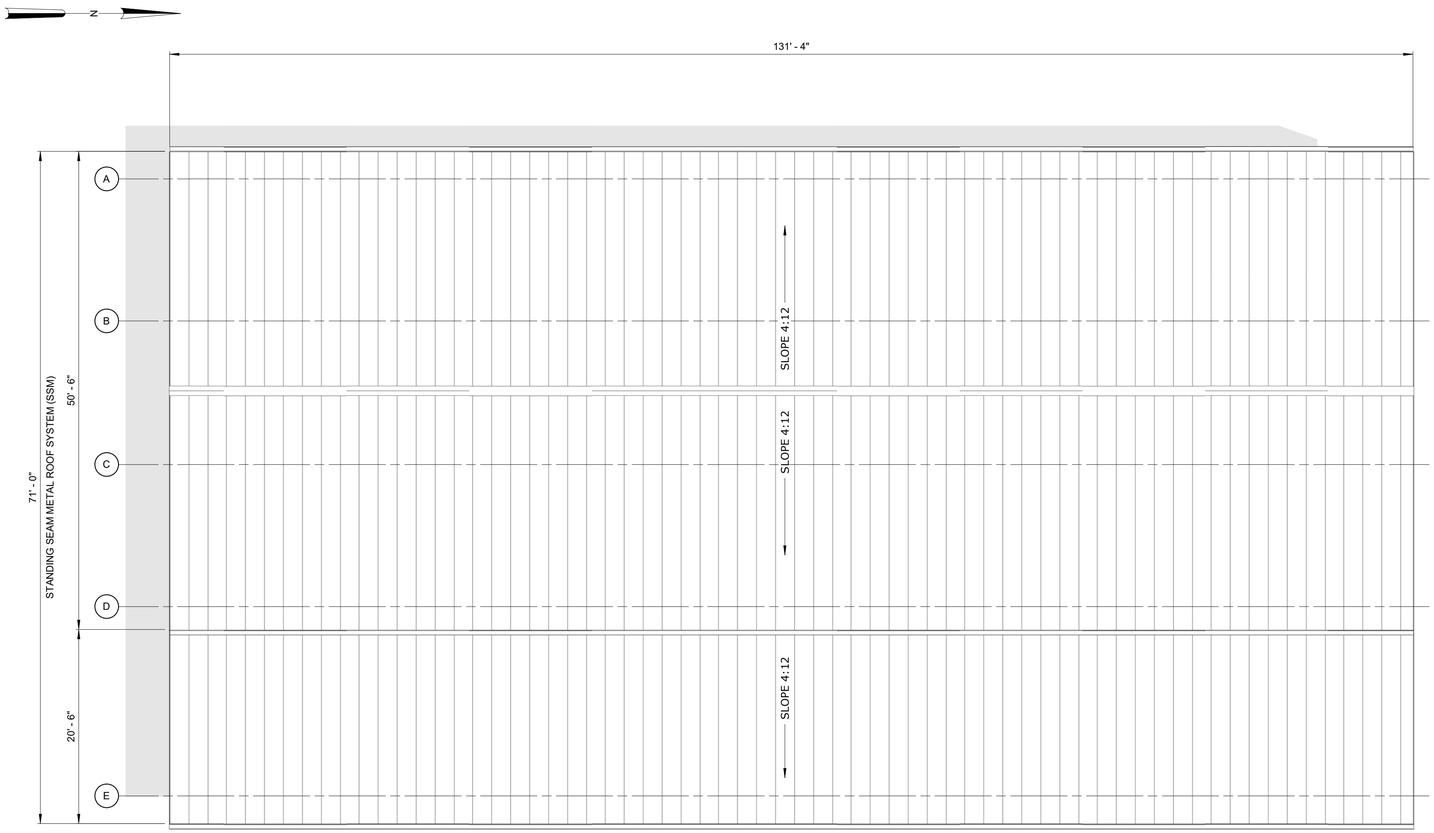

ROOF PLAN
1/8" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

ROOF PLAN

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A4
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-A.rvt
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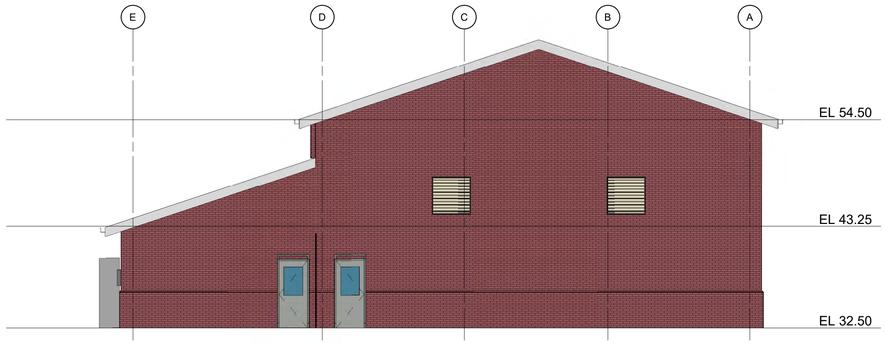
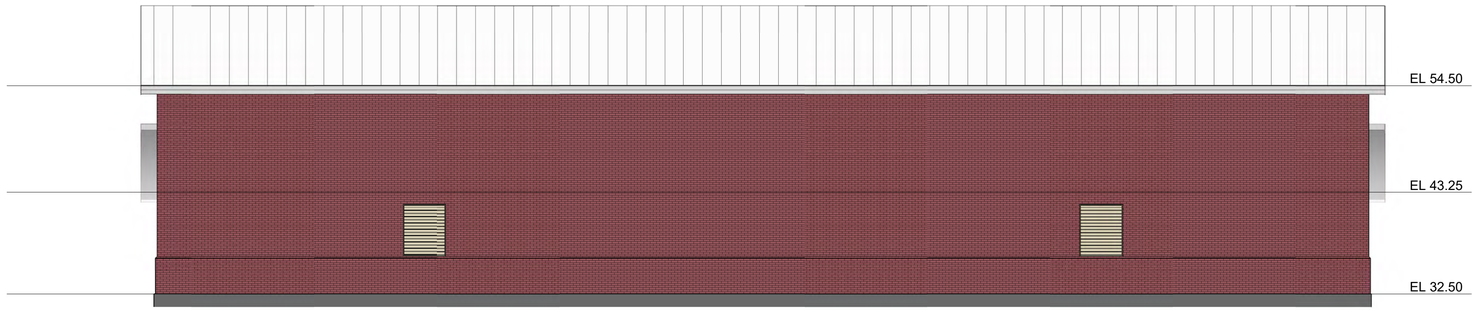
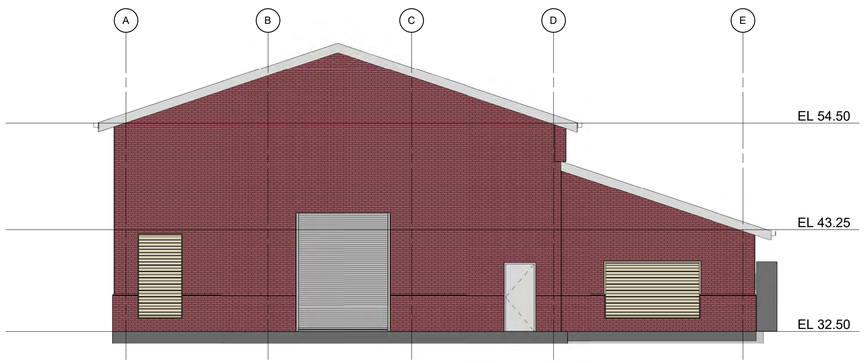


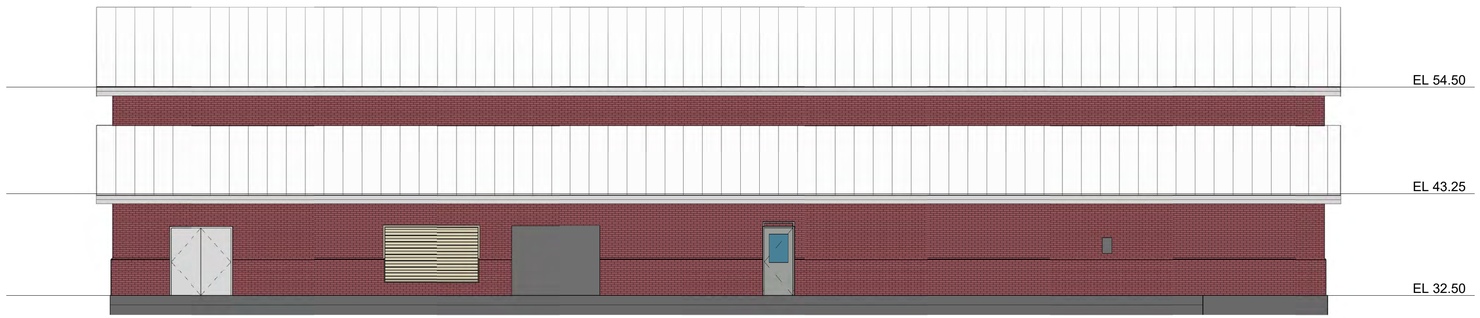
NORTH ELEVATION
1/8" = 1'-0"



WEST ELEVATION
1/8" = 1'-0"



SOUTH ELEVATION
1/8" = 1'-0"



EAST ELEVATION
1/8" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
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PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

BUILDING ELEVATIONS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A5
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-A.rvt
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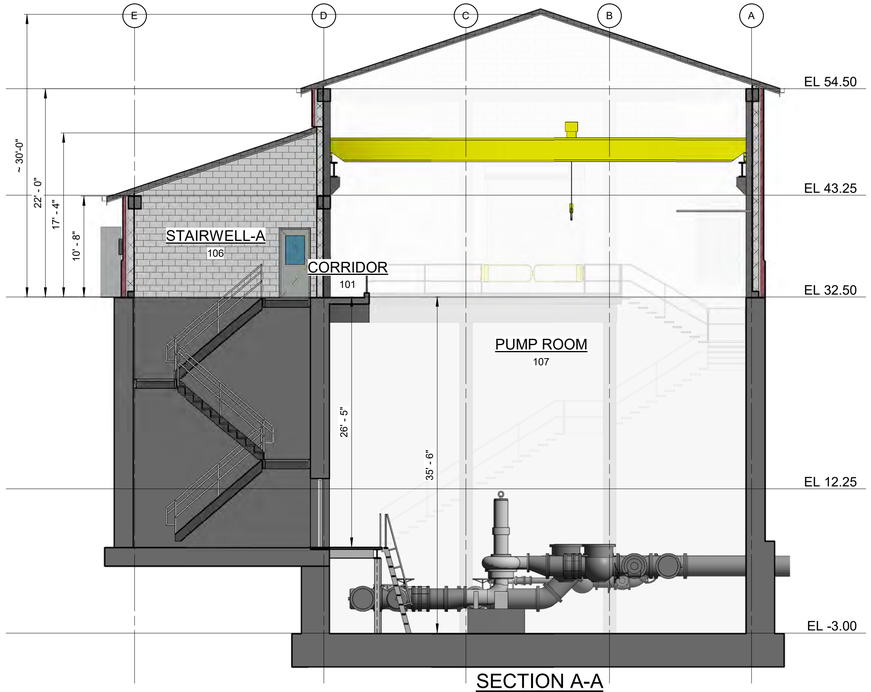
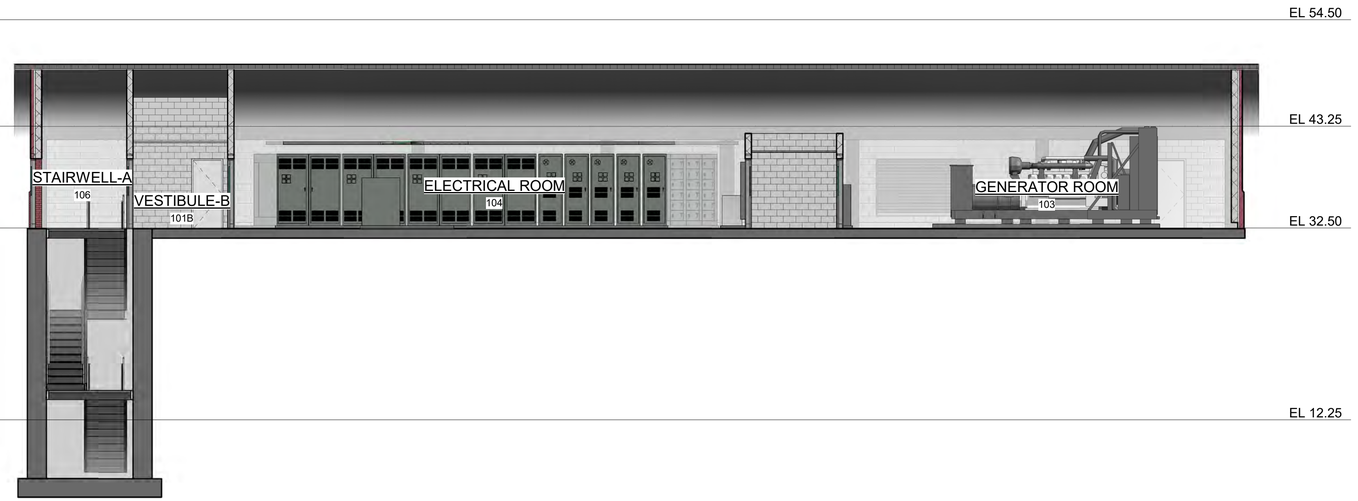


SECTION A-A

1/8" = 1'-0"



SECTION B-B

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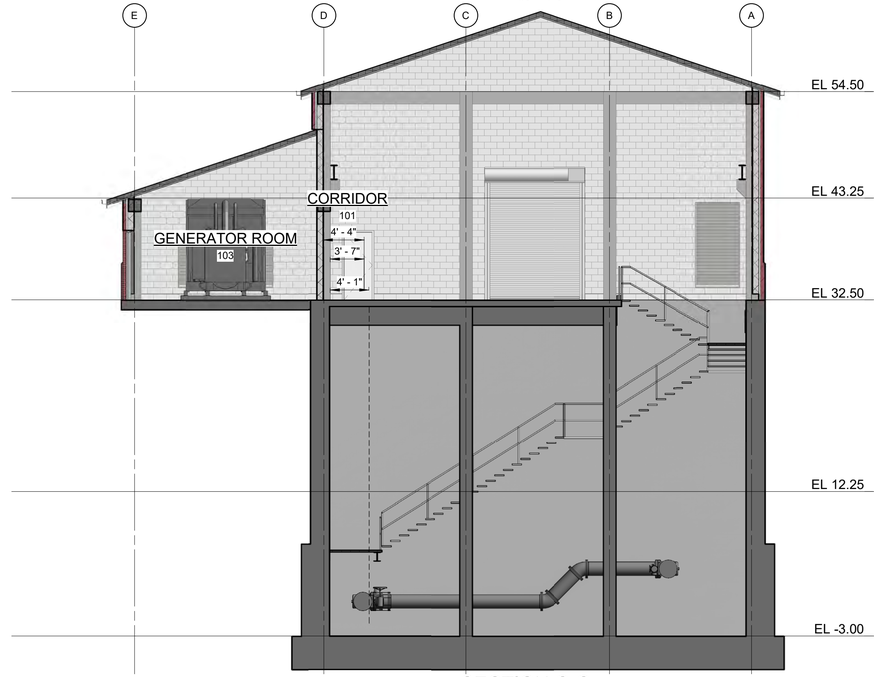
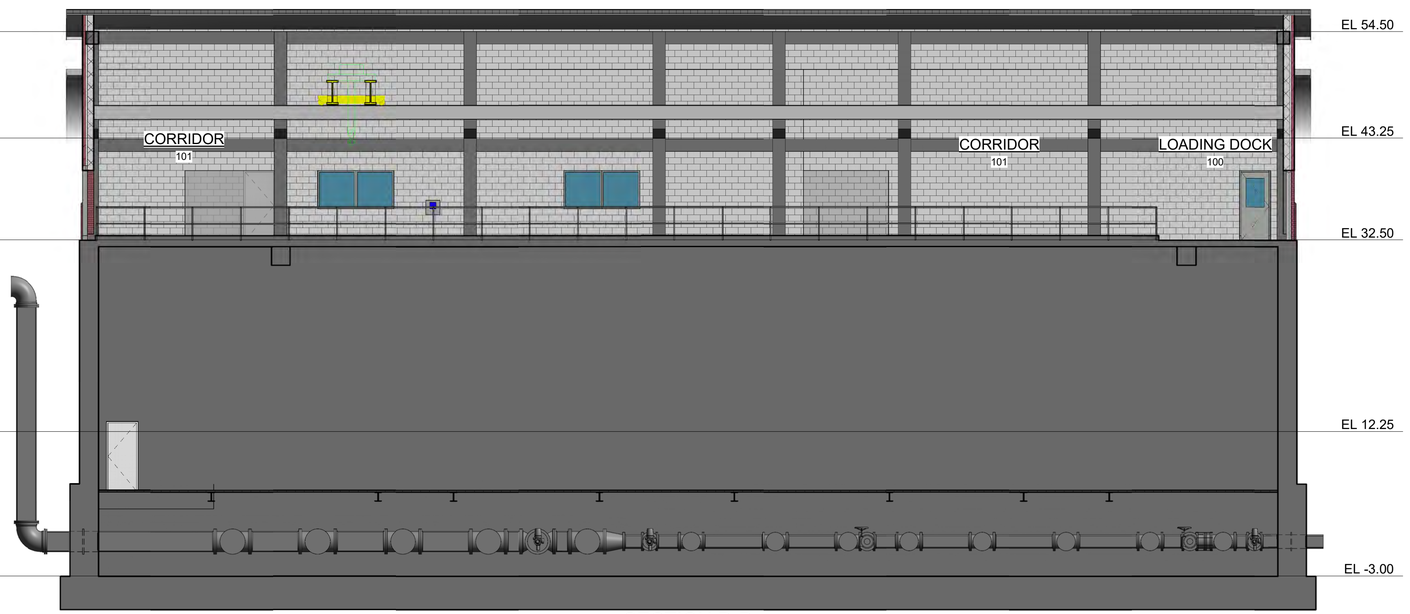


SECTION C-C

1/8" = 1' 0"



SECTION D-D

1/8" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. MOLINA
DRAWN BY:	L. MOLINA
CHECKED BY:	W. RUSSELL

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen

HAZEN AND SAWYER
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PHONE: 757-497-0490

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TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

BUILDING SECTIONS

DATE:	SEPTEMBER 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	A6
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-A.rvt
10/2/2020 8:55:09 AM

ROOM FINISH SCHEDULE

NO.	DESCRIPTION	FLOOR		BASE		WALL-NORTH		WALL-EAST		WALL-SOUTH		WALL-WEST		CEILING			REMARKS
		SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	HEIGHT	
100-PRESSURE REDUCING STATION-TABB																	
100	LOADING DOCK	CONC	SLR	CONC	SLR	---	---	---	---	CMU	PT	---	---	MTLS	ES	26'-0"	CEILING HEIGHT VARIES
101	CORRIDOR	CONC	SLR	CONC/CMU	SLR /PT	CMU	PT	CMU	PT	CMU	PT	---	---	MTLS	ES	26'-0"	CEILING HEIGHT VARIES
101A	VESTIBULE-A	CONC	SLR	CMU	PT	CMU	PT	CMU	PT	CMU	PT	---	---	GCBD	MFR	9'-0"	
101B	VESTIBULE-B	CONC	SLR	CMU	PT	CMU	PT	CMU	PT	CMU	PT	---	---	GCBD	MFR	9'-0"	
102	CORRIDOR	CONC	SLR	CONC	SLR /PT	CMU	PT	---	---	---	---	CMU	PT	MTLS	ES	26'-0"	CEILING HEIGHT VARIES
103	GENERATOR ROOM	CONC	SLR	CONC/CMU	SLR /PT	CMU	PT	CMU	PT	CMU	PT	CMU	PT	MTLS	ES	14'-4"	CEILING HEIGHT VARIES
104	ELECTRICAL ROOM	CONC	SLR	CONC/CMU	SLR /PT	CMU	PT	CMU	PT	CMU	PT	CMU	PT	MTLS	ES	14'-4"	CEILING HEIGHT VARIES
105	RESTROOM	CONC	SLR	CONC/CMU	CRT	CMU	CRT	CMU	PT/CRT	CMU	PT	CMU	PT/CRT	GCBD	MFR	9'-0"	
106	STAIRWELL-A	CONC	SLR	CONC	PT	CONC/CMU	PT	CONC	PT	CONC	PT	CONC	PT	MTLS	ES	49'-10"	CEILING HEIGHT VARIES
107	PUMP ROOM	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	MTLS	ES	26'-0"	CEILING HEIGHT VARIES
108	STAIRWELL-B	CONC	SLR	CONC	SLR	---	---	---	---	CONC	SLR	CONC/CMU	SLR/PT	MTLS	ES	26'-0"	CEILING HEIGHT VARIES
110	PUMP ROOM	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	CONC	SLR	MTLS	ES	26'-0"	CEILING HEIGHT VARIES

DOOR SCHEDULE

NO.	FRAME		DOOR		WIDTH	HEIGHT	DOOR	DETAILS			GLAZING	SECURITY WIRING	FIRE LABEL	FINISH	HDWR NO	THRSHLD	REMARKS
	TYPE	MATL	TYPE	MATL			THICKNESS	HEAD	JAMB	SILL							
100	MFR	STL	OH	STL	10' - 7"	14' - 0"		4/A7	4/A7	4/A7	---	---	---	MFR	MFR	MFR	---
101A	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	1/A7	1/A7	1/A7	IG	---	---	PT	1	AL	---
101B	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	1/A7	1/A7	1/A7	IG	---	---	PT	1	AL	---
103A	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	IG	---	---	PT	3	---	---
103B	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	IG	---	---	PT	3	---	---
103C	F-1	HM	HG	HM	6' - 4"	7' - 2"	1 3/4"	1/A7	1/A7	1/A7	IG	---	---	PT	2	AL	---
104A	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	IG	---	---	PT	3	---	---
104B	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	IG	---	---	PT	3	---	---
104C	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	1/A7	1/A7	1/A7	IG	---	---	PT	1	AL	---
106	F-1	HM	F	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	---	---	---	PT	4	---	---
107A	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	1/A7	1/A7	1/A7	IG	---	---	PT	1	AL	---
107B	F-1	HM	HG	HM	3' - 0"	7' - 2"	1 3/4"	2/A7	2/A7	2/A7	IG	---	60MIN	PT	5	---	---
107C	F-1	HM	NG	HM	3' - 0"	7' - 2"	1 3/4"	3/A7	3/A7	3/A7	IG	---	60MIN	PT	5	---	---

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: T. McPHERSON
DESIGNED BY: L. MOLINA
DRAWN BY: L. MOLINA
CHECKED BY: W. RUSSELL
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND
OFF-LINE STORAGE FACILITY

ARCHITECTURAL

SCHEDULES AND DETAILS

DATE: SEPTEMBER 2020
HAZEN NO.: 32562-000
CONTRACT NO.: 6204050
DRAWING NUMBER: A7
SHEET: OF #

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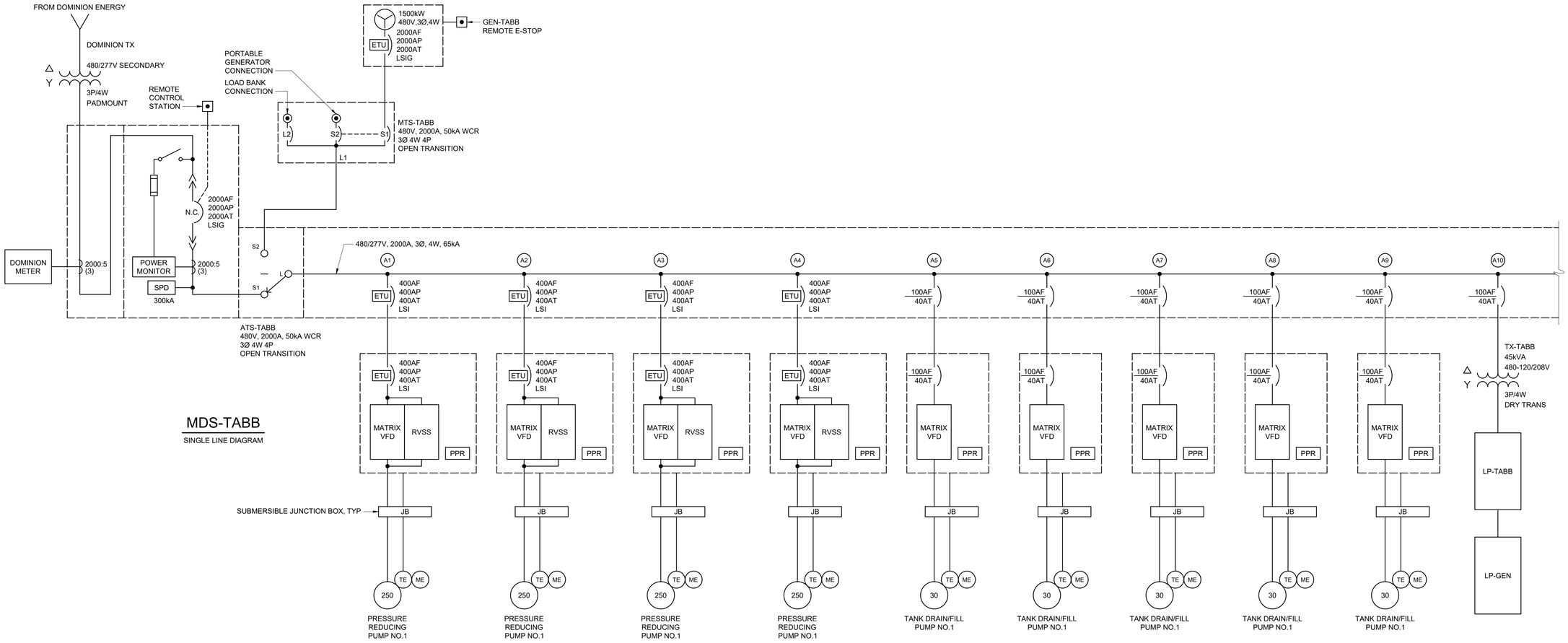
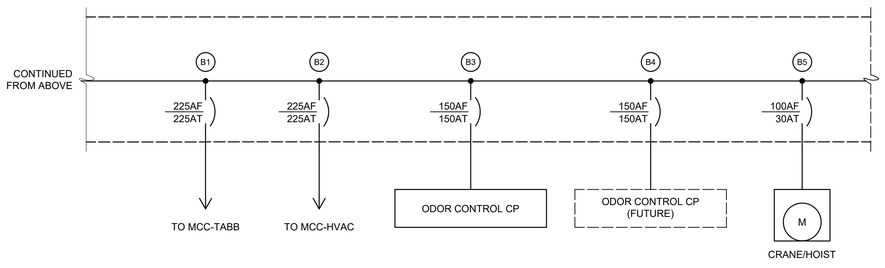
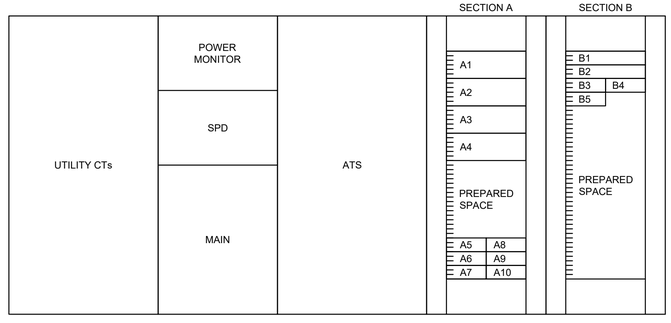


MDS-TABB

SINGLE LINE DIAGRAM





MDS-TABB

ELEVATION (NTS)

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	D. REED
DRAWN BY:	D. REED
CHECKED BY:	----

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

PRELIMINARY DESIGN
DO NOT USE FOR CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

ELECTRICAL

SINGLE LINE DIAGRAM

DATE:	SEPTEMBER 2020
HAZEN NO.:	32452-001
CONTRACT NO.:	VP015400
DRAWING NUMBER:	E100
SHEET	#### OF #

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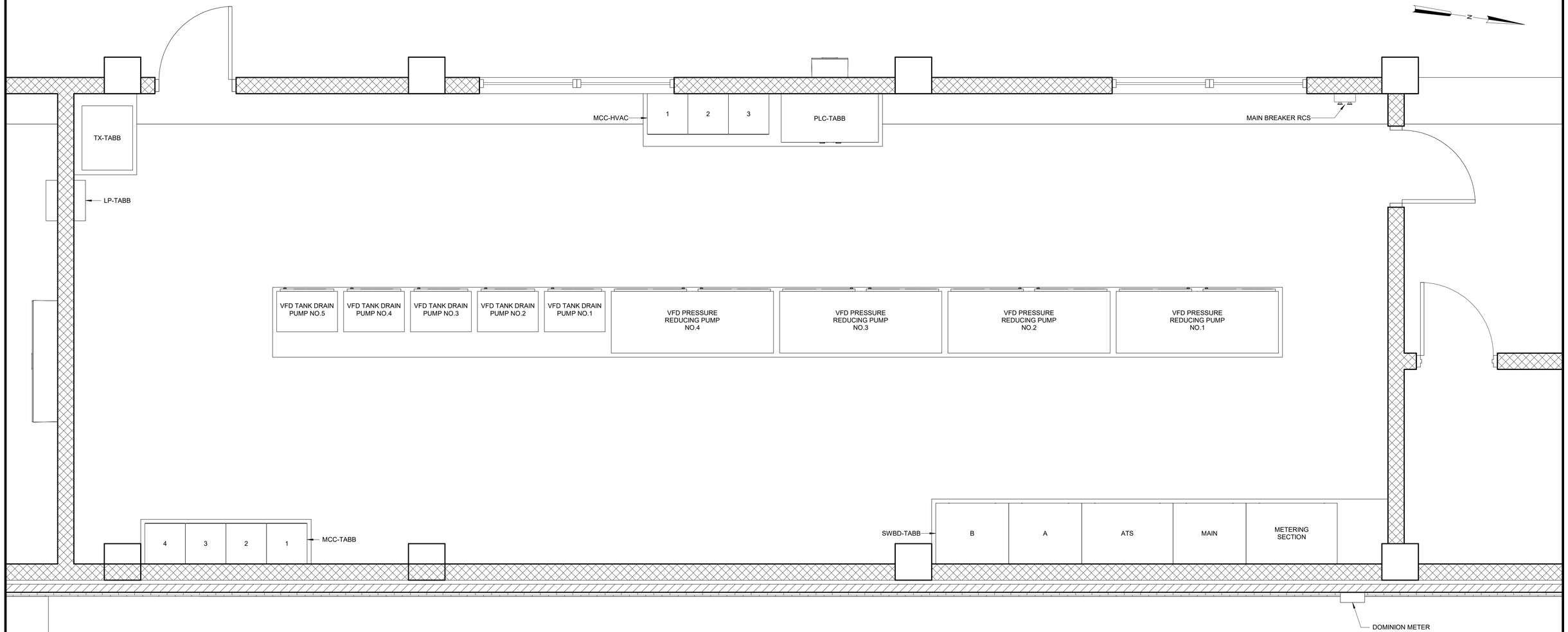
PLOT DATE: 9/18/2020 3:55 PM BY: DREED



CONTROL ROOM PLAN

1/2" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	D. REED
DRAWN BY:	D. REED
CHECKED BY:	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

0 1/2" 1"

PRELIMINARY DESIGN
DO NOT USE FOR CONSTRUCTION

Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
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PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

ELECTRICAL

CONTROL ROOM PLAN

DATE:	JULY 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	E101
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-E.rvt
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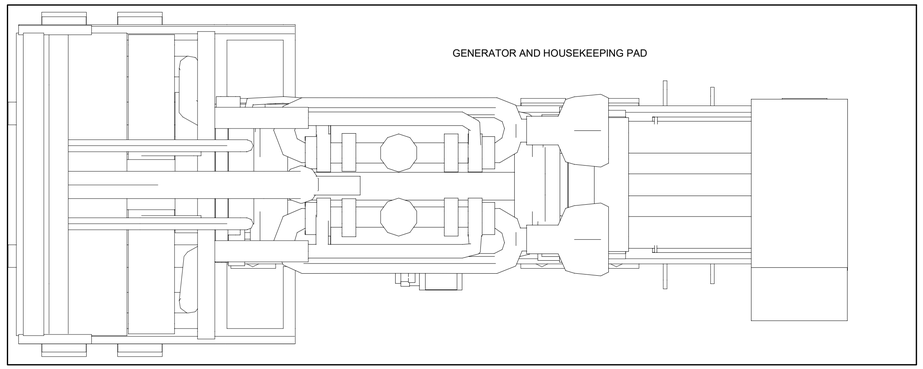

DAY TANK

LP-GEN

FUEL POLISHER

MTS-TABB

GENERATOR ROOM PLAN
1/2" = 1'-0"

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	D. REED
DRAWN BY:	D. REED
CHECKED BY:	

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

PRELIMINARY DESIGN
DO NOT USE FOR CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
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PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

ELECTRICAL

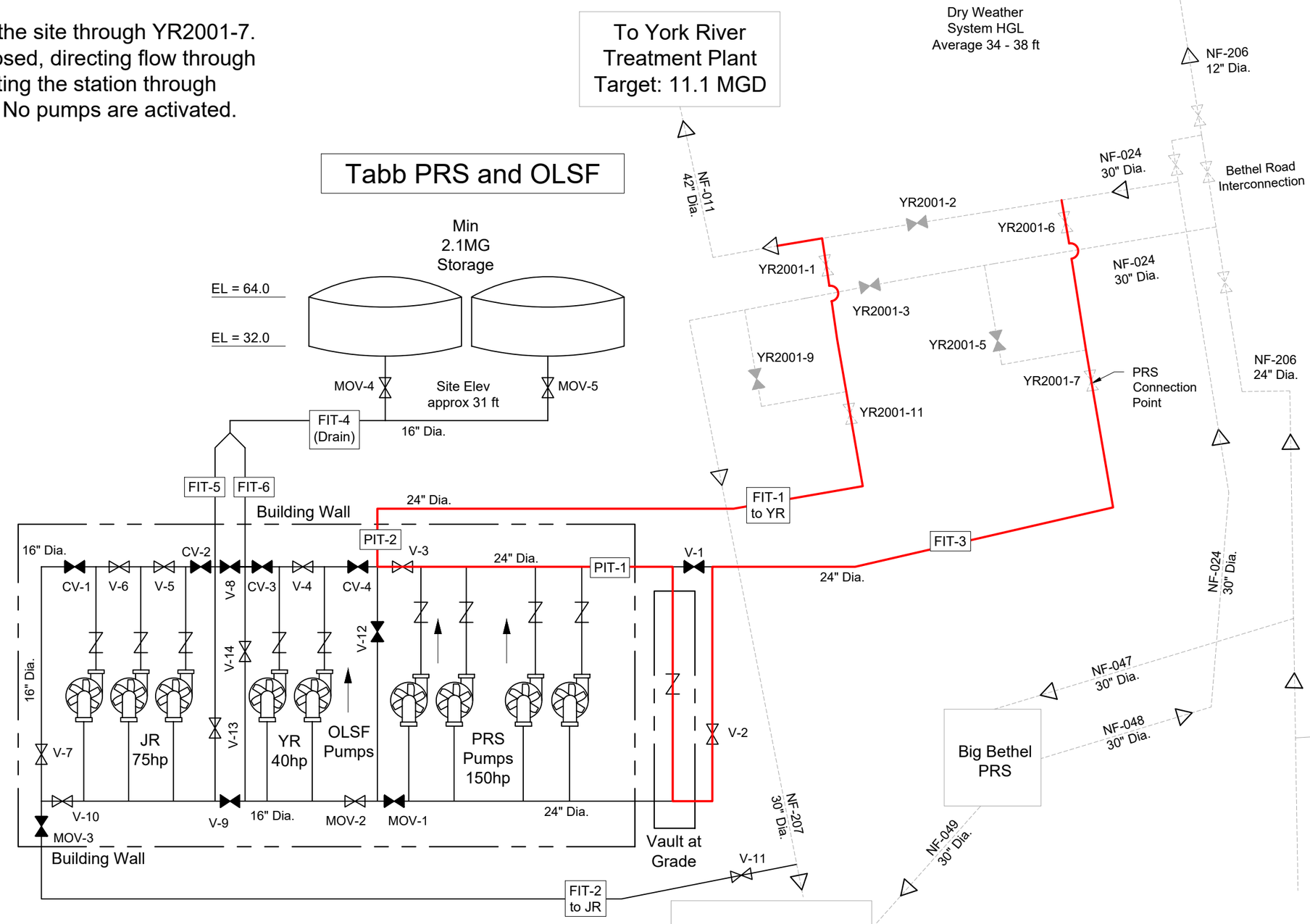
GENERATOR ROOM PLAN

DATE:	JULY 2020
HAZEN NO.:	32562-000
CONTRACT NO.:	6204050
DRAWING NUMBER:	E102
SHEET:	OF #

BIM 360://32562-000_Tabb Pressure Reducing Station/32562-000-100-PRS-E.rvt
9/18/2020 3:54:07 PM

Appendix H: Flow Scenarios

Flow enters the site through YR2001-7. MOV-1 is closed, directing flow through V-3 then exiting the station through YR2001-11. No pumps are activated.



Hazen

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4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 1
PRS (OFF)/ EQUALIZATION (OFF)

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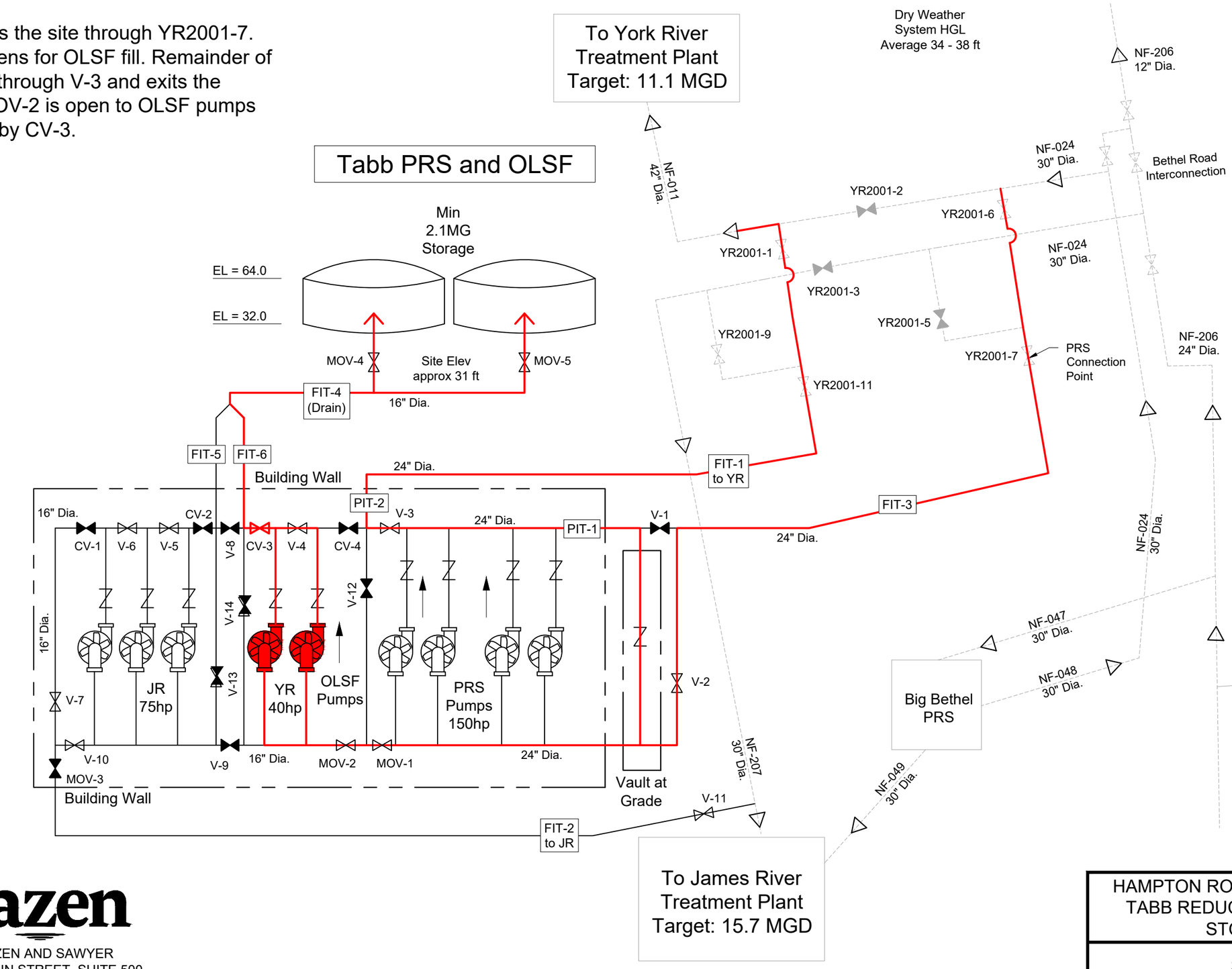
Flow enters the site through YR2001-7. MOV-1 opens for OLSF fill. Remainder of flow goes through V-3 and exits the station. MOV-2 is open to OLSF pumps controlled by CV-3.



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4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 2
PRS (OFF)/ EQUALIZATION (FILL)

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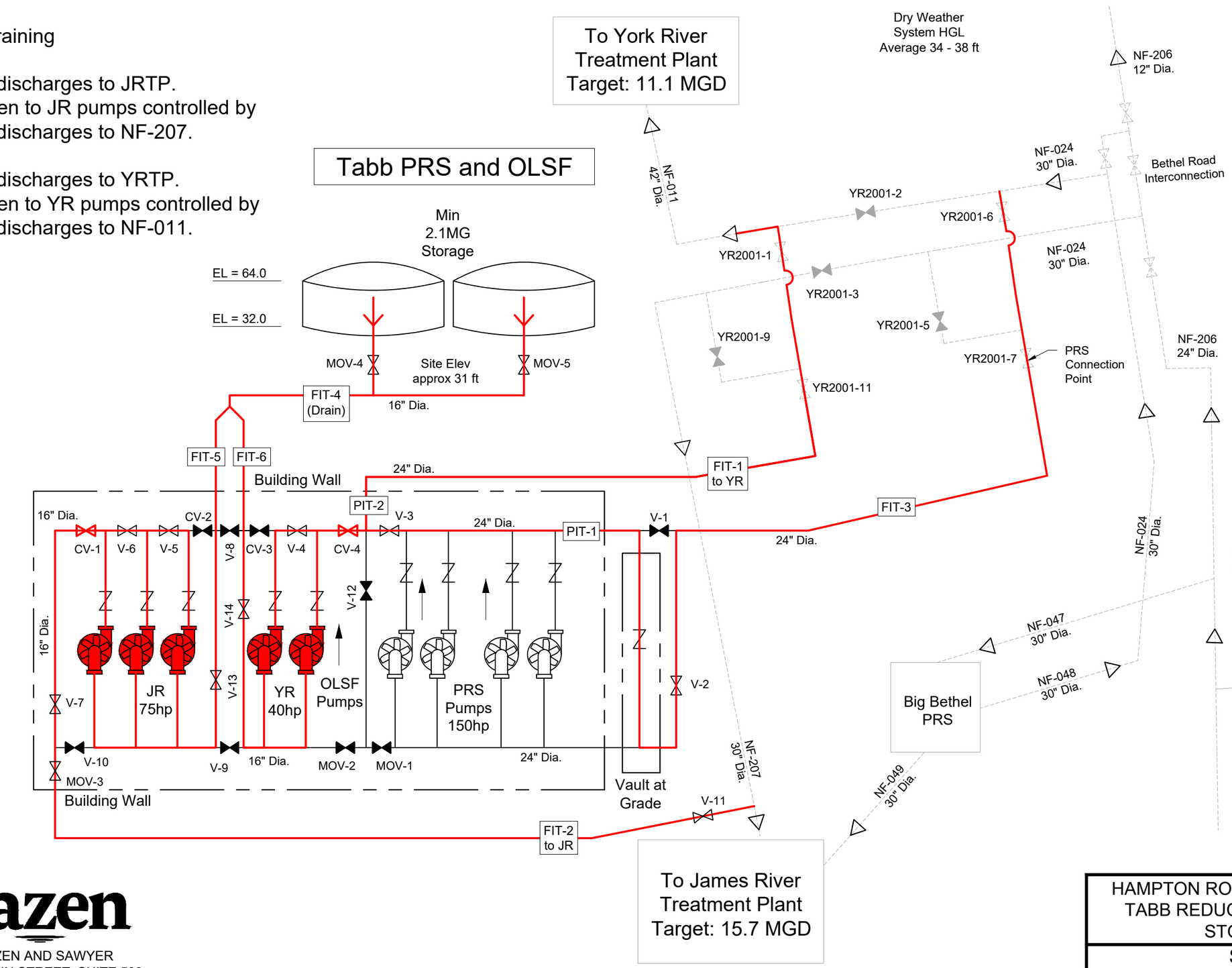
OLSF is draining

3A - Flow discharges to JRTP.
V-13 is open to JR pumps controlled by CV-1 and discharges to NF-207.

3B - Flow discharges to YRTP.
V-14 is open to YR pumps controlled by CV-4 and discharges to NF-011.

Tabb PRS and OLSF



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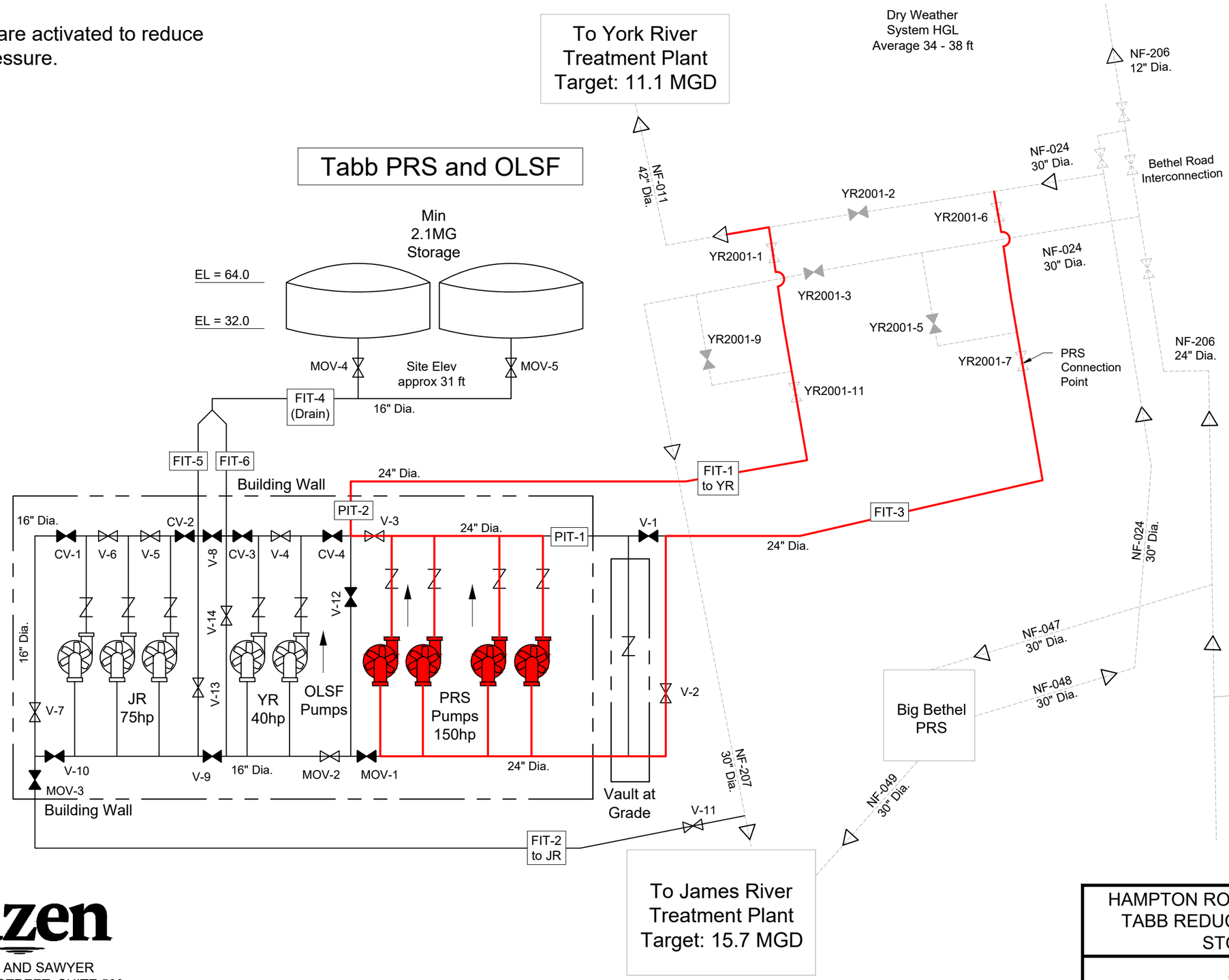
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 3
PRS (OFF)/ EQUALIZATION
(DISCHARGE) 3A- JRTP 3B- YRTP

File = O:\32562-HRD\32562-000\CAD_BIM_Project Files\Hazen\System_Map-Scenarios Saved by RMSmith Save date = 10/1/2020 9:21 PM

PRS pumps are activated to reduce upstream pressure.



Hazen

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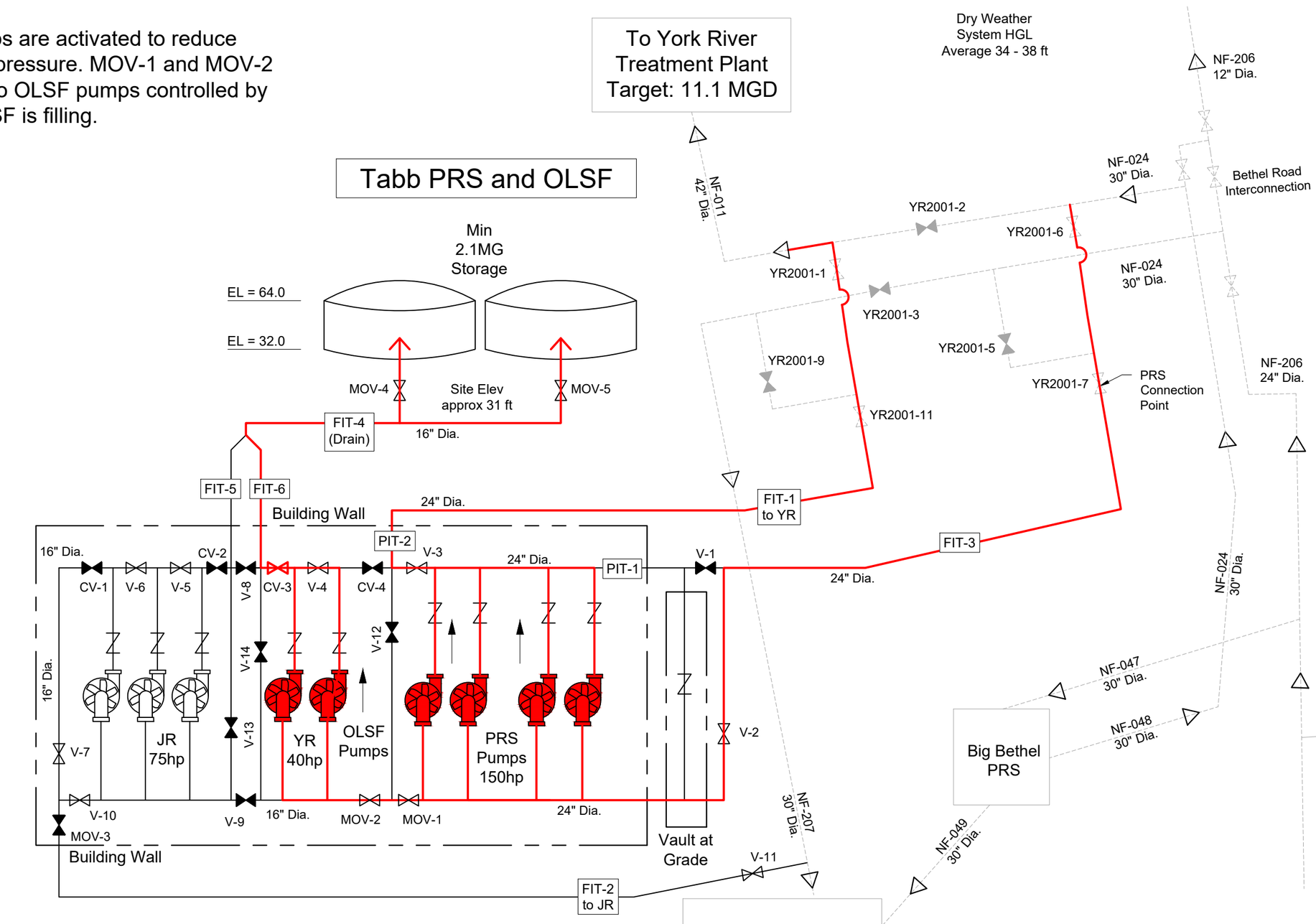
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 4
PRS (ON)/ EQUALIZATION (OFF)

File = O:\32562-HRD\32562-000\CAD_BIM_Project Files\Hazen\System_Map-Scenarios Saved by RMSmith Save date = 10/1/2020 9:21 PM

PRS pumps are activated to reduce upstream pressure. MOV-1 and MOV-2 are open to OLSF pumps controlled by CV-3. OLSF is filling.



Hazen

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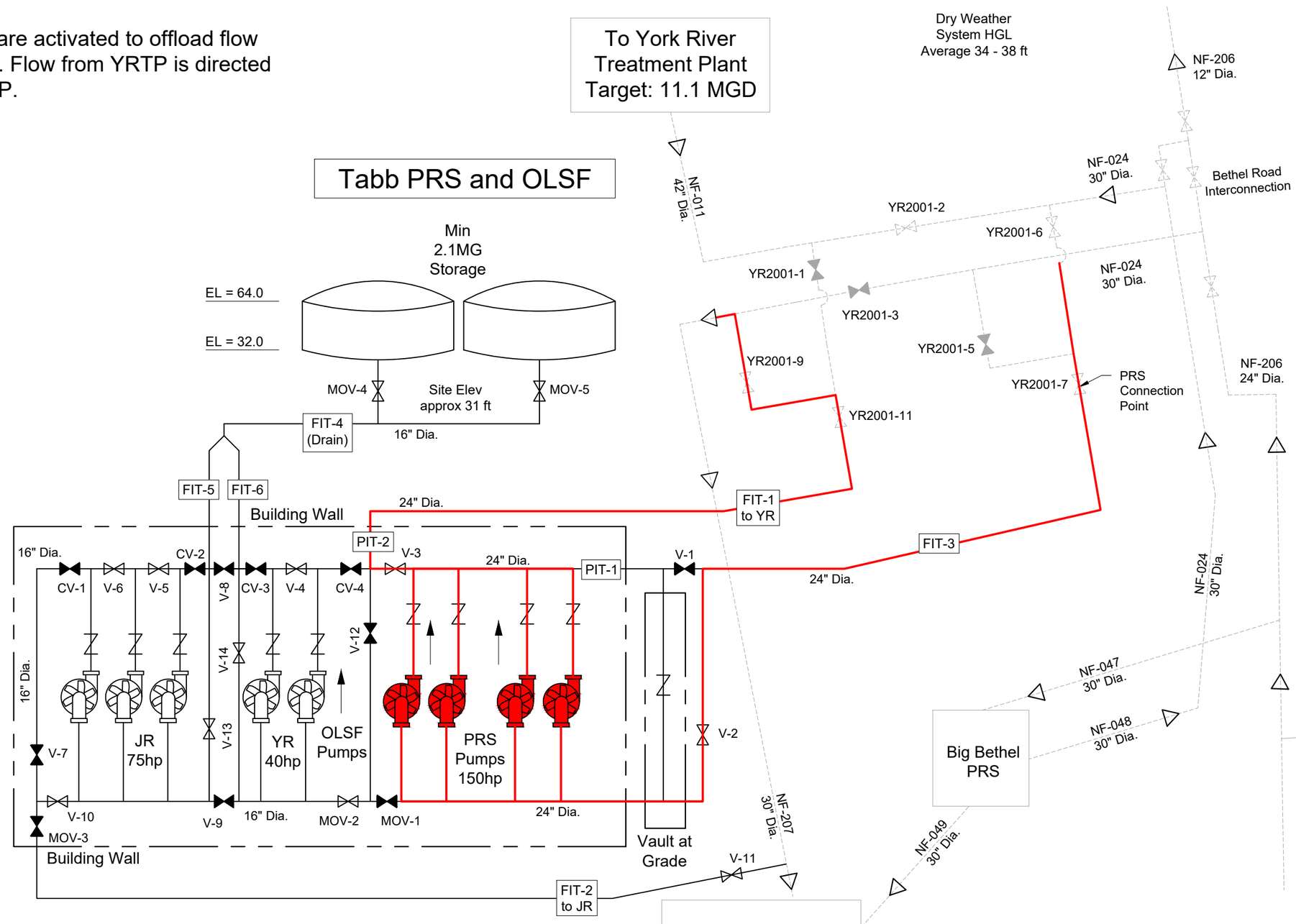
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 5
PRS (ON)/ EQUALIZATION (FILL)

File = O:\32562-HRD\32562-000\CAD_BIM_Project Files\Hazen\System_Map-Scenarios Saved by RMSmith Save date = 10/1/2020 9:21 PM

PRS pumps are activated to offload flow from NF-024. Flow from YRTP is directed towards JRTP.



Hazen

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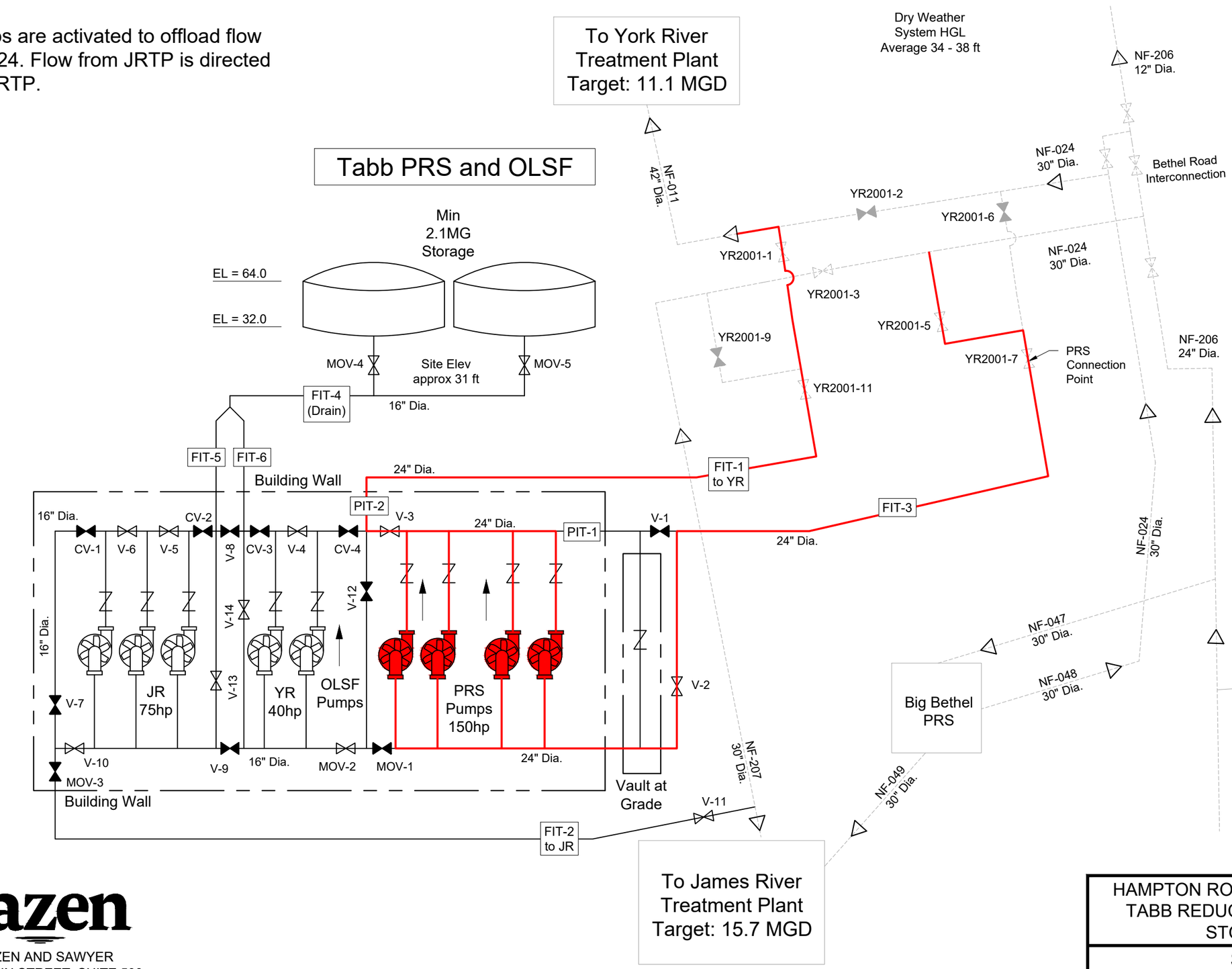
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 6
PRS (ON)/ EQUALIZATION (OFF)
OFFLOAD FLOW YRTP TO JRTP

File = O:\32562-HRD\32562-000\CAD_BIM_Project Files\Hazen\System_Map-Scenarios Saved by RMSmith Save date = 10/1/2020 9:21 PM

PRS pumps are activated to offload flow from NF-024. Flow from JRTP is directed towards YRTP.



Hazen

HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462

HAMPTON ROADS SANITATION DISTRICT
TABB REDUCING STATION & OFF-LINE STORAGE FACILITY

SCENARIO 7
PRS (ON)/ EQUALIZATION (OFF)
OFFLOAD FLOW JRTP TO YRTP

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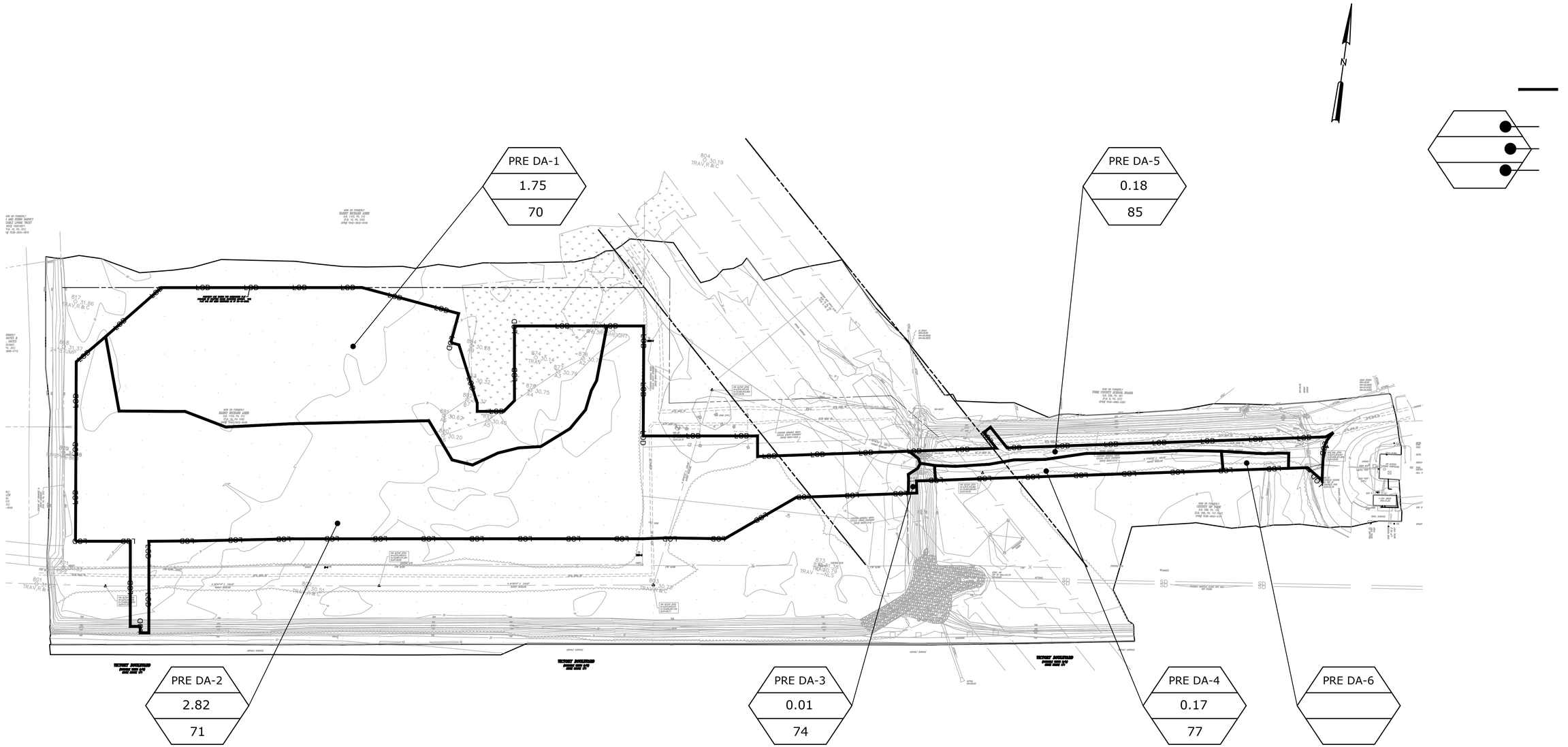
Appendix I: Stormwater



REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

CONCEPTUAL DRAWINGS
DO NOT USE FOR
CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

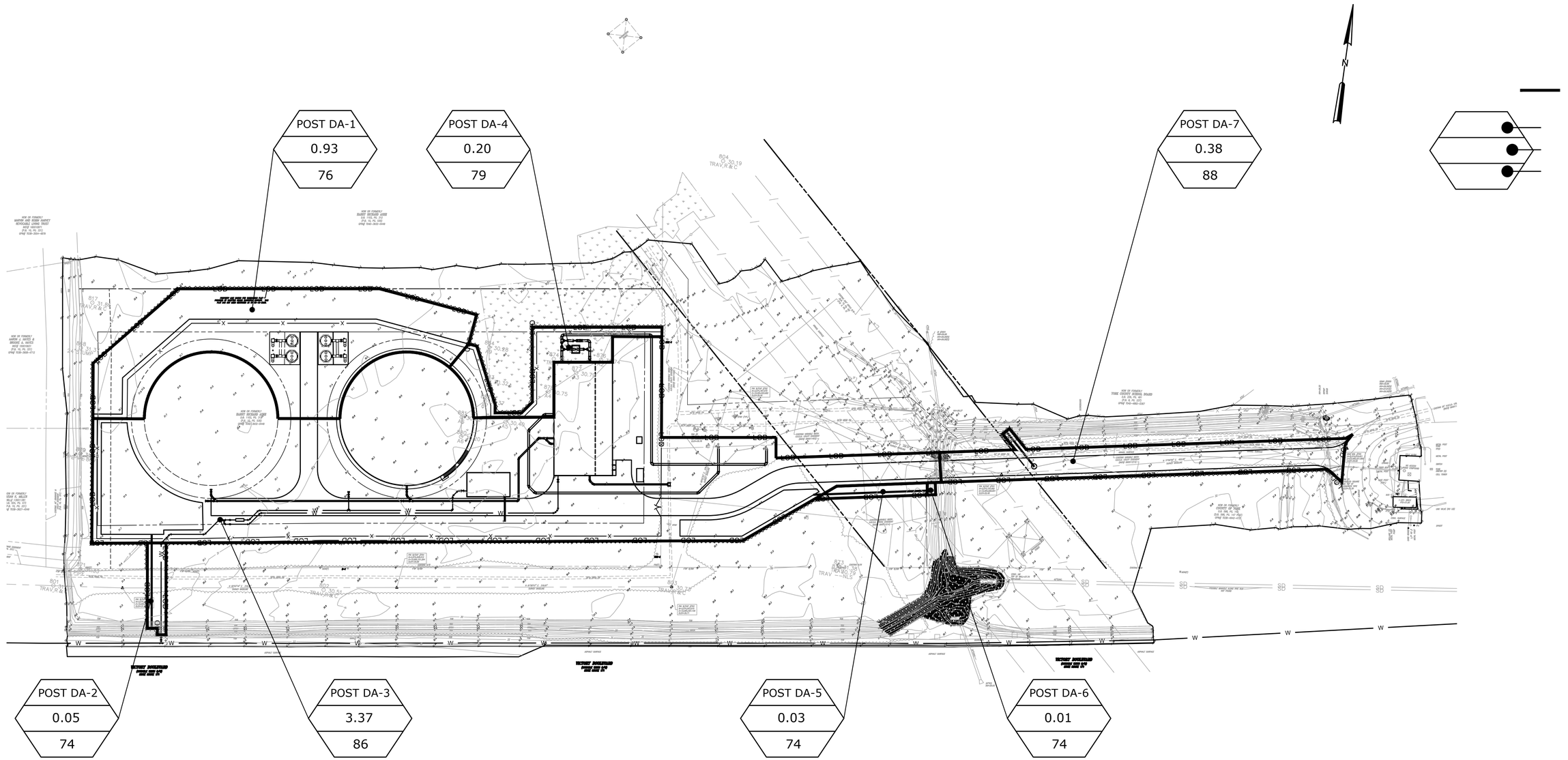
HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

CIVIL

PRE DEVELOPEMENT DRAINAGE MAP

File: O:\32562-HRD\32562-000\CAD_BIM\CIVIL\C05 Saved by NCAROLLO Save date: 9/23/2020 3:06 PM
PLOT DATE: 9/23/2020 3:11 PM BY: NCAROLLO



REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	L. HAMZE
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	B. SLAUGHTER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

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CONSTRUCTION

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VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

CIVIL

POST DEVELOPEMENT DRAINAGE MAP

File: O:\32562-HRD\32562-000\CAD_BIM\CIVIL\C06 Saved by NCAROLLO Save date: 9/23/2020 3:07 PM
PLOT DATE: 9/23/2020 3:13 PM BY: NCAROLLO

Hydrologic Soil Group—James City and York Counties and the City of Williamsburg, Virginia
(HRSD Tabb PRS & OLSF)



Map Scale: 1:2,530 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: James City and York Counties and the City of Williamsburg, Virginia
Survey Area Data: Version 18, Jun 15, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2019—Jul 1, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
5	Bethera silt loam	C/D	6.3	72.0%
18B	Kempsville fine sandy loam, 2 to 6 percent slopes	A	0.0	0.2%
29A	Slagle fine sandy loam, 0 to 2 percent slopes	C	1.4	16.0%
38	Yemassee fine sandy loam	B/D	1.0	11.7%
Totals for Area of Interest			**8.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2011 Stds & Specs**

Site Summary

Project Title: TABB Pressure Reducing Pump Station & Offline Storage Facility
Date: 9.14.2020

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**4.97**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	4.18	0.00	4.18	84
Managed Turf (acres)	0.00	0.00	0.63	0.00	0.63	13
Impervious Cover (acres)	0.00	0.00	0.16	0.00	0.16	3
					4.97	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total	
Forest/Open (acres)	0.00	0.00	0.51	0.00	0.51	10	*
Managed Turf (acres)	0.00	0.00	2.40	0.00	2.40	48	
Impervious Cover (acres)	0.00	0.00	2.06	0.00	2.06	41	
					4.97	100	

*** Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method**

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.50	0.23	0.95	0.12
Treatment Volume (ft^3)	9,095	2,542	6,552	1,386
TP Load (lb/yr)	5.71	1.60	4.12	0.87
	Baseline TP Load (lb/yr):	1.2587*	**Reduction below new development load limitation not required*	

Total TP Load Reduction Required (lb/yr)	**3.68**	0.34	3.34

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
0.28	**1.15**	**0.52**

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	40.88	7.47

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

** Note: % Reduction will reduce post-development TP load to less than or equal to baseline load of 1.26 lb/yr (0.41 lb/ac/yr)*
[Required reduction for Post-ReDev. = Post-ReDev TP load - baseline load of 1.2587 lb/yr], baseline load = site area x 0.41 lb/ac/yr

Total Runoff Volume Reduction (ft^3)	406
Total TP Load Reduction Achieved (lb/yr)	3.69
Total TN Load Reduction Achieved (lb/yr)	19.27
Remaining Post Development TP Load (lb/yr)	2.02
Remaining TP Load Reduction (lb/yr) Required	**0.00**

**** TARGET TP REDUCTION EXCEEDED BY 0.01 LB/YEAR ****

**Reduction below new development load limitation not required*

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	0.51	0.00	0.00	0.00	0.00	0.51
Managed Turf (acres)	2.12	0.00	0.00	0.00	0.00	2.12
Impervious Cover (acres)	2.05	0.00	0.00	0.00	0.00	2.05
Total Area (acres)	**4.68**	**0.00**	**0.00**	**0.00**	**0.00**	**4.68**

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	3.69	0.00	0.00	0.00	0.00	3.69
TN Load Reduced (lb/yr)	19.27	0.00	0.00	0.00	0.00	19.27

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.51	0.00	0.51	11
Managed Turf (acres)	0.00	0.00	2.12	0.00	2.12	45
Impervious Cover (acres)	0.00	0.00	2.05	0.00	2.05	44
					4.68	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	**0.37**	**0.15**	**812.76**	**0.00**	**0.51**	**0.26**	**0.26**	
12.b. Constructed Wetland #2 (Spec #13)	**1.59**	**1.68**	**7,063.25**	**0.00**	**4.43**	**3.32**	**1.11**	
14.a. Manufactured Treatment Device-Hydrodynamic	**0.16**	**0.22**	**886.45**	**0.00**	**0.56**	**0.11**	**0.45**	

Total Impervious Cover Treated (acres)	2.05
Total Turf Area Treated (acres)	2.12
Total TP Load Reduction Achieved in D.A. (lb/yr)	3.69
Total TN Load Reduction Achieved in D.A. (lb/yr)	19.27

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	0.00	0.00	0.00

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		84	0	0	0	0
RR (ft^3)		406	0	0	0	0
1-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	0	0	0	0
2-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	0	0	0	0
10-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	0	0	0	0

Appendix J: Environmental

VCRIS

Virginia Dept. of Historic Resources

V-CRIS

Virginia Cultural Resource Information System

Legend

- Architecture Labels
- Architecture Points
- Historic Districts
- USGS GIS Place names
- County Boundaries



N

Feet

0 200 400 600 800

1:9,028 / 1"=752 Feet

Title: Tabb 1

Date: 6/28/2020

DISCLAIMER:Records of the Virginia Department of Historic Resources (DHR) have been gathered over many years from a variety of sources and the representation depicted is a cumulative view of field observations over time and may not reflect current ground conditions.The map is for general information purposes and is not intended for engineering, legal or other site-specific uses. Map may contain errors and is provided "as-is". More information is available in the DHR Archives located at DHR's Richmond office.

Notice if AE sites:Locations of archaeological sites may be sensitive the National Historic Preservation Act (NHPA), and the Archaeological Resources Protection Act (ARPA) and Code of Virginia §2.2-3705.7 (10). Release of precise locations may threaten archaeological sites and historic resources.

DHR

Arrance, Keven

From: Samantha Henderson <Samantha.Henderson@dhr.virginia.gov>
Sent: Thursday, September 3, 2020 2:40 PM
To: Arrance, Keven
Subject: Tabb Pressure Reducing Station and Off-Line Storage Facility (DHR File No. 2020-4143) | e-Mail #03833

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Caution: *External email – think before you click*

Dear Ms. Arrance:

The Department of Historic Resources (DHR) has received the Tabb Pressure Reducing Station and Off-Line Storage Facility project (DHR File No. 2020-4143) for our review and comment. Our comments are provided as technical assistance in the assessment of potential impacts on historic resources and do not constitute formal State Historic Preservation Office comments under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations at 36 CFR Part 800. The ePIX application identifies the U.S. Army Corps of Engineers (Corps) as the lead federal agency; however, we have not been notified by the Corps or any other federal agency of their involvement with the project. If a federal agency is involved with this project, then that agency has a responsibility to consult directly with our office provided the project is not excluded from review under the terms of an agreement between DHR and the Corps. We reserve the right to provide additional comments under Section 106, if warranted.

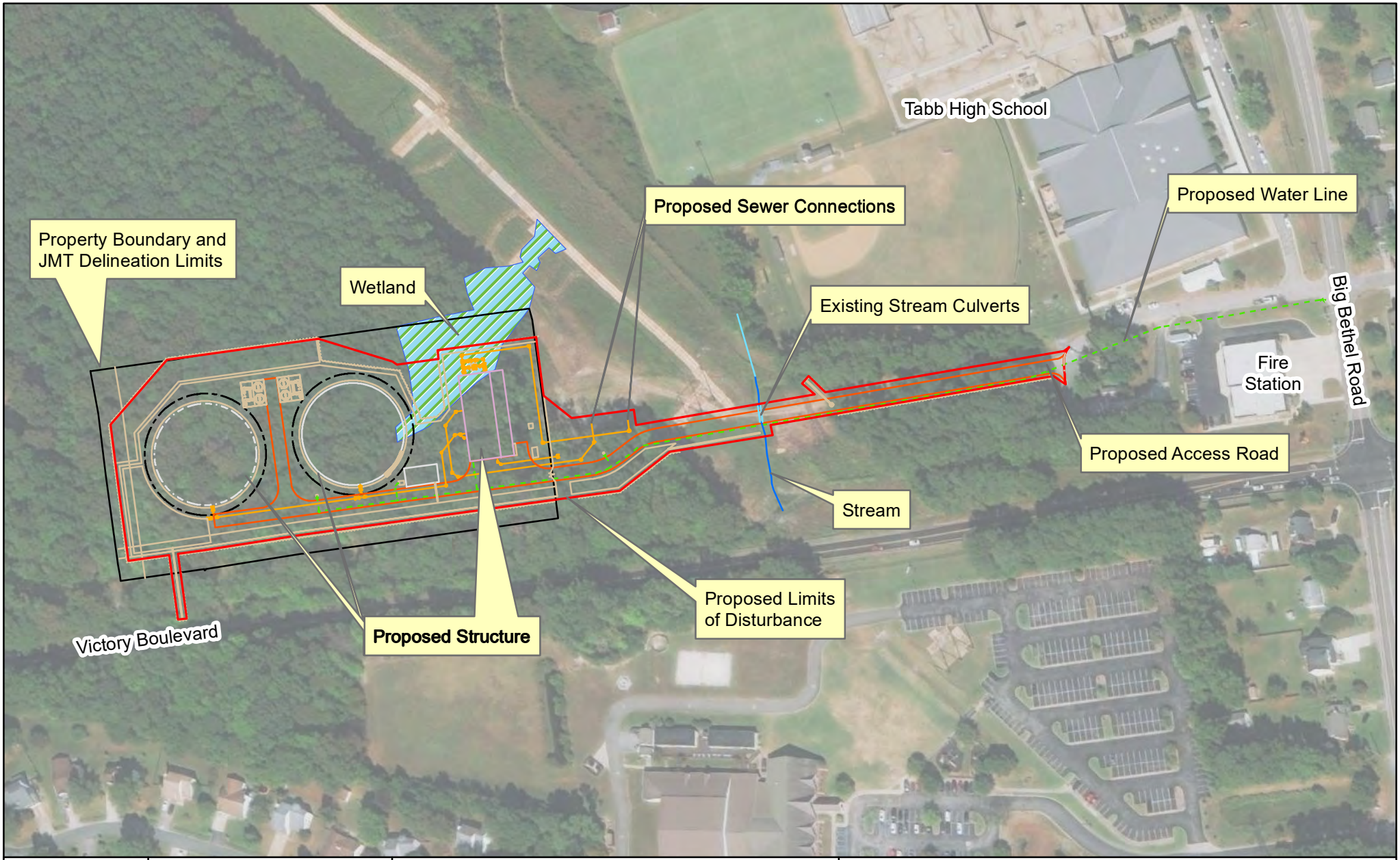
Given the presence of numerous archaeological resources within the vicinity of this project area, it is DHR's opinion that the project area has a potential for unidentified archaeological resources and DHR recommends a Phase I archaeological survey of the project Area of Potential Effects (APE). The studies must be conducted by or under the direct supervision of a qualified professionals meeting the Secretary of the Interior's *Professional Qualification Standards* (48 FR 44738-39) in the appropriate fields, and should be consistent with DHR's *Guidelines for Conducting Historic Resources Survey in Virginia* (September 2017). One bound copy and one digital copy of the resulting report should be submitted to our office for review and approval prior to implementation of the undertaking. After reviewing the results of the studies, we will be able to advise you whether any further investigations and/or mitigative actions are warranted.

Thank you for your consideration of historic resources. Please feel free to contact me if you have any questions regarding our comments or if we can be of any further assistance.

Regards,

Sam Henderson, Archaeologist
Division of Review and Compliance
Phone: (804) 482-6088
Samantha.Henderson@dhr.virginia.gov

Jurisdictional Waters



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S

SCALE

1 inch = 200 feet

0 100 200 Feet

HRSD
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Hazen

Figure 8-1: Jurisdictional Waters Map
Tabb PRS and OLSF
Hampton Roads Sanitation District
York County, Virginia

Invasive Species

Hazen *Memorandum*

August 27, 2020

To: Project File – Hazen Project No. 32562-000

From: Keven Arrance, Senior Principal Scientist

Re: Invasive Species Assessment for the Tabb Pressure Reducing Station and Offline Storage Facility, York County, Virginia for Hampton Roads Sanitation District

Invasive species include nonindigenous or non-native flora, fauna, insects, and aquatic life that adversely affect the habitats or ecosystems into which they are introduced. Invasive species may dominate the new habitat, forcing out existing species by outcompeting native species for nutrients, light, physical space, water, or food. Invasive species can cause harm to natural resources, economic activity, or humans. The Virginia Department of Conservation and Recreation's (DCR) Division of Natural Heritage currently identifies 90 invasive plant species that threaten or potentially threaten natural areas, parks, and other protected lands in Virginia.

An invasive species assessment of the site and immediate vicinity was performed in support of the Envision process, as described in the Preliminary Engineering Report for the subject project. The assessment included identification of species known to be invasive in Virginia, determination of the extent of the spread of the invasive species, and evaluation of the intensity of the infestation at the time of the onsite assessment. The findings of the assessment are described herein and depicted on Figure 1.

Four invasive plant species were identified within or in areas abutting the project site. Johnson grass (*Sorghum halepense*), Chinese lespedeza (*Lespedeza cuneata*), Bradford pear (*Pyrus calleryana*), and Asiatic dayflower (*Commelina communis*) were observed onsite. Johnson grass and Chinese lespedeza are categorized by DCR with a high invasiveness rank. DCR ranks Bradford pear as medium and Asiatic dayflower as low on invasiveness in the state.

Johnson grass, Chinese lespedeza, and Asiatic dayflower were observed along the existing gravel access road. These plants are currently growing in the open area between the access road and the adjacent woods. The infestation covers an area that is approximately 150 feet long and 10 feet wide. Johnson grass provides moderate coverage in the area, and Asiatic dayflower and Chinese lespedeza are minimal constituents of the edge community. Disturbance of the area for construction of the proposed access road provides an opportunity to eliminate the existing invasive plants in this area and to protect against future infestations with timely establishment of temporary and permanent vegetative cover using native species.

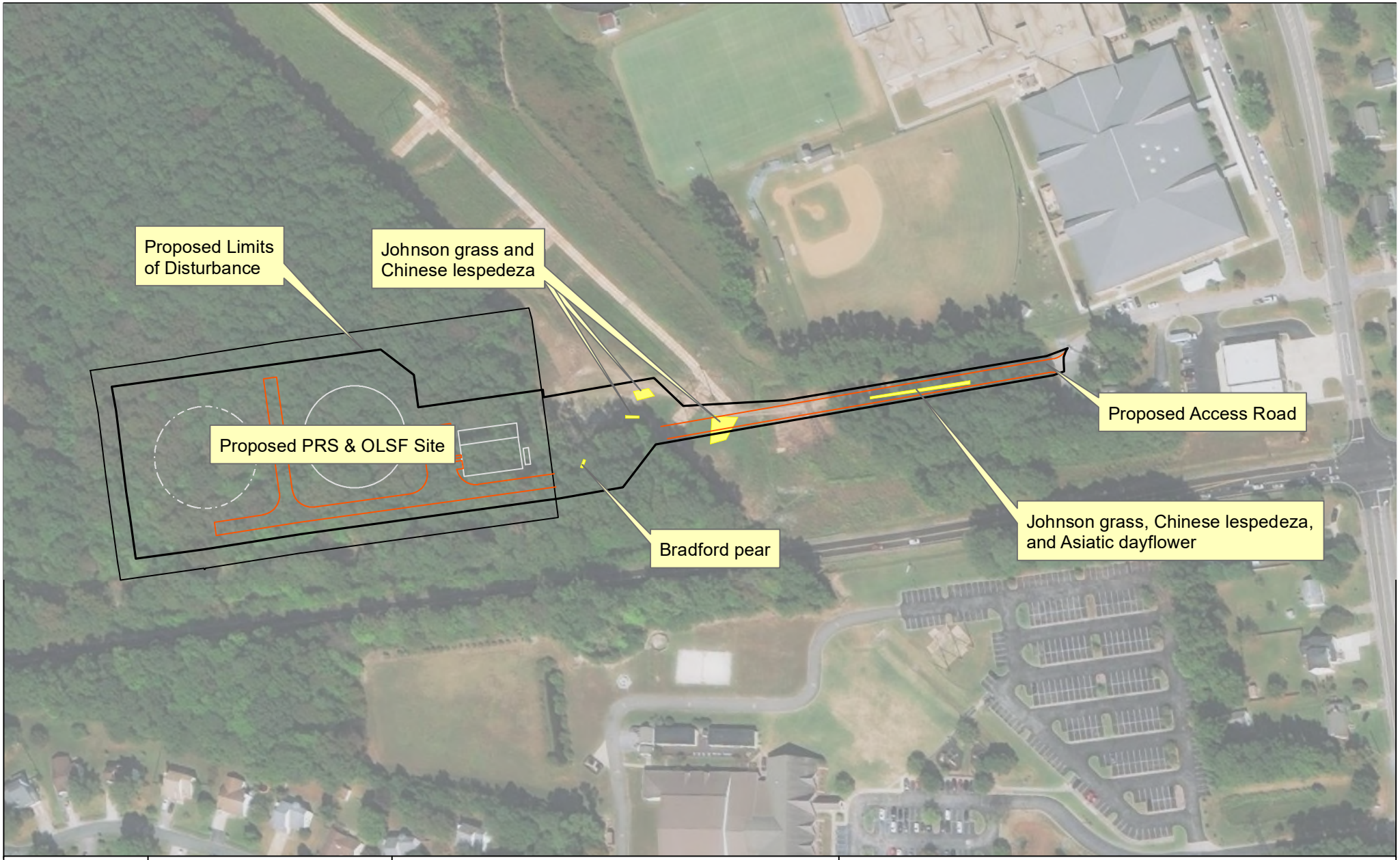
Johnson grass and Chinese lespedeza were observed in non-forested areas associated with the overhead electric easement. Within the project area, two patches of Johnson grass/Chinese lespedeza infestation are located within or abutting the proposed footprint of the access road. These two patches cover approximately 2,000 square feet, representing a moderate infestation within the site. Construction offers an opportunity to eradicate a portion of the existing infestation and protect against future overgrowth. However, adjacent areas under the overhead electric transmission lines that are outside the project site are

more significantly infested than the project site, and the offsite infestation will continue to provide a seed source for future spread of these two invasive species in sunny, open areas.

Bradford pear was observed in the edge of the woods along the eastern edge of the PRS site. The Bradford pear infestation is minimal, represented by a few saplings along the edge of the woodline where full sun is available. The area inhabited by these saplings is proposed to be cleared and built upon. Therefore, the infestation is expected to be eliminated by construction of the project.

The project site and immediate vicinity were visually assessed for the presence of invasive fauna, insects, and aquatic life. The habitats present onsite provide the opportunity for introduction of invasive insects, particularly emerald ash borer, Sirex wood wasp, and imported fire ants. No population or individuals representing these species were observed within or surrounding the project site. No evidence of damage to vegetation characteristic of the emerald ash borer or Sirex wood wasp was observed within the project site. However, it should be noted that intensive surveys specific to these species have not been performed. It is therefore possible that one or more of these species is present and was not detected during onsite investigations.

In summary, four invasive plant species were observed onsite and comprise minimal to moderate infestations. Eradication of the existing infestations onsite is likely to result from clearing and grading activities associated with project construction. Adjacent areas are expected to remain infested with the same species, presenting a challenge for future protection against reinfestation. The risk of reinfestation can be reduced by timely establishment of temporary and permanent ground cover with native vegetation upon completion of final grading.



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SCALE

1 inch = 200 feet

0 100 200

Feet

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Hazen

Figure 1: Invasive Species Map
Tabb PRS and OLSF
Hampton Roads Sanitation District
York County, Virginia

Appendix K: Envision Scoring Summary

Quality of Life

1. WELLBEING

QL 1.1 Improve Community Quality of Life — 0 of 0 Points

Intent: Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities.

Metric: Measures taken to assess community needs and improve quality of life while minimizing negative impacts.

Applicability: It is likely that all projects have the ability to align project objectives with community needs and goals, identified through active engagement, in order to achieve broad community satisfaction. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

	Yes/No
Is this credit applicable?	No

Assessment Questions:		Criteria Met?
A	Has the project team identified and taken into account community needs, goals, and issues?	-
B	Does the project meet or support the needs and goals of the host and/or affected communities?	-
C	Has the project team assessed the social impacts the project will have on the host and affected communities' quality of life?	-
D	Have the affected communities been meaningfully engaged in identifying how the project meets community needs and/or goals?	-
E	Has the project team addressed negative social impacts?	-
F	Are the affected communities satisfied that the project addresses their needs and goals as well as mitigates negative impacts?	-
G	Does the project proactively address long-term social, economic, or environmental changes that impact quality of life?	-
	Yes =	-

QL 1.2 Enhance Public Health and Safety — 20 of 20 Points

Intent: Protect and enhance community health and safety during operation.

Metric: Measures taken to increase safety and provide health benefits on the project site, surrounding sites, and the broader community in a just and equitable manner.

Applicability: It is likely that all projects, large and small, have the ability to positively impact health and/or safety in some way. Safety actions can be relative to the scale of the project, from repainting a crosswalk to preventing major chemical spills. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Does the project meet all health and safety regulations and laws for operations?	Yes
B	Has the project exceeded minimum legal health and safety requirements as established by regulations and laws?	Yes
C	Does the project include health and safety improvements for the immediate surroundings?	Yes
D	Does the project include health and safety improvements for the broader host or affected communities?	Yes
E	Can the project team demonstrate that health and safety risks and impacts are not disproportionately borne by one community over another?	Yes
F	Will the project provide critical infrastructure services to communities experiencing, or at risk of experiencing, imminent negative health and/or personal safety impacts?	Yes
	Yes =	6 of 6

QL 1.3 Improve Construction Safety — 10 of 14 Points

Intent: Enhance public and worker safety during construction.

Metric: Commitments and measures to monitor safety, provide feedback mechanisms, train personnel, establish security plans, and make health programs available.

Applicability: All projects that include construction have the ability to positively impact construction safety. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Have the project owner and contractor (GC/CM) made strong commitments to monitoring and improving health and safety?	Yes
B	Does the project include reliable feedback mechanisms to identify risks, conduct hazard analyses, and communicate hazards to personnel?	Yes
C	Does the project include safety or security training requirements for personnel?	Yes
D	Does the project include a comprehensive security plan to protect workers, the public, and sensitive information?	Yes
E	Does the project include health and/or well-being programs?	No
	Yes =	4 of 5

QL 1.4 Minimize Noise and Vibration — 6 of 12 Points

Intent: Minimize noise and vibrations during operations to maintain and improve community livability.

Metric: The extent that operational noise and vibration is assessed and mitigated, and target levels achieved.

Applicability: Consideration is given to whether the project will have any operational noise. Noises generated by activities induced by the project, such as cars on roads, pedestrians in parks, and trucks accessing facilities, are applicable to this credit. Projects that do not include any operational noise may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team assessed the potential for operational noise impacts on the surrounding community and/or environment?	Yes
B	Has the project mitigated noise generated as a result of the project?	Yes
C	Does the project set or adopt target noise levels?	Yes
D	Has the project team engaged impacted stakeholders on issues of noise and vibration impacts, mitigation strategies, and target levels?	Yes
E	To what extent will the project maintain or reduce existing noise levels? Select one of the following:	No
	None	
	Yes =	4 of 5

QL 1.5 Minimize Light Pollution — 10 of 12 Points

Intent: Reduce backlight, uplight, and glare without jeopardizing safety during operations.

Metric: Lighting meets backlight, uplight, and glare requirements for lighting zones.

Applicability: This credit is not applicable if projects do not include any exterior lighting. Certain types of projects may be required to use lighting that is incompatible with the credit requirements. This is not considered an acceptable reason for designating the credit as not applicable. Projects that are unable to demonstrate achievement in this credit are encouraged to pursue higher performance in other credits.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team conducted an assessment of lighting needs and impacts for the project?	Yes
B	Has the project implemented strategies to reduce light pollution?	Yes
C	Has the project developed a lighting plan establishing lighting zones?	Yes
D	Will luminaires prevent light emission above 90 degrees?	Yes
E	Do all project lights meet backlight, uplight, and glare (BUG) requirements for their respective lighting zones?	Yes
F	Does the project involve the removal or retrofitting of existing lighting so as to significantly reduce overall existing lighting?	No
	Yes =	5 of 6

QL 1.6 Minimize Construction Impacts — 8 of 8 Points

Intent: Minimize or eliminate the temporary inconveniences associated with construction.

Metric: Extent of issues addressed through construction management plans.

Applicability: Consideration is given to whether the project includes construction activities with the potential to impact the quality of life of individuals. Projects that do not include construction impacts (e.g. an internal refurbishment of a private facility or extremely remote site) may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
A	Has the project implemented a construction management plan or policies to address construction impacts?	Yes
B	Does the construction management plan mitigate noise and/or vibrations?	Yes
C	Does the construction management plan address safety and wayfinding for pedestrians and vehicles during construction?	Yes
D	Does the construction management plan maintain access to public space and amenities during construction?	Yes
E	Does the construction management plan address distracting or intrusive lighting during construction?	Yes
F	Does the construction management plan or policies include robust feedback mechanisms and performance monitoring and reporting for construction impacts?	Yes
	Yes =	6 of 6

2. MOBILITY

QL 2.1 Improve Community Mobility and Access — 0 of 0 Points

Intent: Plan the project as part of a connected network that supports all transportation modes for the efficient movement of people, goods, and services.

Metric: The extent to which the project broadens mode choices, reduces commute times, reduces vehicle distance traveled,

Applicability: Consideration is given to whether the project has any potential to impact mobility. Non-transportation projects that do not include any mobility impacts (positive or negative), and can demonstrate no potential for positively impacting mobility, may apply to have this credit deemed not applicable with supporting documentation. This credit is inherently applicable to all transportation infrastructure projects.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Is the project consistent with local transportation plans?	-
B	Has the project team obtained input from the community and key stakeholders regarding issues of mobility and access?	-
C	Does the project include strategies to increase capacity, manage congestion, reduce vehicle distance traveled, or lower accident rates?	-
D	Has the project team worked with the community to expand mobility and access options and/or incorporate complete streets policies?	-
E	Has the project team considered the long-term mobility and access needs of the community?	-
F	Does the project create new or restore previous connections between communities?	-
	Yes =	-

QL 2.2 Encourage Sustainable Transportation — 0 of 0 Points

Intent: Expand accessibility to sustainable transportation choices including active, shared, and/or mass transportation.

Metric: The extent to which active, shared, or mass transportation options are accessible, encouraged, and supported as part of a larger integrated transportation network.

Applicability: Consideration is given to whether the project includes transportation infrastructure, or includes the frequent dependence on transportation for access to the project. This credit is applicable to all transportation infrastructure. Projects that do not include transportation infrastructure and are not accessible, unmanned, or have very small maintenance crews, may apply to have this credit deemed not applicable with supporting documentation.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Does the project provide convenient access to active, shared, or mass transportation options?	-
B	Is the project configured and designed in such a way to encourage active, shared, and/or mass transportation options?	-
C	Does the project include programs and facilities that support the use of active transportation and transit?	-
D	Does the project contribute to a larger integrated active, shared, or mass transportation strategy for the community or region?	-
	Yes =	-

QL 2.3 Improve Access and Wayfinding — 0 of 0 Points

Intent: Design the project to provide safe and appropriate access in and/or around the project in a way that integrates the project with the surrounding community.

Metric: Incorporating and providing clear access, safety, and wayfinding measures to accommodate emergency services and regular vehicular or pedestrian traffic.

Applicability: Consideration is given to the potential for impacting community access on or around the project site. Infrastructure that is inherently inaccessible (e.g., underground) or extremely remote (e.g., inaccessible by public roads) may apply to have this credit deemed not applicable with supporting documentation. Default restrictions on public access are not considered acceptable justification for marking the credit not applicable. This credit is automatically applicable to any project in proximity to populated areas or other development, adjacent to sensitive sites, or involving regular incoming or outgoing traffic.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project addressed access, safety, and wayfinding for incident management including evacuation and emergency personnel?	-
B	Does the project utilize access, safety, and signage to protect or minimize impacts on the surroundings?	-
C	Does the project provide safe public access points for the benefit of the community?	-
D	Does the project have a positive and transformative impact on community neighborhood access, safety, and/or wayfinding?	-
	Yes =	**-**

3. COMMUNITY

QL 3.1 Advance Equity and Social Justice — 0 of 0 Points

Intent: Ensure that equity and social justice are fundamental considerations within project processes and decision making.

Metric: Degree to which equity and social justice are included in stakeholder engagement, project team commitments, and decision making.

Applicability: This credit can be designated as not applicable for projects that do not impact the surrounding community. For example, the installation or refurbishment of systems internal to a facility that do not impact the quality or level of service provided by the infrastructure.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Does the stakeholder engagement process take into account the historic context of equity and social justice within affected communities?	-
B	Has the project team assessed the social impacts the project will have on the host and affected communities?	-
C	Have key members of the project team made commitments to equity and social justice within their organizations?	-
D	Has the project addressed social impacts related to equity and social justice?	-
E	Will the impacts and benefits of the project be distributed equitably throughout affected communities?	-
F	Has the project team empowered communities to engage in the development process?	-
G	Does the project positively address or correct an existing or historic injustice or imbalance?	-
	Yes =	**-**

QL 3.2 Preserve Historic and Cultural Resources — 0 of 0 Points

Intent: Preserve or restore significant historical and cultural sites and related resources.

Metric: Steps taken to identify, preserve, or restore cultural resources.

Applicability: Project teams that are unable to identify any historic or cultural resources relevant to the project may apply to have this credit deemed not applicable with supporting documentation. Supporting documentation should demonstrate how stakeholder engagement activities, cultural resource studies, or equivalent, were implemented in an effort to identify possible historic or cultural resources. This credit is applicable to all infrastructure projects that impact a historic or cultural resource identified in state/provincial, national, or international registries, or identified through stakeholder engagement. This credit is also applicable, and no points achieved, for projects that cannot demonstrate a serious effort was made to identify potential historic or cultural resources.

		Yes/No
	Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project team worked with the community and required regulatory and resource agencies to identify historic and cultural resources?	-
B	Has the project team developed strategies to document, protect, or enhance historic and cultural resources to the project?	-
C	Does the identification of historic/cultural resources extend beyond registries to identify important parts of the community culture?	-
D	Has the project team worked with stakeholders to develop a sensitive design and approach?	-
E	Does the project avoid all historic/cultural resources or fully preserve/protect their character-defining features?	-
F	Does the project enhance or restore threatened or degraded historic/cultural resources in the community, or add a resource to a protected registry?	-
	Yes =	-

QL 3.3 Enhance Views and Local Character — 7 of 14 Points

Intent: Preserve or enhance the physical, natural, and/or community character of the project site and its surroundings.

Metric: Steps taken to assess valued community resources, implement preservation measures, and determine overall satisfaction.

Applicability: Projects that have no public visibility or impact on views, such as underground utilities or the refurbishment of equipment within an existing facility, may submit to have this credit deemed not applicable with supporting documentation. Reviewers are unlikely to accept arguments that a publicly visible project has no impact on views or local character.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team made a reasonable determination of community values and concerns regarding protection and enhancement of views and local character?	Yes
B	Has the project team implemented specific strategies to preserve or enhance views and local character?	Yes
C	Has the project team developed or adopted existing guidelines to preserve views and local character?	Yes
D	Does the project include a construction management plan to protect important natural or man-made features?	Yes
E	Does the community support actions taken to preserve or enhance views and local character?	-
F	Will the project result in the restoration or enhancement of views or local character?	-
	Yes =	4 of 6

QL 3.4 Enhance Public Space and Amenities — 0 of 0 Points

Intent: Improve amenities and publicly accessible spaces to enhance community livability.

Metric: Plans and commitments to preserve, conserve, enhance, and/or restore the defining elements of the amenity.

Applicability: This credit is applicable to projects that are publicly accessible or that impact, adjoin, or otherwise connect to existing public spaces or amenities. This represents the large majority of infrastructure projects. Designating this credit as not applicable can be difficult. Projects that by their nature preclude the possibility of addressing public space or amenities may submit to have this credit deemed not applicable with supporting documentation (e.g., mechanical system refurbishments, offshore wind farms, etc.). Not addressing the potential for public space or amenities is not sufficient alone to designate this credit not applicable. Infrastructure projects, especially those traditionally viewed as inaccessible, are encouraged to consider how they can benefit their surrounding community through the enhancement or provision of public space and amenities.

		Yes/No
	Is this credit applicable?	No

	Assessment Questions:		Criteria Met?
A	Has the project team assessed and mitigated impacts to existing public space and/or amenities?		-
B	Does the stakeholder engagement process specifically address issues of public space and amenities?		-
C	Are public stakeholders satisfied with the project plans involving public space and amenities?		-
D	To what extent does the project involve significantly enhancing, creating, or restoring public space and/or amenities? Select one of the following:	2	No
	None		
		Yes =	-

Envision Framework Pre-Assessment Checklist



Leadership

1. COLLABORATION

LD 1.1 Provide Effective Leadership and Commitment — 18 of 18 Points

Intent: Provide effective leadership and commitment to achieve project sustainability goals.

Metric: The degree to which the project owner and project team have made general, and project-specific, sustainability commitments and instituted sustainability management policies.

Applicability: It is likely that all projects can benefit from effective leadership and strong commitments to sustainability. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
	Have the project owner and project team made written commitments to address the social, environmental, and economic aspects of the project?	
B	Is the project supported by a sustainability management policy commensurate with the scope, scale, and complexity of the project?	
C	Has the project team periodically revisited project sustainability commitments throughout project delivery?	
D	Have key members of the project team made organizational commitments to sustainability?	
	Yes =	4 of 4

LD 1.2 Foster Collaboration and Teamwork — 18 of 18 Points

Intent: Enhance project sustainability through interdisciplinary collaboration and teamwork.

Metric: The breadth and inclusivity of interdisciplinary and collaborative meetings and the resulting sustainability performance enhancements.

Applicability: It is likely that all projects can benefit from better collaboration and teamwork in pursuit of more sustainable projects. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
A	Was an interdisciplinary collaborative kickoff meeting held early in the project to define sustainability goals?	Yes
B	Has project sustainability performance been enhanced as a result of the interdisciplinary collaboration?	Yes
C	Did the project team establish regular interdisciplinary and collaborative meetings to set and achieve sustainability goals?	Yes
D	Does the process include construction, operations, or maintenance stakeholders, for better incorporation of considerations in later project phases?	Yes
	Yes =	4 of 4

Envision Framework
Pre-Assessment Checklist

LD 1.3 Provide for Stakeholder Involvement — 18 of 18 Points

Intent: Early and sustained stakeholder engagement and involvement in project decision making.

Metric: Establishment of sound and meaningful programs for stakeholder identification, early and sustained engagement, and involvement in project decision making.

Applicability: It is likely that all projects can benefit from stakeholder engagement. Although the types and scope of stakeholders may vary depending on the project, it would be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team undertaken a stakeholder mapping exercise to determine stakeholders? Were primary and secondary stakeholders identified through a stakeholder mapping process, and stakeholder concerns and specific objectives for stakeholder engagement defined?	Yes
B	Has the project team analyzed, planned, and executed the engagement for key project stakeholders? Is there a proactive stakeholder engagement process established with clear objectives where: engagement moves beyond education into active dialogue; stakeholder views are monitored, and a two-way line of communication is established to reply to inquiries; and sufficient opportunities are provided for stakeholders to be involved in decision making?	Yes
C	Was a lead member of the project team directly involved with stakeholder groups to understand their needs?	Yes
D	Has stakeholder engagement feedback been incorporated into project plans, design, and/or decision making? Are specific cases in which public input influenced or validated project outcomes, and potentially conflicting stakeholder views were evaluated and addressed equitably during decision making?	Yes
E	Has the project team sought feedback from stakeholders as to their satisfaction with the engagement process and the resulting decisions that were made based on their input?	Yes
F	Has the project engaged one or more stakeholders as partners?	Yes
	Yes =	6 of 6

Envision Framework
Pre-Assessment Checklist

LD 1.4 Pursue Byproduct Synergies — 3 of 18 Points

Intent: Critically reconsider whether traditional waste streams can be beneficially reused.

Metric: The extent to which the project team works with external groups to find beneficial use of waste, excess resources, or capacity.

Applicability: It is likely that all projects that use materials or product waste can benefit from byproduct synergies. It would be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team assessed the availability of either internal or external excess resources or capacity?	Yes
B	Has the project team identified opportunities for byproduct synergies or reuse?	Yes
C	Has the project team actively pursued a byproduct synergy or reuse?	-
D	Does the project include a byproduct synergy by utilizing unwanted excess resources or finding destinations for the beneficial reuse of unwanted excess resources? Select one of the following:	No
	None	
E	Is the project part of a circular economy, whereby the majority of operational byproducts are beneficially repurposed or the majority of operational resources consumed are beneficially repurposed?	No
	Yes =	2 of 5

Envision Framework
Pre-Assessment Checklist

2. PLANNING

LD 2.1 Establish a Sustainability Management Plan — 0 of 18 Points

Intent: Create a project sustainability management plan that can manage the scope, scale, and complexity of a project seeking to improve sustainable performance.

Metric: Extent of organizational policies, authorities, mechanisms, education, and business processes put in place.

Applicability: It is likely that all projects can benefit from a sustainability management plan. It would be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
A	Are roles and responsibilities for addressing sustainability assigned to key members of the project team?	Yes
B	Has a sustainability management plan been developed to assess and prioritize the environmental, economic, and social aspects of the project and set project sustainability goals, objectives, and targets?	No
C	Does the project include a sustainability management plan that contains sufficient processes and management controls to address the sustainability goals, objectives, and targets?	No
D	Was the sustainability management plan implemented and periodically revisited?	No
E	Is the project sustainability management plan adaptable, flexible, and resilient enough to manage changes in the environmental, social, or economic conditions of the project over its life?	No
	Yes =	1 of 5

Envision Framework
Pre-Assessment Checklist

LD2.2 Plan for Sustainable Communities — 0 of 0 Points

Intent: Incorporate sustainability principles into project selection/identification in order to develop the most sustainable project for the community.

Metric: The degree to which project selection/identification includes sustainability performance assessments and is part of a larger sustainable development plan.

Applicability: Consideration is given to the scope and scale of the project and whether it has the potential to more broadly impact community sustainability. For example, small projects that involve the retrofitting or refurbishment of components or systems within an existing facility may contribute to improved sustainability performance but may struggle to demonstrate an impact beyond the project site. Small projects that do not impact the broader community sustainability, and do not have the potential to impact community sustainability, may apply to have this credit deemed not applicable with supporting documentation.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Was sustainability considered during project selection/identification?	-
B	Were alternative analyses conducted on sustainability performance during project identification?	-
C	Was an assessment conducted of the project's impacts to broader long-term community or regional sustainability?	-
D	Is the project part of a comprehensive sustainable development plan?	-
E	Does the project address an inherently unsustainable condition within the community or region?	-
	Yes =	-

LD2.3 Plan for Long Term Monitoring and Maintenance — 12 of 12 Points

Intent: Put in place plans, processes, and personnel sufficient to ensure that long-term sustainable protection, mitigation, and enhancement measures are incorporated into the project.

Metric: Comprehensiveness of long-term monitoring and maintenance plans, implementation goals, and commitment of resources to fund the activities.

Applicability: This credit is applicable to all projects that include ongoing monitoring and maintenance. In rare cases where projects do not include operation or maintenance activities, projects may apply to have this credit deemed not applicable with supporting documentation.

	Yes/No
Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
A	Has the project team considered how to reduce ongoing operational impacts?	Yes
B	Is there a clear and comprehensive plan in place for long-term monitoring and maintenance of the completed project?	Yes
C	Has the monitoring and maintenance plan been communicated with operations and maintenance staff?	Yes
D	Have sufficient resources been allocated for long-term monitoring and maintenance of the completed project and appropriate training been conducted?	Yes
E	Is there a plan in place to re-evaluate and modify the maintenance plan based on monitored data?	Yes
	Yes =	5 of 5

LD2.4 Plan for End of Life — 14 of 14 Points

Intent: Ensure that the project team is informed by an understanding of the full impacts and costs of the project's end-of-life.

Metric: The degree to which the project team analyzes, and communicates with stakeholders, the end-of-life impacts, cost, and value.

Applicability: It is likely that all projects can benefit from end-of-life planning. It would be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team developed an end-of-life plan?	Yes
B	Has the project team evaluated opportunities to extend the project's useful life or beneficially repurpose the project after end-of-life?	Yes
C	Has the project team assessed potential social, environmental, and economic end-of-life impacts?	Yes
D	Has the project team evaluated the costs and salvage value of the project's deconstruction, decommissioning, or replacement?	Yes
E	Has the project team proactively engaged stakeholders in end-of-life planning?	Yes
	Yes =	5 of 5

3. ECONOMY

LD3.1 Stimulate Economic Prosperity and Development — 3 of 20 Points

Intent: Support economic prosperity and sustainable development, including job growth, capacity building, productivity, business attractiveness, and livability.

Metric: The extent of job creation, increased operating capacity, access, quality, and/or improved socioeconomic conditions.

Applicability: The scope of this credit is broad, covering commercial, industrial, cultural, and recreational aspects of community development. In determining whether this credit is applicable to a project assessment, it is likely that all projects have the ability to support and stimulate economic prosperity and sustainable development. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Does the project create a significant number of new jobs during its design, construction, and operation?	Yes
B	Does the project provide new operating capacity for business, industry, or the public?	Yes
C	Does the project provide additional access, increase the number of choices, and/or increase the quality of infrastructure services for business, industry, or the public?	No
D	Does the project improve community attractiveness for business, industry, or the public by generally improving the socioeconomic conditions of the community?	No
E	Will the project stimulate economic prosperity and further economic development?	No
	Yes =	2 of 5

Envision Framework
Pre-Assessment Checklist

LD3.2 Develop Local Skills and Capabilities — 0 of 16 Points

Intent: Expand the knowledge, skills, and capacity of the community workforce to improve their ability to grow and develop.

Metric: The inclusion of current and future training programs, informed by skill or capability gaps, and targeted to economically depressed or underemployed communities.

Applicability: For this credit, an alternative compliance path is provided in the Evaluation Criteria and Documentation Guidance for projects that are too small to include independent training and skill development. It is therefore unlikely that a project could demonstrate no opportunity for education at any point during its planning, design, or construction. When organizational-level training programs are referenced, project teams must demonstrate a relevance to the project.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Will the project include training programs for local skill development?	No
B	Has the project team identified skill or capability gaps in the local workforce and targeted training programs to address them? Select one of the following:	No
	None	
C	Will training, education, or skill development programs continue after project delivery?	No
D	Will training and skill development programs specifically target economically depressed, underemployed, or disadvantaged communities?	No
	Yes =	0 of 4

LD3.3 Conduct a Life Cycle Economic Evaluation — 10 of 14 Points

Intent: Utilize economic analyses to identify the full economic implications and the broader social and environmental benefits of the project.

Metric: The comprehensiveness of the economic analyses used to determine the net impacts of the project, and their use in assessing alternatives to inform decision making.

Applicability: It would be difficult to demonstrate that this credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has a life-cycle cost analysis been conducted to identify the financial impacts of the whole project?	Yes
B	Have life-cycle cost analyses been used to compare alternatives for at least one major project component?	Yes
C	Has the project team mapped the social, environmental, and financial costs and benefits of the project?	Yes
D	Has a cost benefit analysis been conducted to identify the financial, social, and environmental impacts of the whole project?	No
E	Have cost benefit analyses, including financial, environmental, and social benefits, been used to compare the alternatives for at least one major project component?	No
	Yes =	3 of 5

Resource Allocation

1. MATERIALS

RA1.1 Support Sustainable Procurement Practices — 0 of 12 Points

Intent: Develop sustainable procurement policies and programs to source materials and equipment from manufacturers and suppliers that implement sustainable practices.

Metric: The extent of sustainable procurement programs, and the percentage of materials sourced from manufacturers and/or suppliers that implement sustainable practices.

Applicability: This credit is applicable to all projects that include the use or consumption of physical materials in construction or operation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team implemented a sustainable procurement policy or program?	No
B	To what extent do materials, supplies, equipment, manufacturers, and suppliers meet sustainable procurement policy/program requirements? Select one of the following:	No
	None	
		Yes = 0 of 2

RA1.2 Use Recycled Materials — 4 of 16 Points

Intent: Reduce the use of virgin natural resources and avoid sending useful materials to landfills by specifying reused materials, including structures, and material with recycled content.

Metric: Percentage of project materials that are reused or recycled. Plants, soil, rock, and water are not included in this credit.

Applicability: This credit is applicable to all projects that include the use or consumption of physical materials in construction or operation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	To what extent has the project team used recycled materials, including materials with recycled content and/or reused existing structures or materials? Select one of the following:	Yes
	At least 5% (by weight, volume, or cost) of recycled materials including materials with recycled content and/or reused existing structures or materials.	
		Yes = 1 of 1

Envision Framework
Pre-Assessment Checklist

RA1.3 Reduce Operational Waste — 0 of 14 Points

Intent: Reduce operational waste and divert waste streams from disposal to recycling and reuse.

Metric: Percentage of total operational waste or byproducts diverted from disposal.

Applicability: This credit is applicable to all projects that produce operational waste or byproducts. Projects that do not include any operational waste may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team developed a waste management plan to decrease project waste and divert waste from landfills during operation?	No
B	To what extent has the project team reduced waste or diverted waste from landfills? Select one of the following:	No
	None	
		Yes = 0 of 2

RA1.4 Reduce Construction Waste — 0 of 16 Points

Intent: Divert construction and demolition waste streams from disposal to recycling and reuse.

Metric: Percentage of total waste diverted from disposal.

Applicability: This credit is applicable to all projects that produce construction waste. Projects that do not include any construction waste may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team developed a comprehensive waste management plan to decrease project waste and divert waste from landfills during construction?	No
B	To what extent has construction waste been diverted from landfills? Select one of the following:	No
	None	
		Yes = 0 of 2

RA1.5 Balance Earthwork On Site — 6 of 8 Points

Intent: Minimize the movement of soils and other excavated materials off site to reduce transportation and environmental impacts.

Metric: Percentage of excavated material retained on site or nearby.

Applicability: This credit is applicable to all projects that involve the excavation of qualifying earthwork. Projects that do not include any earthwork, or only involve the excavation of excluded material considered contaminated or hazardous, may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of excavated soil is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of excavated material in the context of the project.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	To what extent has the project team designed the project to balance cut and fill to reduce the excavated material taken off site? Select one of the following:	Yes
	Excavated material moved off site and/or fill brought onto the site does not exceed 20% of total site soil handling. OR 100% of fill and excavated materials are sourced or reused within 5 mi/8 km of the site.	

Yes = 1 of 1

2. ENERGY

RA2.1 Reduce Operational Energy Consumption — 6 of 26 Points

Intent: Conserve energy by reducing overall operational energy consumption throughout the project life.

Metric: Percentage of operational energy reductions achieved.

Applicability: This credit is applicable to all projects that consume energy during their operation. Projects that do not include operational energy may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of operational energy use is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of operational energy use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team determined the estimated annual energy consumption of the project during operations?	Yes
B	To what extent has the project reduced operational energy consumption? Select one of the following:	Yes
	Operational energy is reduced at least 10%.	

Yes = 2 of 2

Envision Framework
Pre-Assessment Checklist

RA2.2 Reduce Construction Energy Consumption — 0 of 12 Points

Intent: Conserve resources and reduce greenhouse gases and air pollutant emissions by reducing energy consumption during construction.

Metric: The number of strategies implemented on the project during construction that reduce energy consumption and emissions.

Applicability: This credit is applicable to all projects that consume energy during construction. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award. In rare cases, where the amount of energy used during construction is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of construction energy use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team conducted planning reviews to reduce energy consumption during construction?	No
B	To what extent have energy conservation strategies been implemented during construction? (strategies are listed in the Envision Guidance Manual) Select one of the following:	No
	None	

Yes = 0 of 2

RA2.3 Use Renewable Energy — 15 of 24 Points

Intent: Meet operational energy needs through renewable energy sources.

Metric: Extent to which renewable energy sources are incorporated.

Applicability: This credit is applicable to all projects that consume energy (fuel or electricity) during their operation. Projects that do not include operational energy may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of operational energy use is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of operational energy use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	To what extent does the project meet electricity or fuel needs from renewable sources? Select one of the following:	Yes
	The project meets 30% of energy needs (electricity and fuel) from renewable sources.	

Yes = 1 of 1

Envision Framework
Pre-Assessment Checklist

RA2.4 Commission and Monitor Energy Systems — 0 of 14 Points

Intent: Ensure efficient functioning and extend useful life by specifying commissioning and monitoring of energy systems.

Metric: The inclusion of monitoring equipment and software, the extent of commissioning, and the commissioning agent's independence from the project.

Applicability: This credit is applicable to all projects that consume energy during their operation. Projects that do not include operational energy may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of operational energy use is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of operational energy use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Does the design incorporate advanced integrated monitoring systems in order to enable more efficient operations? Select one of the following:	No
	None	
B	To what extent has a commissioning been conducted? Select one of the following:	No
	None	
C	Is there a plan for ongoing commissioning of the energy systems throughout the project's life?	No
	Yes =	0 of 3

Envision Framework
Pre-Assessment Checklist

RA3.1 Preserve Water Resources — 0 of 0 Points

Intent: Assess and reduce the negative net impact on fresh water availability, quantity, and quality at a watershed scale to positively impact the region's water resources.

Metric: The extent to which the project considers and contributes to positively addressing broader watershed issues.

Applicability: This credit is applicable to all projects that consume water or impact receiving waters. Projects that do not include any impacts to water quantity or quality may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the impact to water quantity or quality is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant impact to water quantity or quality use in the context of the project.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project team conducted a watershed assessment?	-
B	Has the project team estimated the water usage and wastewater generation over the life of the project?	-
C	Does the project include features to minimize the negative impacts of water usage, and/or watershed-scale issues?	-
D	Does the project have a net-zero impact on the quantity and availability of fresh surface water and groundwater supplies without compromising water quality?	-
E	Is the project part of a watershed-level or regional plan?	-
F	Does the project make a direct net-positive improvement to the watershed?	-
	Yes =	**-**

Envision Framework
Pre-Assessment Checklist

RA3.2 Reduce Operational Water Consumption — 17 of 22 Points

Intent: Reduce overall water consumption while encouraging the use of greywater, recycled water, and stormwater to meet water needs.

Metric: Percentage reduction in potable water use and overall water use.

Applicability: This credit is applicable to all projects that consume water during operations. Projects that do not include any operational water consumption may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of water consumption is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of operational water use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team conducted planning and design reviews to identify potable water reduction strategies during operation of the project?	Yes
B	To what extent has the project reduced potable water use? Select one of the following:	Yes
	The project reduces potable water use by at least 95%.	
C	To what extent has the project reduced overall water use (including potable and nonpotable water)? Select one of the following:	Yes
	Overall water use (potable and nonpotable) is reduced by at least 50%.	
D	Does the project have a net positive impact on water use?	No
	Yes =	3 of 4

RA3.3 Reduce Construction Water Consumption — 1 of 8 Points

Intent: Reduce potable water consumption during construction.

Metric: The number of strategies implemented during construction that reduce potable water consumption.

Applicability: This credit is applicable to all projects that consume water during construction. Projects that do not include any operational water consumption may apply to have this credit deemed not applicable with supporting documentation. In cases where the amount of water consumption during operations is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of operational energy use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team conducted planning reviews to reduce water consumption during construction?	Yes
B	To what extent have water conservation strategies been implemented during construction? Select one of the following:	Yes
	At least one (1) potable water conservation strategy is implemented.	
	Yes =	2 of 2

Envision Framework
Pre-Assessment Checklist

RA3.4 Monitor Water Systems — 12 of 12 Points

Intent: Improve operational performance by including monitoring capabilities.

Metric: Extent and capability of water monitoring equipment and inclusion of response plans.

Applicability: This credit is applicable to all projects that consume water during their operation or include the conveyance of large quantities of water. Projects that do not include operational water use or water conveyance may apply to have this credit deemed not applicable with supporting documentation. In rare cases, where the amount of operational water use, or conveyance, is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant quantity of water use in the context of the project.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Does the design incorporate advanced integrated monitoring systems in order to improve performance? Select one of the following:	Yes
	The equipment is capable of monitoring all primary project functions, accounting for at least 95% of water use.	
B	Does the project include real-time water monitoring?	Yes
	Yes =	2 of 2

Envision Framework
Pre-Assessment Checklist

Natural World

1. SITING

NW1.1 Preserve Sites of High Ecological Value — 0 of 0 Points

Intent: Avoid placing the project and temporary works on a site that has been identified as being of high ecological value.

Metric: Avoidance of high ecological value sites and establishment of protective buffer zones.

Applicability: Projects that do not contain areas of high ecological value, and cannot demonstrate they actively avoided areas of high ecological value, may apply to have this credit deemed not applicable with supporting documentation.

			Yes/No
	Is this credit applicable?		No

	Assessment Questions:		Criteria Met?
A	Has the project team identified whether the site contains areas of high ecological value?		-
B	Has the project mitigated any areas of high ecological value that are disturbed? Select one of the following:	2	No
	None		
C	Does the project avoid developing or disturbing areas of high ecological value on site?		-
D	Does the project preserve an effective protective buffer zone around areas of high ecological value?		-
E	Was the project intentionally sited to avoid areas of high ecological value?		-
F	Does the project significantly increase the area of high ecological value?		-
		Yes =	-

Envision Framework
Pre-Assessment Checklist

NW1.2 Provide Wetland and Surface Water Buffers — 0 of 20 Points

Intent: Protect, buffer, enhance, and restore wetlands, shorelines, and waterbodies by providing natural buffer zones, vegetation, and soil-protection zones.

Metric: Type and quality of natural buffer zone established around all wetlands, shorelines, and waterbodies.

Applicability: Projects that do not contain wetlands or surface waters, and for which no siting options containing wetlands or surface waters were possible or seriously considered, may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team identified wetlands and surface waters on or near the site?	Yes
B	Has the project team determined the type and width of buffer zones necessary to protect wetlands and surface waters?	Yes
C	To what extent has the project implemented protective buffer zones around wetlands and surface waters? Select one of the following:	No
	None	
D	Was the project intentionally sited to avoid wetlands and surface waters?	-
E	Will the project involve returning previously developed or disturbed sites within the buffer zone to a natural state?	-
	Yes =	2 of 5

NW1.3 Preserve Prime Farmland — 0 of 0 Points

Intent: Identify and protect soils designated as prime farmland, unique farmland, or farmland of importance.

Metric: Percentage of farmland avoided or preserved during development.

Applicability: Projects that do not contain prime farmland, and for which no siting options containing prime farmland were possible or seriously considered, may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project team assessed the project site for soils identified as prime farmland, unique farmland, or farmland of importance?	-
B	To what extent will the project protect or preserve prime farmland, unique farmland, or farmland or importance? Select one of the following: 2	No
	None	
C	Has the project team mitigated any damage or disturbance to prime farmland, unique farmland, or farmland of importance?	-
D	Was the project intentionally sited to avoid prime farmland?	-
E	Does the project preserve existing farmland for posterity or restore previously disturbed farmland?	-
	Yes =	-

Envision Framework
Pre-Assessment Checklist

NW1.4 Preserve Undeveloped Land — 0 of 24 Points

Intent: Conserve undeveloped land by locating projects on previously developed land.

Metric: Percentage of project development that is located on previously developed land.

Applicability: Assessment of this credit is determined by the extent to which the project is located on previously developed land or previously undeveloped land. As all land falls within these two classifications, it would be difficult to demonstrate that the credit is not applicable. Inability to locate the project on developed land is not sufficient justification to remove this credit from consideration.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	To what extent is the project located on previously developed land? Select one of the following:	No
	None	
B	Has the project returned developed areas to a condition that supports natural open space, habitat, or natural hydrology?	No
	Yes =	0 of 2

2. CONSERVATION

NW2.1 Reclaim Brownfields — 0 of 0 Points

Intent: Locate projects on sites classified as brownfields.

Metric: The extent of remediation of the brownfield site.

Applicability: Project teams that were unable to identify a suitable site may apply to have this credit deemed not applicable with supporting documentation that efforts were made. If no evidence is provided that any consideration was given to locating the project on a brownfield, the credit is considered applicable and no points achieved.

			Yes/No
	Is this credit applicable?		No

	Assessment Questions:		Criteria Met?
A	Is the project located on a site currently identified as a closed brownfield?		-
B	Is the project located on a site currently identified as an active brownfield?		-
C	To what extent has the project mitigated or remediated the site? Select one of the following:	2	No
	None		
D	Has the brownfield site been closed or deregulated?		-
		Yes =	-

Envision Framework
Pre-Assessment Checklist

NW2.2 Manage Stormwater — 0 of 24 Points

Intent: Minimize the impact of development on stormwater runoff quantity, rate, and quality.

Metric: Degree to which the project infiltrates, evapotranspirates, reuses, and/or treats stormwater while not exceeding rate or quantity runoff targets.

Applicability: This credit is applicable to all projects that impact stormwater runoff. In rare cases, where the impact on stormwater runoff is insignificant in comparison to the scale of the project, teams may apply to have this credit deemed not applicable with supporting documentation. However, the reviewer may exercise his/her discretion in determining what constitutes an insignificant impact on stormwater runoff in the context of the project.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	To what extent does the project infiltrate, evapotranspirate, reuse, and/or treat stormwater on site? Select one of the following:	No
	None	
B	To what extent does the completed project limit rate or quantity of runoff compared to existing conditions? Select one of the following:	No
	None	
C	Does the project include an erosion, sedimentation, and pollution control plan for all construction activities?	Yes
D	Does the project treat stormwater from other sites or does it function as part of a larger stormwater management plan?	No
	Yes =	1 of 4

NW2.3 Reduce Pesticide and Fertilizer Impacts — 9 of 12 Points

Intent: Reduce non-point-source pollution by reducing the quantity, toxicity, bioavailability, and persistence of pesticides and fertilizers.

Metric: Reductions in quantity, toxicity, bioavailability, and persistence of pesticides and fertilizers used on site, selection of plant species, and use of integrated pest management techniques.

Applicability: Consideration is given as to whether the scope of the project includes exterior vegetated areas. Projects that do not include exterior vegetated areas may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Have operational policies and programs been put in place to control the application of fertilizers and pesticides?	Yes
B	Have runoff controls been put in place to minimize contamination of groundwater and surface water?	Yes
C	To what extent has the project team designed landscaping to require fewer pesticides and fertilizers? Select one of the following:	Yes
	Landscaping is designed with plant species that do not require pesticides or fertilizers.	
D	Has the project team selected pesticides and fertilizers that have lower toxicity, persistence, and bioavailability?	Yes
	Yes =	4 of 4

Envision Framework
Pre-Assessment Checklist

NW2.4 Protect Surface and Groundwater Quality — 5 of 20 Points

Intent: Preserve water resources by preventing pollutants from contaminating surface water and groundwater and monitoring impacts during construction and operations.

Metric: Designs, plans, and programs instituted to prevent and monitor surface water and groundwater contamination during construction and operations.

Applicability: This credit is applicable to all projects that contain or use hazardous and/or potentially polluting substances with the potential to contaminate water sources. In addition to chemical use, project teams should consider how chemical leaching from materials may be a source of contamination.

		Yes/No
	Is this credit applicable?	Yes

Assessment Questions:		**Criteria Met?**
A	Has project team determined the potential for surface water and/or groundwater contamination during construction and operations?	Yes
B	Does the project include spill and leak prevention and response plans, and avoid creating new pathways for contamination during construction and operations?	Yes
C	Based on the types of impacts identified in criterion A, does the project reduces the risk of quality degradation to surface water and/or groundwater? This should include water temperature.	Yes
D	Have adequate and responsive surface water and/or groundwater quality monitoring and reporting systems been incorporated into the project?	No
E	Has the project actively eliminated at least one source of hazardous and/or potentially polluting substances, or replaced them with nonhazardous or nonpolluting substances or materials?	No
F	Does the project improve surface water and/or groundwater quality?	No
	Yes =	3 of 6

2. ECOLOGY

NW3.1 Enhance Functional Habitats — 2 of 18 Points

Intent: Preserve and improve the functionality of terrestrial (land) habitats.

Metric: The number of habitat functions addressed in order to preserve or enhance the net area and quality of functional habitat.

Applicability: Consideration is given to whether the project contains or impacts natural habitat. Projects that do not contain or impact natural habitat may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team identified existing terrestrial habitats and sited the project to minimize impact?	Yes
B	Does the project mitigate all disturbances to functional terrestrial (land) habitats? Select one of the following:	Yes
	The project ensures that no existing habitats are disturbed or damaged.	
C	Does the project increase the quantity of terrestrial habitat?	No
D	Does the project improve the quality of any existing or proposed new terrestrial habitat?	No
E	Does the project facilitate movement between terrestrial habitats, provide new connections, or remove barriers, in order to improve habitat connectivity?	No
F	Does the project return developed land to natural habitat, or set aside existing habitat for permanent conservation and protection?	No
	Yes =	2 of 6

Envision Framework
Pre-Assessment Checklist

NW3.2 Enhance Wetland and Surface Water Functions — 3 of 20 Points

Intent: Maintain and restore the ecosystem functions of streams, wetlands, waterbodies, and their riparian areas.

Metric: Number of functions maintained and restored.

Applicability: Consideration is given to whether the project contains or impacts wetlands or surface waters. This includes direct, indirect, and/or cumulative impacts. Projects that do not contain or impact natural wetlands or surface waters may apply to have this credit deemed not applicable with supporting documentation

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team identified impacts to wetland and surface water functions?	Yes
B	Does the project minimize and mitigate disturbance to wetland and surface water functions? Select one of the following:	Yes
	Efforts are made to avoid and minimize negative impacts to wetland and surface water functions and to compensate for remaining unavoidable losses. Mitigation measures must maintain net aquatic habitat quality and quantity and follow a hierarchy that prioritizes avoidance, minimization, restoration, and compensation	
C	Does the project protect or restore hydrologic connection?	No
D	Does the project protect or restore water quality?	No
E	Does the project protect or restore aquatic habitat?	No
F(1)	Does the project protect sediment transport and reduce sedimentation?	Yes
F(2)	In addition to protecting all existing wetland and surface water functions, can the project demonstrate it has restored at least one previously degraded wetlands and/or surface water function?	No
	Yes =	3 of 7

Envision Framework
Pre-Assessment Checklist

NW3.3 Maintain Floodplain Functions — 0 of 0 Points

Intent: Preserve floodplain functions by limiting development and impacts of development in the floodplain.

Metric: Efforts to avoid floodplains or maintain natural-acting floodplain functions.

Applicability: Projects that are not within the floodplain and do not impact floodplain functions, may apply to have this credit deemed not applicable with supporting documentation. Some projects that are not directly within the floodplain may still have an impact on flooding and floodplain functions through their handling of stormwater runoff. These projects may also pursue achievement in this credit if they can demonstrate a direct connection to the floodplain. There are strong links between this credit and NW2.2 Manage Stormwater, and some project components and strategies may apply to both credits.

			Yes/No
	Is this credit applicable?		No

	Assessment Questions:		Criteria Met?
A	Has the project team identified the 100-year or design frequency floodplain in relation to the project location?		-
B	To what extent does the project preserve vegetated zones within the floodplain? Select one of the following:	2	No
	None		
C	Does the project mitigate impacts to floodplain functions?		-
D	Was the project intentionally sited to avoid floodplains?		-
E	Does the project remove structures from the floodplain or return previously developed areas to a vegetated state?		-
		Yes =	-

NW3.4 Control Invasive Species — 1 of 12 Points

Intent: Use appropriate noninvasive species, and control or eliminate existing invasive species.

Metric: Degree to which invasive species have been reduced or eliminated.

Applicability: This credit is applicable to all projects with sites that contain invasive species. Project teams that conduct site investigations and do not identify existing invasive species may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	**Criteria Met?**
A	Does the project avoid introducing invasive species to the site?	Yes
B	Has the project team conducted a site assessment to determine if invasive species are present?	No
C	Does the project implement controls for existing infestations of invasive species before, during and post-construction?	Yes
D	Does the project guard against future infestations by supporting the establishment of native and/or noninvasive species?	Yes
E	Does the project provide long-term controls to prevent the reintroduction of invasive species?	Yes
F	Does the project include the ongoing control, suppression, or containment of major infestations of invasive species after construction?	Yes
	Yes =	5 of 6

Envision Framework
Pre-Assessment Checklist

NW3.5 Protect Soil Health	4 of 8 Points

Intent: Preserve the composition, structure and function of site soils.

Metric: Degree to which the disruption of soil health has been minimized and restored.

Applicability: This credit is applicable to all projects that impact soils during construction. Projects that do not impact soil (e.g. the internal refurbishment of an existing facility) may apply to have this credit deemed not applicable with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team limited the area that is disturbed by development activities?	Yes
B	Have vegetated areas disturbed by development activities been restored for appropriate soil type, structure, and function to support healthy plant and tree growth?	Yes
C	Has the project team implemented a soil protection plan or policies? Select one of the following:	Yes
	A soil protection plan, or policies, are prepared and implemented. The plan/policies specifically include any special landscape features.	
D	Has the project restored appropriate soil type, structure, and function to vegetated areas disturbed by previous development?	No
	Yes =	3 of 4

Climate And Resilience

1. Emissions

CR1.1 Reduce Net Embodied Carbon — 0 of 20 Points

Intent: Reduce the impacts of material extraction, refinement/manufacture, and transport over the project life.

Metric: Percentage of reduction in net embodied carbon of materials.

Applicability: This credit is applicable to all projects that include the use or consumption of physical materials in construction or operation.

		Yes/No
	Has the project team determined materials that are the primary contributors to embodied carbon for the project during construction and operation?	
B	Has the project team calculated the primary contributors to overall embodied carbon?	
C	To what extent does the project reduce the net embodied carbon of materials used in construction and operation? Select one of the following:	No
	None	
	Yes =	0 of 3

CR1.2 Reduce Greenhouse Gas Emissions — 13 of 26 Points

Intent: Reduce greenhouse gas emissions during the operation of the project, reducing project contribution to climate change.

Metric: Percentage of reduction in operational greenhouse gas emissions.

Applicability: This credit is applicable to all projects that consume energy, fuel, or otherwise produce greenhouse gas emissions during their operation. Projects that do not include greenhouse gas emissions during operations may apply to have this credit deemed not applicable with supporting documentation. However, projects that do not produce greenhouse gas emissions because of intentional planning decisions may apply for the Conserving level with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	To what extent does the project reduce greenhouse gas emissions during its operational life? Select one of the following:	Yes
	The project team demonstrates at least a 25% reduction in total CO2e over the operational life of the project compared to the baseline.	
B	Has the project team calculated and reported the annual greenhouse gas emissions of the project?	Yes
	Yes =	2 of 2

Envision Framework
Pre-Assessment Checklist

CR1.3 Reduce Air Pollutant Emissions — 9 of 18 Points

Intent: Reduce emissions of air pollutants: particulate matter (including dust), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, and volatile organic compounds.

Metric: Reduction of air pollutants compared to baseline.

Applicability: This credit is applicable to all projects that directly produce any of the criteria pollutants. Projects that do not include air pollutant emissions may apply to have this credit deemed not applicable with supporting documentation. However, projects that do not produce air pollutant emissions because of intentional planning decisions to choose non-polluting alternatives may apply for the Conserving level with supporting documentation.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Does the project meet all relevant minimum air quality standards and regulations?	Yes
B	To what extent does the project reduce air pollutant emissions during operations? Select one of the following:	Yes
	Air pollution controls are within the 95th percentile, or represent the lowest levels possible compared to projects of similar type.	
C	Does the project include the ongoing monitoring and management of direct air pollutant emissions?	Yes
D	Has the project team assessed the materiality of volatile organic compounds to the health of construction workers and the project operators?	Yes
E	Does the project remove existing air pollutant sources?	No
	Yes =	4 of 5

2. RESILIENCE

CR2.1 Avoid Unsuitable Development — 0 of 0 Points

Intent: Minimize or avoid development on sites prone to hazards.

Metric: The degree to which the project is designed and/or sited to avoid or mitigate site-related risks.

Applicability: Projects that are not located within regions at risk of site hazards, and therefore cannot demonstrate they actively avoided site hazards, may apply to have this credit deemed not applicable with supporting documentation.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project team identified potential siting hazards, the vulnerability of the project to the hazard, and the potential for the project to exacerbate the hazard?	-
B	Can the project team demonstrate that siting and project alternatives were seriously considered in order to minimize exposure to risk?	-
C	Has the project team implemented strategies to mitigate the impact of site hazards?	-
D	Can the project team demonstrate that the chosen project and site resulted in the lowest exposure to site hazards while still meeting project requirements?	-
E	Was the site chosen to intentionally avoid known site hazards?	-
F	Does the project remove or modify structures subject to frequent damage?	-
	Yes =	-

CR2.2 Assess Climate Change Vulnerability — 0 of 0 Points

Intent: Develop a comprehensive climate change vulnerability assessment.

Metric: Scope and comprehensiveness of climate change vulnerability assessment.

Applicability: This credit is applicable to all projects potentially impacted by climate change, which is the vast majority of infrastructure.

	Yes/No
Is this credit applicable?	No

	Assessment Questions:	Criteria Met?
A	Has the project team determined climate change threats to the project and its surroundings?	-
B	Has the project team determined the vulnerability of the project to climate change threats?	-
C	Has the project team determined the vulnerability of the infrastructure system to climate change threats?	-
D	Has the project team determined the vulnerability of the community to climate change threats?	-
E	Has the project team or owner shared their climate threat findings?	-
	Yes =	-

Envision Framework
Pre-Assessment Checklist

CR2.3 Evaluate Risk and Resilience — 18 of 26 Points

Intent: Conduct a comprehensive, multihazard risk and resilience evaluation.

Metric: Scope and comprehensiveness of the multihazard risk and resilience evaluation.

Applicability: It is likely that all projects would benefit from a thorough investigation of potential risks. It would, therefore, be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award. Risks are not always major catastrophic events; small and large projects alike may consider how crime/vandalism or personal injury are also potential risks with associated impacts.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	To what extent does the project team's risk assessment include the project, infrastructure system, and community? Select one of the following:	Yes
	The project team draws the assessment boundary for subsequent criteria (B, C, D, and E) around the interdependencies of the project and its associated/connected infrastructure system/network.	
B	Has the project team identified the critical functions and dependencies of the infrastructure asset and its primary components?	Yes
C	Has the project team identified the threats or hazards to the project and its surroundings?	Yes
D	Has the project team identified the vulnerabilities of the critical functions and dependencies of the infrastructure asset?	Yes
E	Has the project team evaluated risks by determining the probability of a threat or hazard occurring and the associated impacts?	Yes
F	Did the risk evaluation conducted by the project include the participation of the owner and a diverse and integrated team of key stakeholders?	Yes
	Yes =	6 of 6

CR2.4 Establish Resilience Goals and Strategies — 14 of 20 Points

Intent: To support increased project and community resilience through the establishment of clear objectives and goals.

Metric: The degree to which resilience goals expand from initial commitments to quantifiable project objectives, long-term operating plans, and community-wide development plans.

Applicability: All projects that are exposed to risks would benefit from establishing resilience goals and strategies. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes
Assessment Questions:		**Criteria Met?**
A	Has the project team identified the project performance goals and risk appetite of the owner?	Yes
B	Has the project team developed risk management strategies based on a comprehensive risk evaluation?	Yes
C	Have key stakeholders been engaged in developing resilience goals?	Yes
D	Is the project part of, or does it support, larger community resilience or climate change adaptation goals?	No
	Yes =	3 of 4

Envision Framework
Pre-Assessment Checklist

CR2.5 Maximize Resilience — 20 of 26 Points

Intent: Increase resilience, life-cycle system performance, and the ability to withstand hazards by maximizing durability.

Metric: The degree to which the project incorporates elements that increase durability, the ability to withstand hazards, and extend useful life.

Applicability: All projects that are exposed to risks would benefit from increased resilience. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Has the project team developed resilience goals and strategies based on a comprehensive risk evaluation?	Yes
B	Has the project team implemented resilience strategies sufficient to address major project risks and improve project resilience?	Yes
C	Has the project team periodically monitored the implementation of project resilience strategies and reviewed their continued effectiveness throughout project delivery?	Yes
D	Will resilience goals and strategies be incorporated into the ongoing operations and maintenance of the project?	Yes
E	Does the project include methods for measuring or quantifying resilience performance targets?	No
	Yes =	4 of 5

CR2.6 Improve Infrastructure Integration — 18 of 18 Points

Intent: Enhance the operational relationships and strengthen the functional integration of the project into connected, efficient, and diverse infrastructure systems.

Metric: The degree to which the project is integrated into other connected systems, where beneficial and appropriate, in order to increase resilience and systems performance.

Applicability: It is likely that all infrastructure would, and should, benefit from the application of an integrated systems approach. It would therefore be difficult to demonstrate that the credit is not relevant or applicable to a project seeking an Envision award.

		Yes/No
	Is this credit applicable?	Yes

	Assessment Questions:	Criteria Met?
A	Does the project increase internal systems integration?	Yes
B	Will the infrastructure integration reduce the risk of systemic or cascading failures?	Yes
C	Does the project increase external systems integration?	Yes
D	Does the project integrate infrastructure networks?	Yes
E	Does the project integrate data or monitoring systems in order to improve performance?	Yes
	Yes =	5 of 5

Appendix L: Preconstruction Assessment

Hazen

October 2, 2020

To: Tabb PRS and OLSF - File

From: Kyle Thompson, PE

Re: HRSD Tabb Pressure Reducing Station and Offline Storage Facility
Preconstruction Assessment and Damage Mitigation Memorandum

Preconstruction Assessment and Damage Mitigation

Introduction

In recent years, HRSD has received an increasing number of complaints from residents and locality staff regarding the condition of roads, sidewalks, drainage ditches, private property, damage to buildings, etc. within close proximity to active construction. This assessment provides evaluation of the potential construction related impacts to the surrounding area as well as monitoring and potential remediation strategies.

Project Background

The Tabb Pressure Reducing Station and Off-Line Storage Facility is a partially buried pressure reducing pump station and up to two (2) 2.5 million-gallon storage tanks to be constructed in York County, in the vicinity of Tabb High School. The system will be utilized to divert flow during peak events, store flow until system pressures subside, and return stored flows back into the HRSD system. This project will provide flexibility in the interceptor system during both dry weather and wet weather events, enhance treatment operations at the James River Treatment Plant, and satisfy one of the requirements of the Regional Wet Weather Management Plan. The Tabb PRS and OLSF will include a storage tank, pump station, control room, generator room, and odor control system. Specific work includes clearing of the property, construction of buried piping, storage tank foundation and associated pile supports, above and below grade PRS facility, incidental concrete work, site work and stormwater system accommodations, instrumentation and control systems, HVAC systems, odor control systems, potable water systems, flushing/cleaning systems and all other incidental electrical, I&C, and structural work. The project is tentatively scheduled to proceed to construction in early 2021.

1. Construction Impact Research and Evaluation

1.0 Soil Conditions

Based upon the boring log information that was gathered during the preliminary site exploration, soil conditions were identified primarily as sand (SP and SP-SM) and silty sand (SM) with small amounts of clay identified 12-15 feet below grade. Soils which were found to be sand and silty sand appear to be suitable for re-use as structural fill material. Areas where uncontrolled fill appear present in the top two feet of soil will require removal in locations where foundations are to be present. For a full detailed report of soil conditions onsite, reference **Appendix B** of the Tabb PRS and OLSF Preliminary Engineering Report.

1.1 Previous Projects in the Area of Similar Scope

In 2011, HRSD constructed the Coliseum Drive Pressure Reducing Station and Offline Storage Facility at 166 Butler Farm Road in Hampton, VA. The project consisted of the construction of a partially below-grade pressure reducing station, an above grade prestressed concrete storage tank, odor control system, and associated yard piping.

1.2 Sensitive Structures in the Vicinity of Project Site

The proposed project site is located in the vicinity of various structures, Owner's of which have been identified as stakeholders in the preliminary engineering report. Structures with the potential to experience impacts from the construction process include:

- Tabb High School
- York County Fire Station No. 2
- Peninsula Community Chapel
- Residential Houses located in the neighborhoods of Hollymeade and Meadowlake Farms

Potential impacts for each of the structures listed will be identified and evaluated in detail as described in Section 2 of this memorandum. A map indicating all sensitive structures surrounding the proposed site location can be found in **Appendix C**.

1.3 Anticipated Construction Means and Methods

For the Tabb PRS and OLSF, Preconstruction Assessment and Damage Mitigation evaluation was based upon Section 12 of HRSD's Design and Construction Standards dated January 2020. The design team utilized a 6-phase construction activity approach as shown in Table 1. Specific equipment anticipated with each phase of work is further detailed in the phased construction tables provided in **Appendix A** of this document.

Table 1

PHASE	ACTIVITY	DESCRIPTION
1	Clearing & Grubbing	Activities consist of removal of vegetation, topsoil, trees, root matt, and unsuitable fill in the areas of construction and construction access.
2	Excavation and Sedimentation Control	Activities consist of installation of erosion and sediment control elements, sediment traps, tree removal, and preliminary excavations as needed to prepare for dewatering efforts.
3	Dewatering Operations	Activities consist of installation of a well-point system and likely shoring for dewatering operations to the required depths of construction.
4	Pile Driving	Activities consist of pile driving for the tank foundation and continued dewatering operations.
5	Utility, Tank, and PRS Construction	Activities consist of concrete placement for the tank and PRS, installation of below ground utilities, and all general construction activities.
6	Backfill & Grading	Activities consist of backfilling of soils for tank and final grading.

1.4 Potential Construction Related Impacts

Construction impact research and investigations for this project and related activities on the Tabb PRS and OLSF site considered means and methods of the proposed work and was based on input from GET in combination with Hazen's design team's analysis of the following anticipated construction related impacts:

- Noise Generation and Impacts from construction equipment such as dewatering pumps, excavators, dump trucks, dozers, soil compactors, and pile driving activities.
- Vibration Impacts from construction equipment such as excavators, dump trucks, dozers, soil compactors, and pile driving activities.
- Dewatering Impacts on Ground Structures and Settlement as they relate to the extents of the cone of depression for the ground watering operations.
- Permanent Impacts to existing topography are anticipated to be minimal due to the preliminary site layout and the existing site topography being relatively flat. Project design will include final grading and drainage plans to properly route all stormwater runoff resulting from any changes to existing topography upon the completion of construction. Topography during construction may be manipulated to assist in the mitigation of noise impacts to the surrounding areas as discussed in Section 2.
- Additional possible impacts from construction including dust, odor, and emissions are expected to be negligible. Provided the project location, a vegetative buffer will remain in place throughout

the entirety of construction that will prevent these items from being impactful to the surrounding stakeholders.

- Construction travel routes are currently planned to be routed to site access along Big Bethel Rd. The use of a site entrance at this location will minimize impacts to traffic along the primary thoroughfare of Victory Blvd.

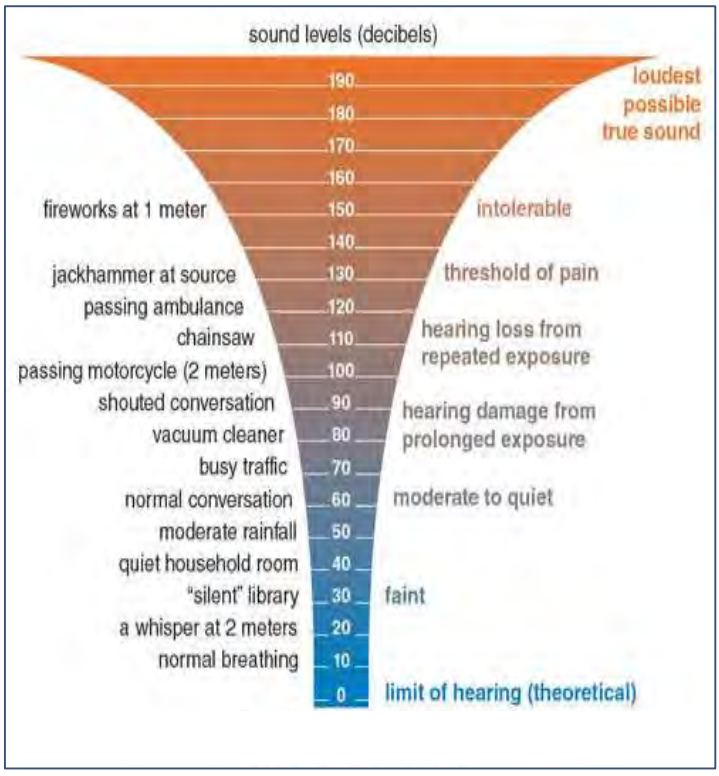
2. Risk Mitigation Analysis and Recommendations

2.0 Noise Generation and Impacts

Noise Generation and Impacts were calculated using the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) version 1.1. The model predicts the noise generated at the identified receptors by applying related historic noise data associated with each piece of equipment. See **Appendix B** for detailed information related to the RCNM program. Each construction phase was modeled based on the proximity of the construction activity identified in Table 1. Specific equipment for each phase/activity was estimated by Hazen and GET and combined within their respective areas of application to predict the noise generated for each phase. See **Appendix A** for phase maps and tabular results of the noise generation and impact analysis. Noise Levels for this analysis were calculated for L_{10} and L_{max}. L_{10} is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic. L_{max} is the highest noise level for the measuring period.

2.0.1 Noise Reduction

While the distance between each noise source and receptor was considered, an additional estimated noise shielding of 3 dBA was utilized in the calculations to account for noise reduction associated with existing vegetation and change in topography. Understanding that existing site vegetation and soil stockpile(s) will provide additional shielding, 3 dBA is considered conservative (less than a whisper). Typical Threshold of Hearing comparisons are shown in Figure 1.



2.0.2 Time of Day Considerations

Acceptable noise levels are compared with Daytime, Evening and Nighttime Baseline noise levels with relative decreasing baselines and exceedance limits. The Tabb PRS and OLSF project will limit construction work hours to 7 a.m. to 5 p.m. Monday-Friday, therefore, Daytime Noise Limits were used as the exceedance metric. The only exception to the time of day consideration is use of

dewatering pumps. The dewatering pumps will run constantly to maintain the necessary ground water levels required for the project. Therefore, noise related to dewatering pumps was compared to nighttime baseline noise levels and measured relative to the nighttime noise exceedance limits.

2.0.3 Noise Analysis Results

A summary of the predicted noise levels indicates that individual and combined calculated noise levels for the subject project exceed the noise limits (L_{10} and L_{max}) in some instances ranging from 0 (dBA) – 26.0 (dBA). The predicted exceedance(s) are considered minimal as 30 dBA is considered "faint". See Figure 1 for various noise level characterizations. **See Appendix A** for phase maps and tabular results of the noise generation and impact analysis.

2.0.4 Noise Recommendations

- Monitor and document baseline noise levels at three or more locations near the identified receptor boundary during non-working periods prior to the commencement of construction related activities.

- Monitor and document noise levels at the same receptor locations during the peak construction activity period.

- Use a Type 2 / Class 2 sound level meter that meets or exceeds IEC 61672 to collect all data.

2.1 Vibration Generation and Impacts

Vibration impacts are anticipated due to use of heavy equipment and pile driving activities within the proposed site location adjacent to the residential properties to the West and South and church to the South. Vibration Generation and Impacts were analyzed based upon the Damage Assessment formula (*shown below*) for Quantitative Construction Vibration Assessment Methods noted in the *Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment (2006).*
The formula predicts the vibration generated at the identified distance by applying related historic

$$PPV_{equip} = PPV_{ref} \, x \, (25/D)^{1.5}$$

where:

- *PPV(equip) is the peak particle velocity in in/sec of the equipment adjusted for distance*
- *PPV(ref) is the reference vibration level in in/sec at 25 feet*
- *D is the distance from the equipment to the receiver.*

vibration data associated with each piece of equipment. Each construction phase was modeled based on the proximity of the construction activity identified in **Table 1**. Specific equipment for each phase/activity were estimated by Hazen and GET and combined within their respective areas of application to predict the vibration generated for each activity. See **Appendix A** for the tabular results of the vibration generation and impact analysis.

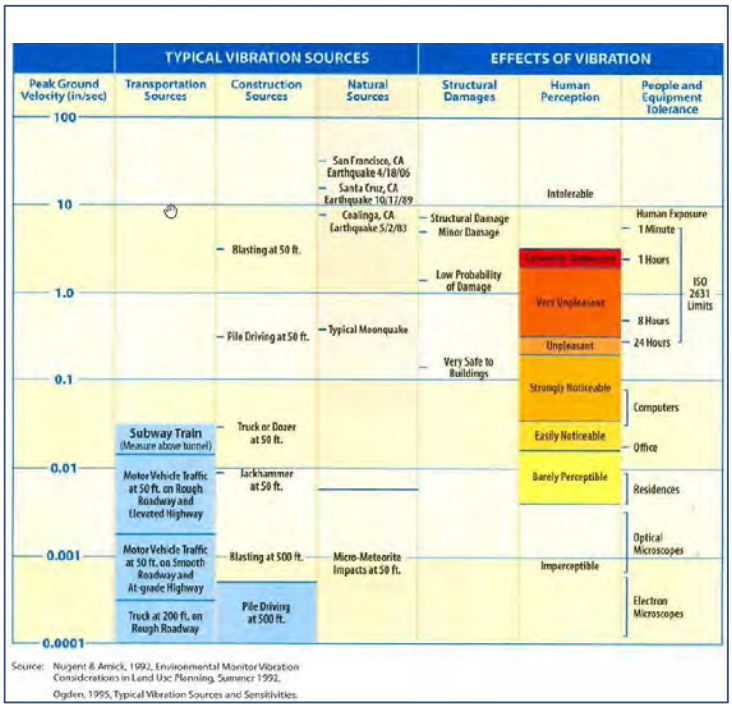
2.1.1 Projected Vibrations Associated with Pile Driving

When considering the suitability of a driven pile foundation, consideration should be given to the integrity of nearby structures. Due to the large amount of energy required to install driven deep

foundations, vibrations of considerable magnitude are generated. These vibrations may affect nearby structures. These structures can, due to their proximity, be detrimentally affected by the construction unless proper protection measures are taken. In addition, experience has shown that these construction features will often lead adjacent property owners to conclude that damage to their property has taken place, even though none has occurred. **Appendix A** shows the extents of the 200 ft offset that represents the area of projected impacts. See Section 2.1.3 for specific recommendations associated with the vibration analysis.

2.1.2 Vibration Analysis Results

A summary of the predicted vibration levels indicates that individual calculated vibration levels for the subject project range from 0.0001 PPV to 0.103 PPV. The high-end vibration predictions are generated from the pile driving operations along the Western boundary of the project site during tank foundation installation and are primarily influenced by the proximity to the receptor. While considered to be "strongly noticeable", vibrations at this level are considered to be "very safe to buildings". Note the receptor as calculated is at the residential property boundaries; however, the residential structures are located an additional 150 feet away bringing the projected vibration levels to .036 which is barely perceptible at such location. See Figure 2 for Typical Vibration Sources and Sensitivities.



2.1.3 Vibration Recommendations

- Prepare a vibration monitoring plan ; specific requirements for such plans will be detailed in the contract design documents. The plan shall include the following:
  - Photo documentation of the condition of all potentially affected structures that will remain during construction, in particular documentation of the nearest residential structures and church.
  - Monitor and document baseline vibration levels at three or more locations near the identified receptor boundary during non-working periods.
- Continuously monitor and document vibration levels at the receptor locations during the full construction activity period.

2.2 Groundwater Dewatering Impacts

Excavations within the footprint of the Tabb PRS and OLSF will extend to depths of up to 35 feet below existing site grades, corresponding to ELEV -5 for an extended duration. Considering the depth of the excavation and the observed groundwater levels within the proposed tank and pump station footprint (approximately 4.5 feet below existing grade), significant dewatering operations are anticipated to be required. Lowering the groundwater table during dewatering activities will result in an increase in effective stresses and may induce settlements of the soils underlying adjacent structures/pavements.

Additionally, hydraulic compaction of predominately granular soils (e.g. SP, SP-SM, SM soils) and potential consolidation settlement is anticipated as a result of lowering the groundwater table.

2.2.1 Dewatering Analysis

Prior to the detailed design phase, it will be advisable to enlist a specialist to design and provide the necessary dewatering system for the Tabb PRS and OLSF site. Such a company will be able to analyze the dewatering for the excavations utilizing a series of analytical equations for estimating the flow from radial source in an unconfined aquifer (Thiem Equation). The radius of influence of the system can then be determined using an empirical relationship developed by Sichart and Kryieleis.

2.2.2 Dewatering Recommendations

- Place settlement monuments for tracking elevation changes and monitor/document at regular intervals.
- Should settlement become evident contractor should develop a plan for remediation of estimated total settlement related to dewatering.

2.3 Risk Tracking

All potential risks associated with the Tabb PRS and OLSF will be tracked in a risk register for the project. Each risk will be identified and assigned a probability of occurrence along with a determined possible impact to the project in order to generate an overall risk score. For instances where the risk score is considered high, a mitigation strategy will be prepared to allow quick action in the event the risk becomes a reality. The risk register will capture all items mentioned in the preconstruction assessment along with all outstanding risks arising during the preliminary engineering phase of the project. The preliminary risk register has been included in **Appendix E** for Reference.

Appendix A: Figures

NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
										Lmax	L10	Lmax	L10	Lmax	L10		Day	Night	
0	Construction Entrance	Yes	No	Dump Truck	5	40%	Delivery and removal of materials.	Tabb High School	125	68.5	67.5	85	75	80	35	0	0	N/A	No Action Required
1	Clearing & Grubbing	Yes	No	Chainsaw	1	20%	Tree Removal	Residential homes	70	77.8	73.8	85	75	80	35	3	2.3	N/A	Exceedence is minimal and imperceptable. No action required.
1	Clearing & Grubbing	Yes	No	Dozer	1	40%	Dozer for clearing	Residential homes	70	75.7	74.8								
2	Excavation	Yes	No	Excavator	2	40%	Foundation for tank on the west side of project site	Residential homes	110	71.7	70.7	85	75	80	35	3.0	0	N/A	No Action Required
2	Excavation	Yes	No	Off-Road Dump Truck	3	40%	Foundation for tank on the west side of project site	Residential homes	100	67.4	66.5								
2	Excavation	Yes	No	Dozer	1	40%	Foundation for tank on the west side of project site	Residential homes	100	71.8	70.8								
3	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential Homes	350	61.0	61.0	85	75	80	35	3.0	0	26	Exceedance is minimal. Consider application of an Acoustic Shadow/Barrier such as straw bails or other. Combine with receptor perimeter monitoring.
4	Pile Driving	Yes	No	Pile Driver Impact	1	20%	Pile Driving for tank foundation	Residential homes	150	88.7	84.7	85	75	80	35	3	9.7	N/A	Consider natural barrier placement such as stockpile to dampen. Also note noise noted is at property line, not house.
4	Pile Driving	Yes	No	Use Crane, Derrick	1	16%	Crane for pile driving	Residential homes	150	68	63						0	N/A	
4	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential homes	350	57.9	57.9	85	75	80	35	3.0	0	26	Exceedance is minimal. Consider application of an Acoustic Shadow/Barrier such as straw bails or other. Combine with receptor perimeter monitoring.
5	Utility Installation	Yes	No	Backhoe	1	40%	Process piping on north side of western storage tank	Residential homes	230	61.3	60.3	85	75	80	35	3.0	0.0	N/A	No Action Required
5	Utility Installation	Yes	No	Compactor	1	20%	Process piping on north side of western storage tank	Residential homes	230	67	63							N/A	
5	Utility Installation	Yes	No	Loader	1	40%	Process piping on north side of western storage tank	Residential homes	230	62.9	61.9							N/A	
5	PRS & Tank Construction	Yes	No	Use Crane, Derrick	1	16%	West tank construction	Residential homes	110	68	63							N/A	
5	PRS & Tank Construction	Yes	No	Concrete Mixer Truck	2	40%	West tank construction	Residential homes	150	69	68							N/A	
	PRS & Tank Construction	Yes	No	Excavator	2	40%	West tank construction	Residential homes	110	70.9	69.9							N/A	
5	PRS & Tank Construction	Yes	No	Air Compressor	1	20%	West tank construction	Residential homes	110	67.8	66.8							N/A	
5	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential homes	350	57.9	57.9							26	Exceedance is minimal. Possible additional shielding will occur via existing vegetation and stockpile storage area. Install receptor perimeter monitoring and potential remediation of proximity related equipment.
6	Backfill & Final Grading	Yes	No	Excavator	1	40%	Backfilling of excavated areas and site-wide grading.	Residential homes	110	70.9	69.9	85	75	80	35	3.0	0	N/A	No Action Required
6	Backfill & Final Grading	Yes	No	Off-Road Dump Truck	2	40%	Backfilling of excavated areas and site-wide grading.	Residential homes	110	66.6	65.6								
7	Backfill & Final Grading	Yes	No	Dozer	2	40%	Backfilling of excavated areas and site-wide grading.	Residential homes	80	71.8	70.8								
6	Backfill & Final Grading	Yes	No	Roller	1	20%	Backfilling of excavated areas and site-wide grading.	Residential homes	80	72.9	68.9								
6	Backfill & Final Grading	Yes	No	Grader	1	40%	Preparation of onsite roadways	Residential homes	185	70.6	69.7								
6	Backfill & Final Grading	Yes	No	Paver	1	40%	Paving of onsite roadways	Residential homes	185	62.9	62.8								

*Note: All calculations and noise data were developed using the Roadway Construction Noise Model (RCNM) developed by the Federal Highway Administration (FHWA). Version 1.1

**Note: Referenced Receptor may not be the only receptor of noise. Closest anticipated receptor to the activity was used to formulate data.

Note: Distances are to residential property lines, not houses

NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
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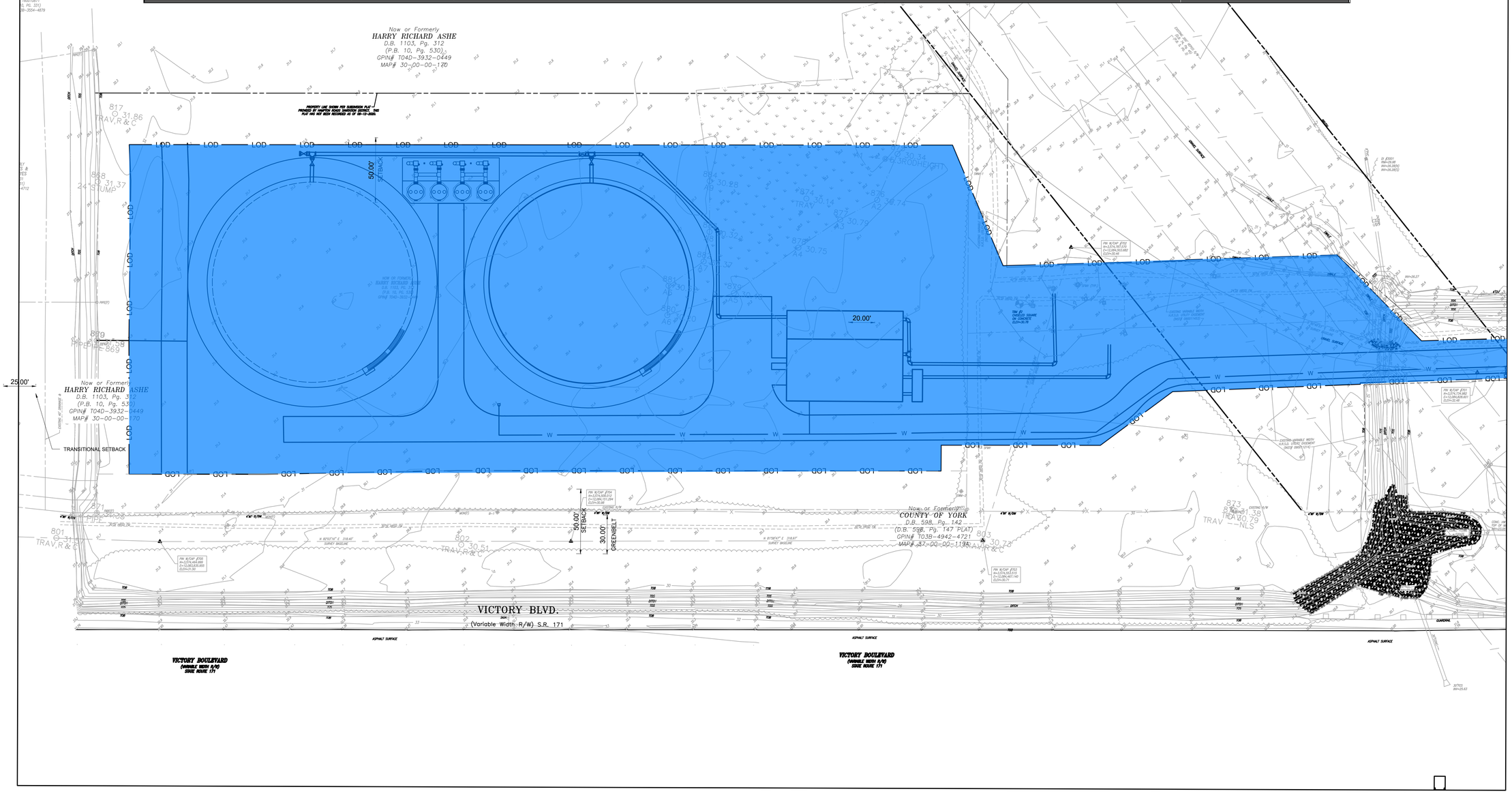

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	T. McPHERSON
DESIGNED BY:	--
DRAWN BY:	E. PAGSANJAN
CHECKED BY:	--

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE (0, 1/2", 1")

30% DESIGN
DO NOT USE FOR CONSTRUCTION

Hazen
HAZEN AND SAWYER
4500 MAIN STREET, SUITE 500
VIRGINIA BEACH, VIRGINIA 23462
PHONE: 757-497-0490

HRSD

TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
NOISE GENERATION AND IMPACTS
PHASE 1
CLEARING AND GRUBBING
SITE PLAN

CIVIL

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NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
										Lmax	L10	Lmax	L10	Lmax	L10		Day	Night	
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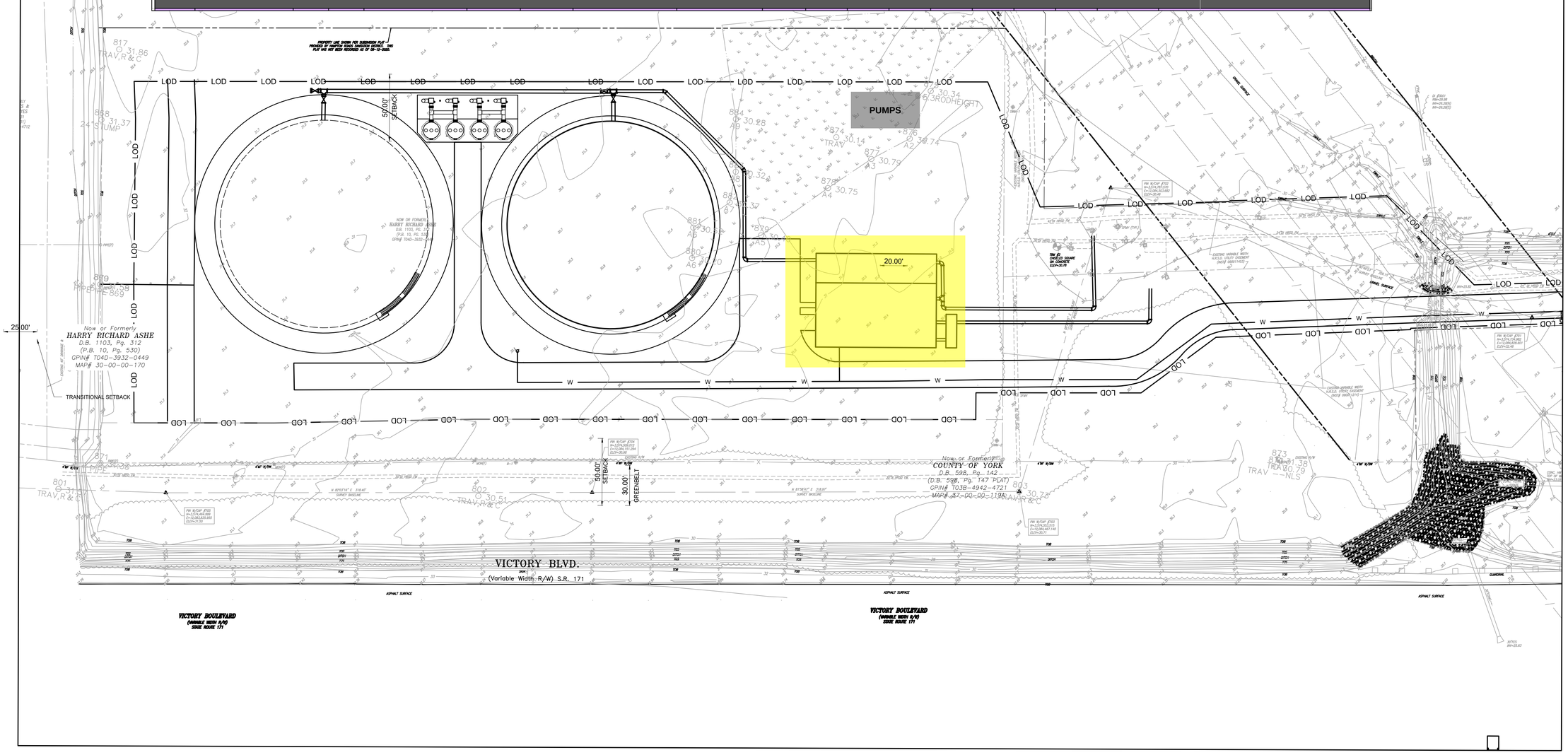
3	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential Homes	350	61.0	61.0	85	75	80	35	3.0	0	26	Exceedance is minimal. Consider application of an Acoustic Shadow/Barrier such as straw bails or other. Combine with receptor perimeter monitoring.



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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
NOISE GENERATION AND IMPACTS
PHASE 2-3
EXCAVATION AND DEWATERING

CIVIL
SITE PLAN

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NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
										Lmax	L10	Lmax	L10	Lmax	L10		Day	Night	
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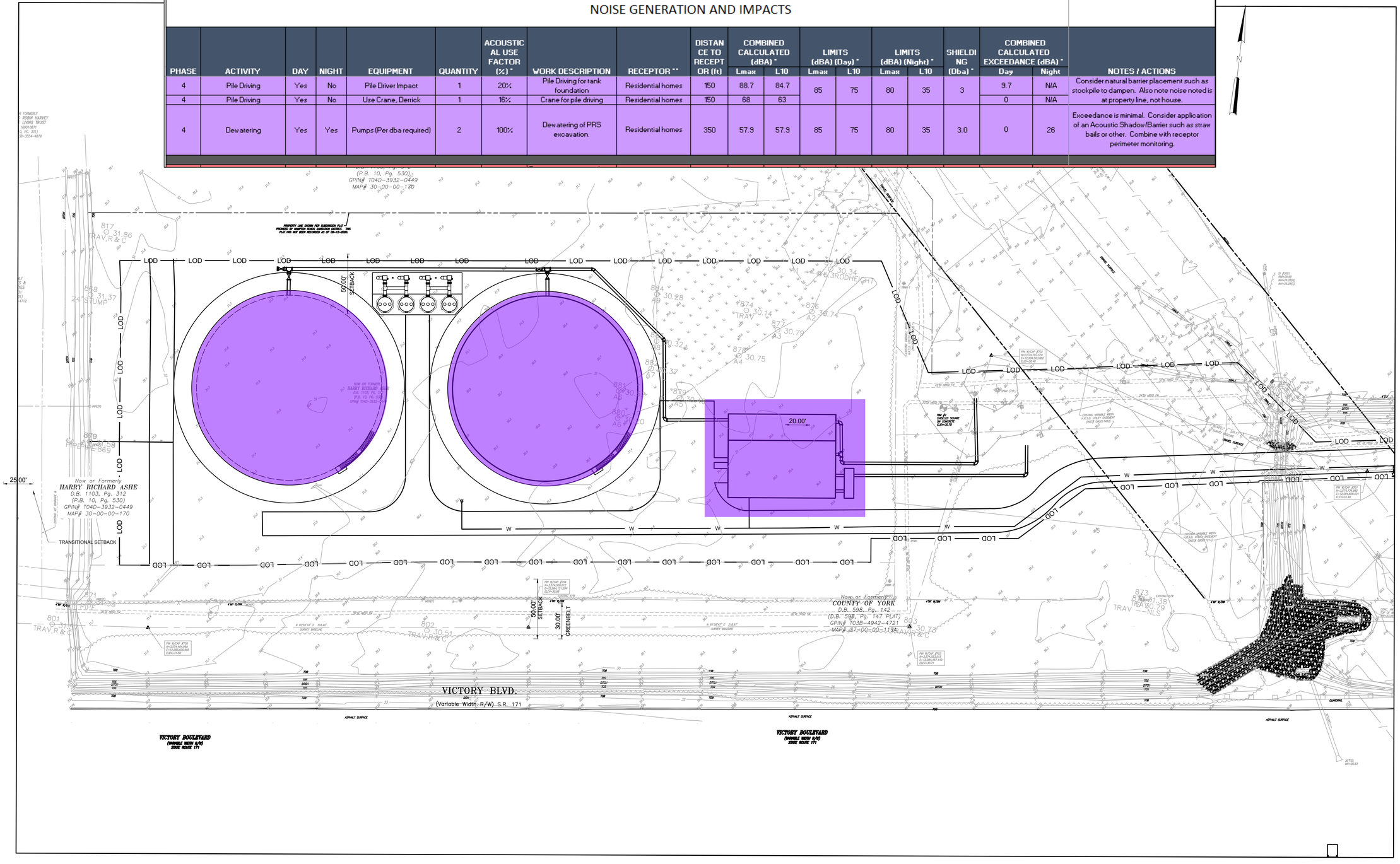
4	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential homes	350	57.9	57.9	85	75	80	35	3.0	0	26	Exceedance is minimal. Consider application of an Acoustic Shadow/Barrier such as straw bails or other. Combine with receptor perimeter monitoring.



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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
NOISE GENERATION AND IMPACTS
PHASE 4
SITE PLAN

CIVIL

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NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
										Lmax	L10	Lmax	L10	Lmax	L10		Day	Night	
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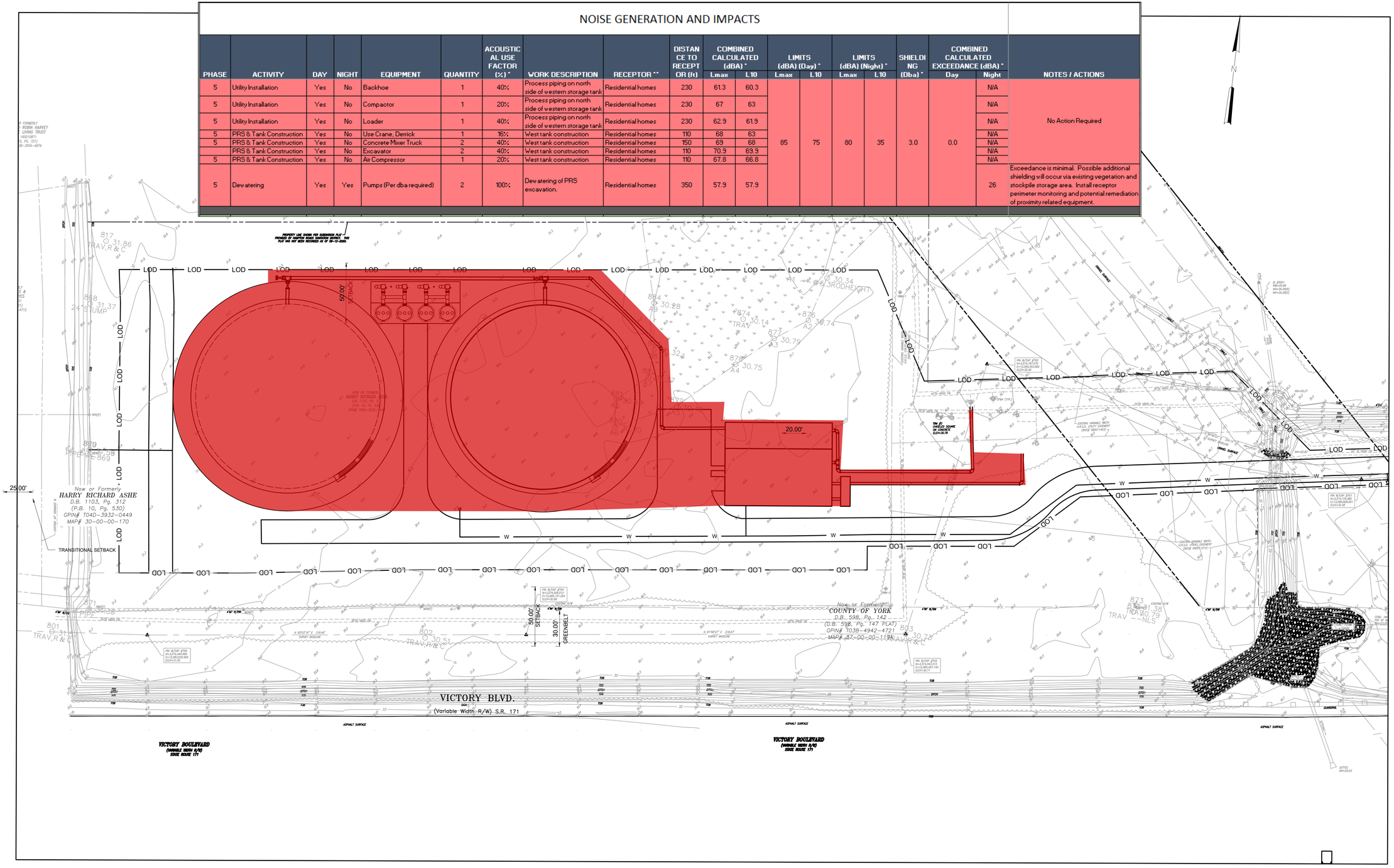
5	Utility Installation	Yes	No	Compactor	1	20%	Process piping on north side of western storage tank	Residential homes	230	67	63							N/A	
5	Utility Installation	Yes	No	Loader	1	40%	Process piping on north side of western storage tank	Residential homes	230	62.9	61.9							N/A	
5	PRS & Tank Construction	Yes	No	Use Crane, Derrick	1	16%	West tank construction	Residential homes	110	68	63							N/A	
5	PRS & Tank Construction	Yes	No	Concrete Mixer Truck	2	40%	West tank construction	Residential homes	150	63	68							N/A	
	PRS & Tank Construction	Yes	No	Excavator	2	40%	West tank construction	Residential homes	110	70.9	69.9							N/A	
5	PRS & Tank Construction	Yes	No	Air Compressor	1	20%	West tank construction	Residential homes	110	67.8	66.8							N/A	
5	Dewatering	Yes	Yes	Pumps (Per dba required)	2	100%	Dewatering of PRS excavation.	Residential homes	350	57.9	57.9							26	Exceedance is minimal. Possible additional shielding will occur via existing vegetation and stockpile storage area. Install receptor perimeter monitoring and potential remediation of proximity related equipment.



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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
NOISE GENERATION AND IMPACTS
PHASE 5
UTILITY AND TANK INSTALLATION

CIVIL
SITE PLAN

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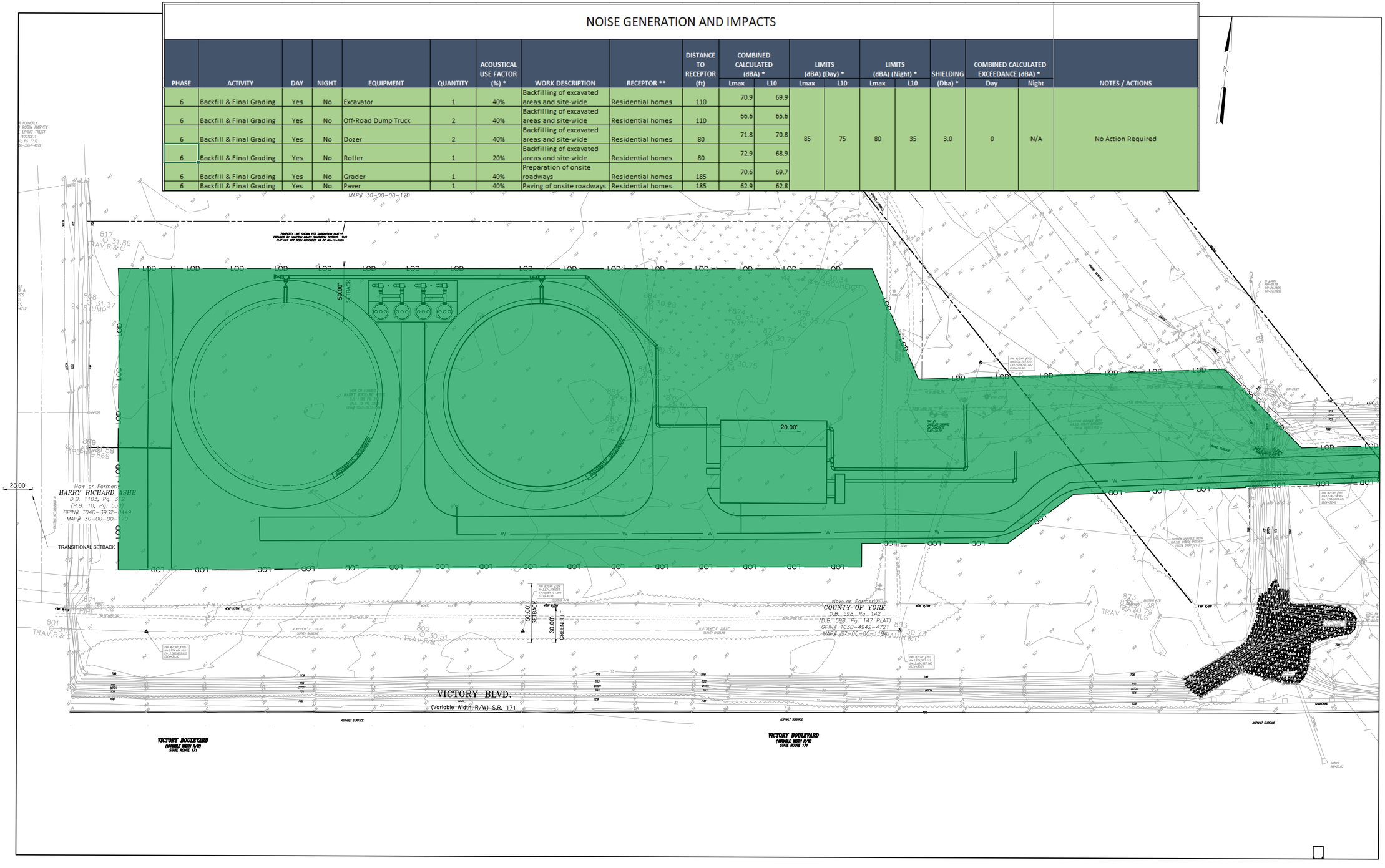
NOISE GENERATION AND IMPACTS

PHASE	ACTIVITY	DAY	NIGHT	EQUIPMENT	QUANTITY	ACOUSTICAL USE FACTOR (%) *	WORK DESCRIPTION	RECEPTOR **	DISTANCE TO RECEPTOR (ft)	COMBINED CALCULATED (dBA) *		LIMITS (dBA) (Day) *		LIMITS (dBA) (Night) *		SHIELDING (Dba) *	COMBINED CALCULATED EXCEEDANCE (dBA) *		NOTES / ACTIONS
										Lmax	L10	Lmax	L10	Lmax	L10		Day	Night	
6	Backfill & Final Grading	Yes	No	Excavator	1	40%	Backfilling of excavated areas and site-wide	Residential homes	110	70.9	69.9	85	75	80	35	3.0	0	N/A	No Action Required
6	Backfill & Final Grading	Yes	No	Off-Road Dump Truck	2	40%	Backfilling of excavated areas and site-wide	Residential homes	110	66.6	65.6								
6	Backfill & Final Grading	Yes	No	Dozer	2	40%	Backfilling of excavated areas and site-wide	Residential homes	80	71.8	70.8								
6	Backfill & Final Grading	Yes	No	Roller	1	20%	Backfilling of excavated areas and site-wide	Residential homes	80	72.9	68.9								
6	Backfill & Final Grading	Yes	No	Grader	1	40%	Preparation of onsite roadways	Residential homes	185	70.6	69.7								
6	Backfill & Final Grading	Yes	No	Paver	1	40%	Paving of onsite roadways	Residential homes	185	62.9	62.8								



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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
NOISE GENERATION AND IMPACTS
PHASE 6
BACKFILL AND GRADING

CIVIL
SITE PLAN

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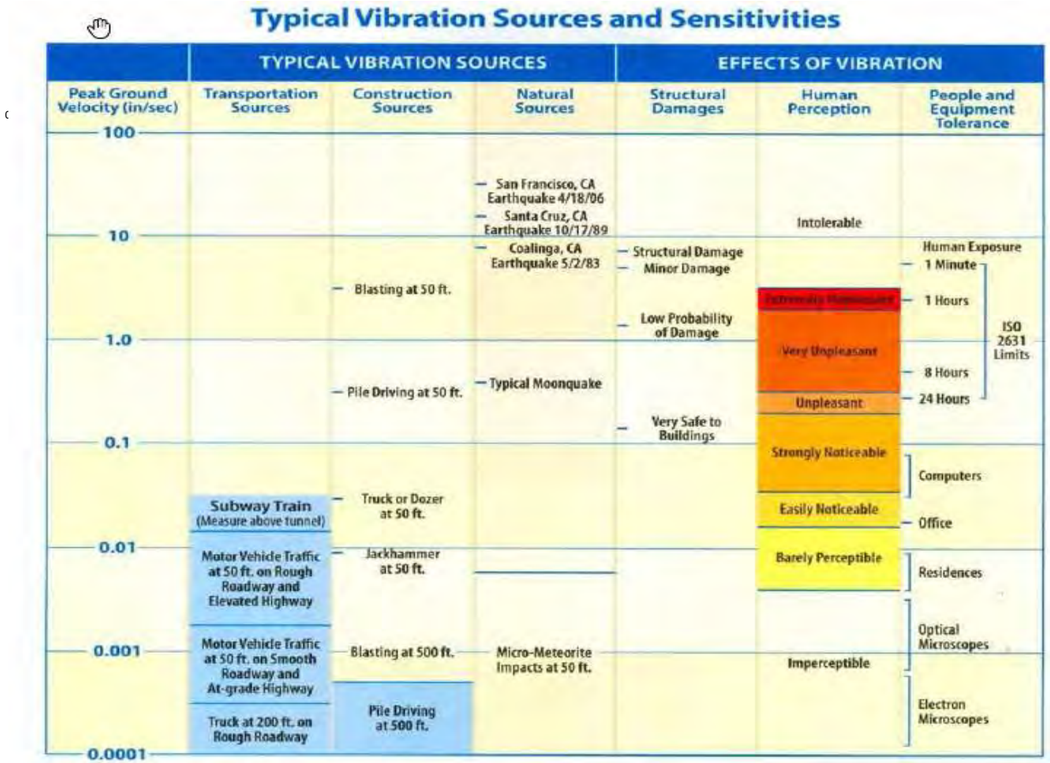
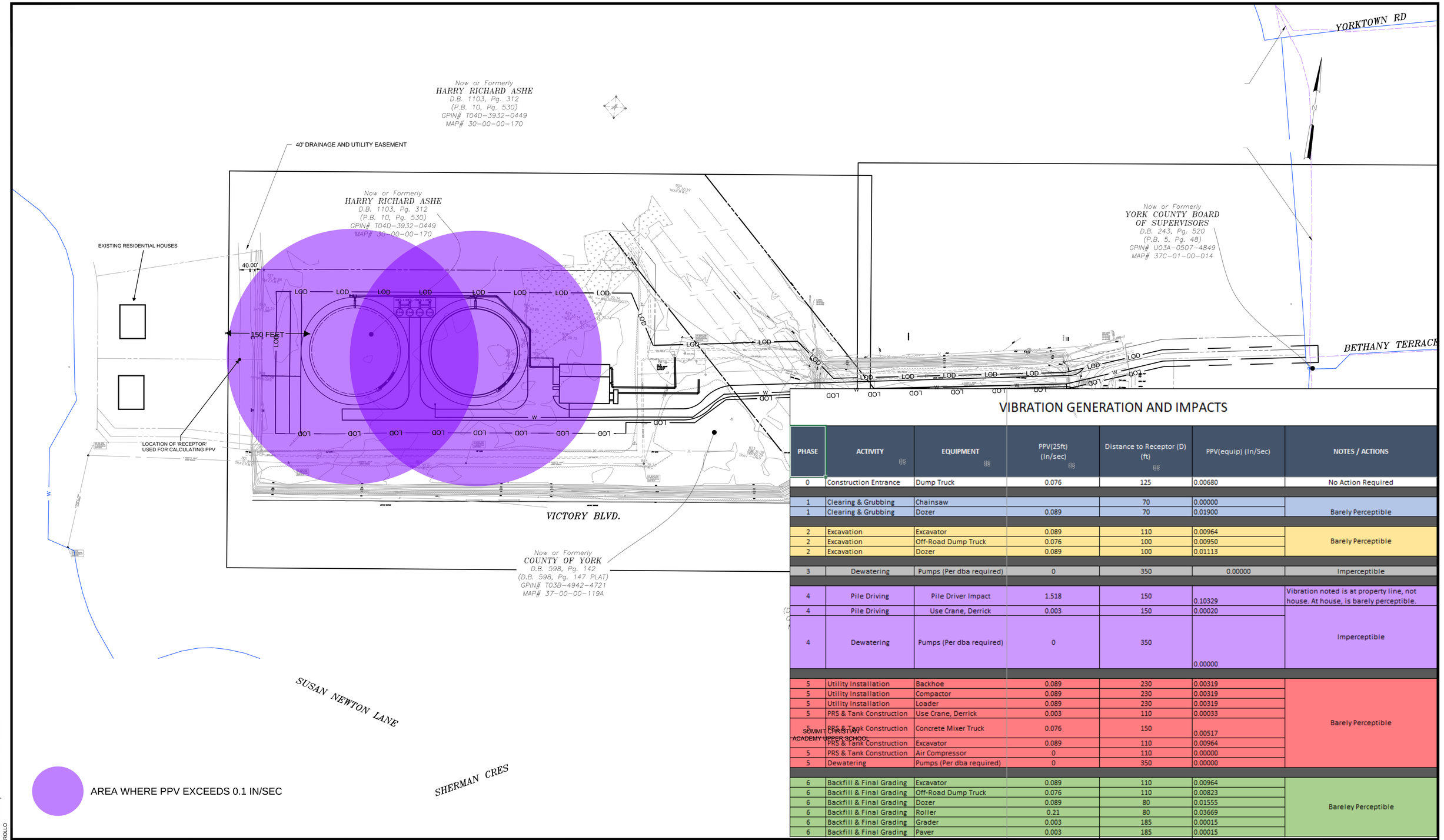
VIBRATION GENERATION AND IMPACTS

PHASE	ACTIVITY	EQUIPMENT	PPV(25ft) (In/sec)	Distance to Receptor (D) (ft)	PPV(equip) (In/Sec)	NOTES / ACTIONS
0	Construction Entrance	Dump Truck	0.076	125	0.00680	No Action Required
1	Clearing & Grubbing	Chainsaw		70	0.00000	Barely Perceptible
1	Clearing & Grubbing	Dozer	0.089	70	0.01900	
2	Excavation	Excavator	0.089	110	0.00964	Barely Perceptible
2	Excavation	Off-Road Dump Truck	0.076	100	0.00950	
2	Excavation	Dozer	0.089	100	0.01113	
3	Dewatering	Pumps (Per dba required)	0	350	0.00000	Imperceptible
4	Pile Driving	Pile Driver Impact	1.518	150	0.10329	Vibration noted is at property line, not house. At house, is barely perceptible.
4	Pile Driving	Use Crane, Derrick	0.003	150	0.00020	Imperceptible
4	Dewatering	Pumps (Per dba required)	0	350	0.00000	
5	Utility Installation	Backhoe	0.089	230	0.00319	Barely Perceptible
5	Utility Installation	Compactor	0.089	230	0.00319	
5	Utility Installation	Loader	0.089	230	0.00319	
5	PRS & Tank Construction	Use Crane, Derrick	0.003	110	0.00033	
5	PRS & Tank Construction	Concrete Mixer Truck	0.076	150	0.00517	
	PRS & Tank Construction	Excavator	0.089	110	0.00964	
5	PRS & Tank Construction	Air Compressor	0	110	0.00000	
5	Dewatering	Pumps (Per dba required)	0	350	0.00000	
6	Backfill & Final Grading	Excavator	0.089	110	0.00964	Bareley Perceptible
6	Backfill & Final Grading	Off-Road Dump Truck	0.076	110	0.00823	
6	Backfill & Final Grading	Dozer	0.089	80	0.01555	
6	Backfill & Final Grading	Roller	0.21	80	0.03669	
6	Backfill & Final Grading	Grader	0.003	185	0.00015	
6	Backfill & Final Grading	Paver	0.003	185	0.00015	



Source: Nugent & Amick, 1992, Environmental Monitor Vibration Considerations in Land Use Planning, Summer 1992.
Ogden, 1995, Typical Vibration Sources and Sensitivities.



VIBRATION GENERATION AND IMPACTS

PHASE	ACTIVITY	EQUIPMENT	PPV(25ft) (In/sec)	Distance to Receptor (D) (ft)	PPV(equip) (In/Sec)	NOTES / ACTIONS
0	Construction Entrance	Dump Truck	0.076	125	0.00680	No Action Required
1	Clearing & Grubbing	Chainsaw		70	0.00000	Barely Perceptible
1	Clearing & Grubbing	Dozer	0.089	70	0.01900	
2	Excavation	Excavator	0.089	110	0.00964	Barely Perceptible
2	Excavation	Off-Road Dump Truck	0.076	100	0.00950	
2	Excavation	Dozer	0.089	100	0.01113	
3	Dewatering	Pumps (Per dba required)	0	350	0.00000	Imperceptible
4	Pile Driving	Pile Driver Impact	1.518	150	0.10329	Vibration noted is at property line, not house. At house, is barely perceptible.
4	Pile Driving	Use Crane, Derrick	0.003	150	0.00020	Imperceptible
4	Dewatering	Pumps (Per dba required)	0	350	0.00000	
5	Utility Installation	Backhoe	0.089	230	0.00319	Barely Perceptible
5	Utility Installation	Compactor	0.089	230	0.00319	
5	Utility Installation	Loader	0.089	230	0.00319	
5	PRS & Tank Construction	Use Crane, Derrick	0.003	110	0.00033	
5	PRS & Tank Construction	Concrete Mixer Truck	0.076	150	0.00517	
5	PRS & Tank Construction	Excavator	0.089	110	0.00964	
5	PRS & Tank Construction	Air Compressor	0	110	0.00000	
5	Dewatering	Pumps (Per dba required)	0	350	0.00000	
6	Backfill & Final Grading	Excavator	0.089	110	0.00964	Bareley Perceptible
6	Backfill & Final Grading	Off-Road Dump Truck	0.076	110	0.00823	
6	Backfill & Final Grading	Dozer	0.089	80	0.01555	
6	Backfill & Final Grading	Roller	0.21	80	0.03669	
6	Backfill & Final Grading	Grader	0.003	185	0.00015	
6	Backfill & Final Grading	Paver	0.003	185	0.00015	

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TABB PRESSURE REDUCING STATION AND OFF-LINE STORAGE FACILITY

PRECONSTRUCTION ASSESSMENT
VIBRATION IMPACTS
PILE DRIVING AREA OF IMPACT
OVERALL SITE PLAN

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Appendix B: FHWA Roadway Construction Noise Model User's Guide

U.S. Department
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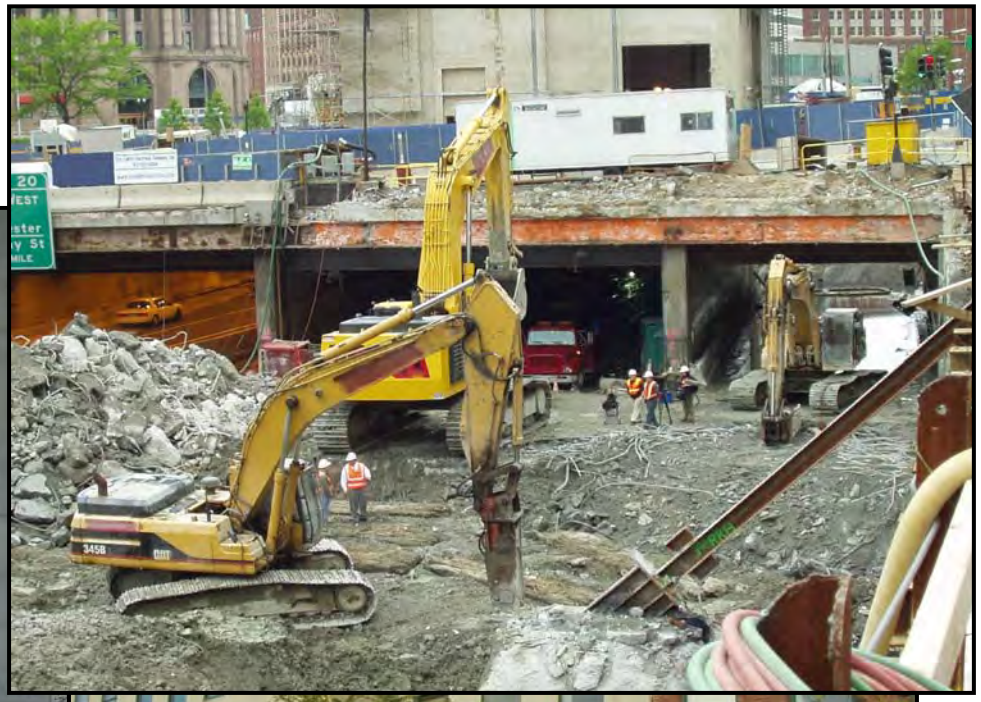
Federal Highway Administration

FHWA Roadway Construction Noise Model User's Guide

FHWA-HEP-05-054
DOT-VNTSC-FHWA-05-01

Final Report
January 2006







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13. ABSTRACT (Maximum 200 words)

The Roadway Construction Noise Model (RCNM) is the Federal Highway Administration's (FHWA) national model for the prediction of construction noise. Due to the fact that construction is often conducted in close proximity to residences and businesses, construction noise must be controlled and monitored to avoid impacts on surrounding communities. In addition to community issues, excessive noise can threaten a construction projects' progress. Each project needs to balance the community's need for peace and quiet with the contractor's need to progress the work.

During the Central Artery/Tunnel (CA/T) project in Boston, Massachusetts, the project's noise control program developed the Construction Noise Control Specification 721.560, the most comprehensive noise specification ever developed in the United States. As part of the CA/T project noise control program, a construction noise prediction spreadsheet was developed. Because the CA/T prediction tool can benefit other state and local governments, the FHWA developed the RCNM, which is based on the noise prediction calculations and equipment database used in the CA/T prediction spreadsheet. The RCNM provides a construction noise screening tool to easily predict construction noise levels and determine compliance with noise limits for a variety of construction noise projects of varying complexity.

14. SUBJECT TERMS
construction noise, noise levels, dBA, noise models, community impact, Federal Highway Administration

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METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he) = 4,000 square meters (m^2)

MASS – WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gm)
1 pound (lb) = 0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup © = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres

MASS – WEIGHT (APPROXIMATE)

1 gram (gm) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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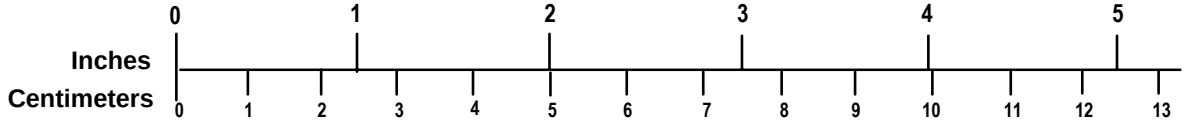
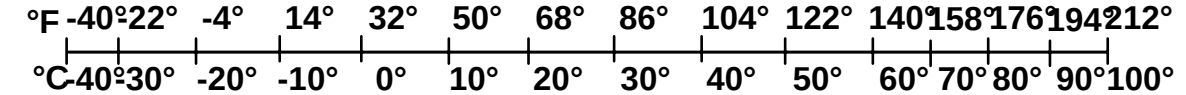


QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures.
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1 Introduction

The Roadway Construction Noise Model (RCNM) is the Federal Highway Administration's (FHWA) national model for the prediction of construction noise. Due to the fact that construction is often conducted in close proximity to residences and businesses, construction noise must be controlled and monitored to avoid impacts on surrounding communities. In addition to community issues, excessive noise can threaten a construction project's progress. Each project needs to balance the community's need for peace and quiet with the contractor's need to progress the work.

The Central Artery/Tunnel (CA/T) project in Boston, Massachusetts, which began in the early 1990s, is the largest urban construction project ever conducted in the United States. Its noise control program developed the Construction Noise Control Specification 721.560, the most comprehensive noise specification ever developed in the United States [1]. As part of the CA/T project noise control program, a construction noise prediction spreadsheet was developed [2]. Because the CA/T prediction tool can benefit other state and local governments, the FHWA developed the RCNM, which is based on the noise prediction calculations and the equipment database used in the CA/T prediction spreadsheet. The RCNM provides a construction noise screening tool to easily predict construction noise levels and to determine compliance with noise limits for a variety of construction noise projects of varying complexity.

2 Background

The RCNM is a national model based on the noise calculations and extensive construction noise data compiled for the CA/T Project. The basis for the national model is a spreadsheet tool developed in support of the CA/T project [2]. The CA/T predictions originated from Environmental Protection Agency (EPA) noise level work [3] and an Empire State Electric Energy Research Corp. Guide [4] which utilizes an "acoustical usage factor" to estimate the fraction of time each piece of construction equipment is operating at full power (i.e., its loudest condition) during a construction operation. Table 1 presents a construction equipment noise database compiled through the CA/T project [2]. This database is used to predict construction noise within the RCNM. The noise levels listed represent the A-weighted maximum sound level (Lmax), measured at a distance of 50 feet from the construction equipment.

Table 1. CA/T equipment noise emissions and acoustical usage factors database.

CA/T Noise Emission Reference Levels and Usage Factors					
filename: EQUIPLST.xls					
revised: 7/26/05		Acoustical	Spec 721.560	Actual Measured	No. of Actual
	Impact	Use Factor	Lmax @ 50ft	Lmax @ 50ft	Data Samples
Equipment Description	Device ?	(%)	(dBA, slow)	(dBA, slow)	(Count)
				(samples averaged)	
All Other Equipment > 5 HP	No	50	85	-- N/A --	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	-- N/A --	0
Blasting	Yes	-- N/A --	94	-- N/A --	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	-- N/A --	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	-- N/A --	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr. Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	-- N/A --	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	-- N/A --	0
Tractor	No	40	84	-- N/A --	0
Vacuum Excavator (Vac-truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder / Torch	No	40	73	74	5

3 The RCNM

The RCNM is a computer program used to assess construction noise impacts. The computer on which it is installed should be equipped with the Microsoft Windows 98 or newer operating system (OS) and 192 MB or more of random access memory (RAM). The display should be set to 1024 x 768 pixels or greater, and the computer should carry the Adobe Acrobat 4.0 or newer software.

The RCNM allows the estimation of three key metrics of interest: Lmax, Leq, and L10 at receptor locations for a construction operation that can include up to 20 pieces of equipment. RCNM allows for user-defined construction equipment and user-defined noise limit criteria. The two main uses of the RCNM are to allow typical computer users to: 1. easily predict noise emissions from construction equipment, and 2. determine a construction work plan's compliance with noise criteria limits. A variety of construction work scenarios can be created quickly, allowing the user to determine the impact of changing construction equipment and adding/removing the effects of shielding due to noise mitigation devices such as barriers.

3.1 RCNM Main Page

The RCNM consists of one main display page with Input Data and Results sections, shown in Figure 1.

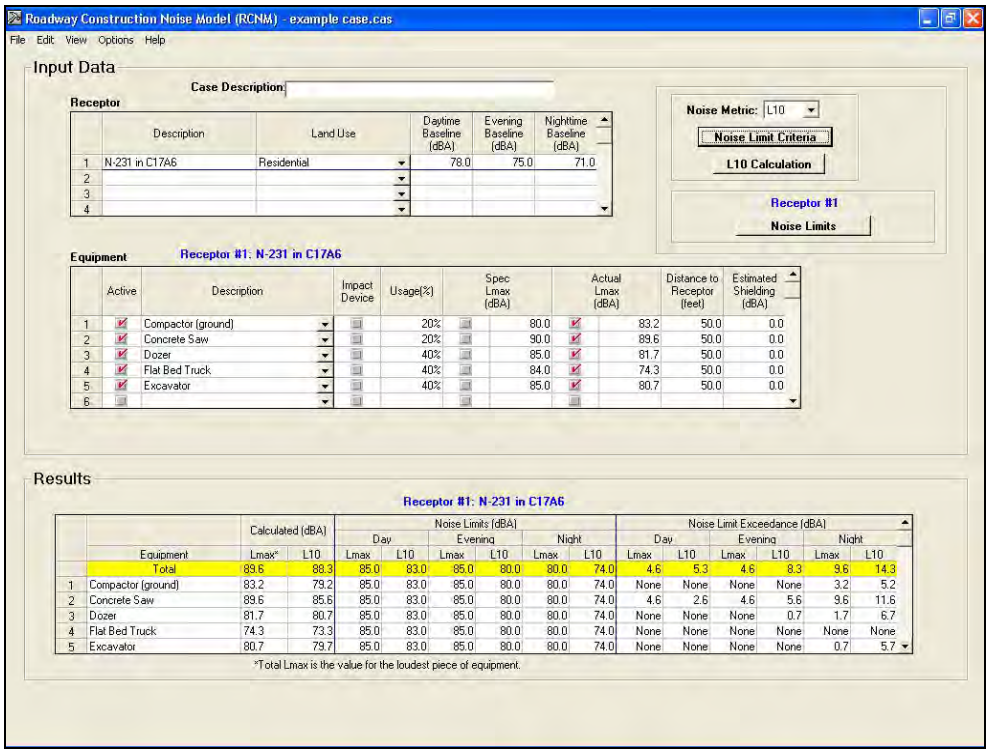


Figure 1. The RCNM main page

Several command buttons and pull-down menus allow the user to modify the input data before results are calculated by the model.

3.1.1 File Menu

The <File> menu, shown in Figure 2, contains items that allow the user to create, open, and save a case, export the results of a case, and exit the program.

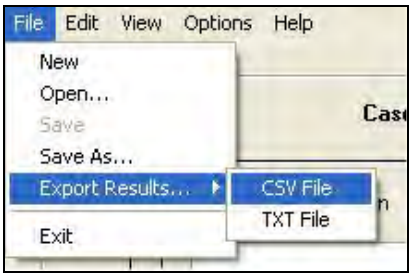


Figure 2. <File> Menu

- <New> creates a new case. If a case is currently open, the user is prompted to save it before closing.
- <Open…> allows the user to open an existing case file ([name].cas).
- <Save> saves the case with the current filename. If this is a new case, the user is asked for a new filename ([name].cas).
- <Save As…> The user is asked for a filename for a new case ([name].cas) and saves the case with that filename.
- <Export Results> prompts the user to save the case results for the current or all receptors to a comma separated value (CSV) file with the following naming convention: [name].csv. This type of file is easily read into a spreadsheet program. The user can also save the case results to a text file (TXT), which saves the results to a space-separated text format with the following naming convention: [name].txt.
- <Exit> closes the application. If changes have been made to the open case, the user is asked if he/she would like to save the case.

3.1.2 Edit Menu

The <Edit> menu, shown in Figure 3, allows the user to copy and paste data, delete data, and undo changes.



Figure 3. <Edit> Menu

- <Copy> lets the user copy into a clipboard the contents of a single cell or an entire line from an RCNM dialogue box.
- <Paste> lets the user copy the contents of the clipboard into a single cell or an entire line of an RCNM dialogue box.
- <Delete> lets the user delete from the case a receptor or piece of equipment selected in the receptor or equipment dialogue box.
- <Undo> lets the user revert the RCNM one step to where it was before the latest change was made.

3.1.3 View Menu

The <View> menu, shown in Figure 4, allows the user to focus in <Zoom +> on either the Input Data or Results section of the RCNM's main page. To activate Zoom +, click on Zoom + and guide the spyglass + icon to either Input Data or Results and single-click.

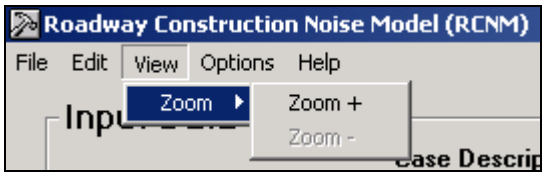


Figure 4. <View> Menu

To deactivate Zoom + and go back to the full RCNM screen, click on Zoom – and guide the spyglass – icon to the Input Data or Results section that has been maximized on the screen.

3.1.4 Options Menu

The <Options> menu, shown in Figure 5, allows the user to modify the equipment list and change the case's units of measure from feet to meters.

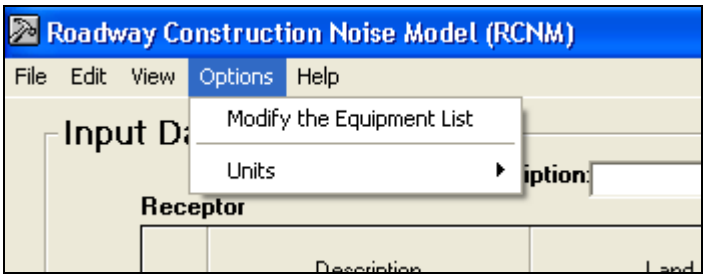


Figure 5. <Options> menu

The <Options> menu allows the user to add new types of equipment to the equipment list. The equipment list modification dialogue box, shown in Figure 6, allows the user to specify a user-defined piece of equipment and add it. The user can specify the following

data: whether the equipment is an impact device, the equipment's usage factor[1], and the equipment's Lmax level (spec and/or actual[2]). The user can also delete equipment that's been added by selecting it and clicking the delete button. The default equipment cannot be modified, but it may be deleted entirely from the case by selecting it and clicking the delete button. Selecting the default button restores the default equipment list (from the CA/T Project) and eliminates any user-defined equipment.

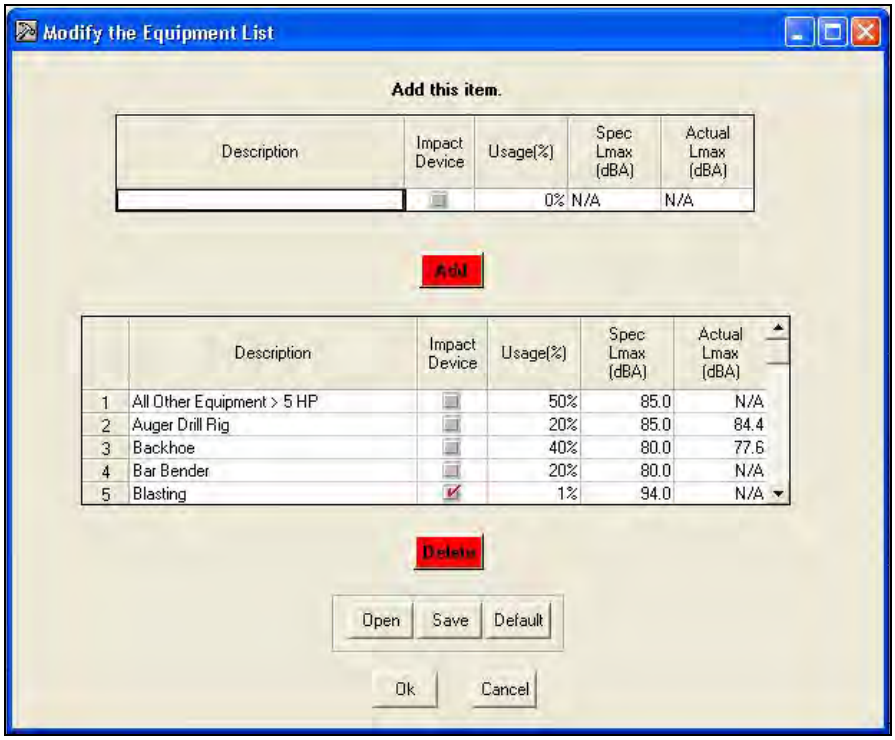


Figure 6. Equipment list modification dialogue box

Data for user-defined pieces of equipment may be saved to an equipment file ([name].equ), along with all other equipment in the current list, including default equipment. This file may be opened in other cases to incorporate these pieces of equipment.

The <Options> menu, as shown in Figure 7, also allows the user to change the case's units of measure from feet to meters or from meters to feet. The only input data affected by this tool are the Distance to Receptor values.

[1] Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power. In the case of construction blasting, the equipment gives a very short duration blast, and can be quantified by using a 1% usage factor in the RCNM to allow for some prediction. Never use a usage factor of zero because the log of zero causes a mathematical impossibility. The usage factor term only affects the computation of Leq and L10. The usage factor does not enter into the equation when calculating the more important term for blasting, that being the Lmax.

[2] "Spec" refers to noise levels stated in noise specifications, and "Actual" refers to Lmax values measured at 50 ft from the equipment.

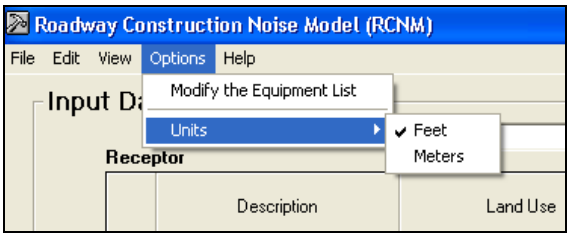


Figure 7. Units modification pull-down menu

3.1.5 Help Menu

The <Help> Menu loads for the user the RCNM User's Guide in Portable Document Format (PDF). This PDF is searchable by key word using the Adobe Acrobat Edit / Find search tool.

3.2 Input Data

The user is required to input receptor data and equipment data before a case can be processed. The user is advised to type in some summary comments about the case in the Case Description dialogue box before inputting data. Also, in order to determine noise limit exceedance values, the user can input noise limit criteria.

3.2.1 Receptors

Multiple receptors may be input for a case, but only one receptor may be processed at a time. The name of the highlighted receptor chosen for processing appears in blue type above the Equipment input dialogue box and the Noise Limits command button (see Figure 1). The user specifies the receptors for a study by entering information into the Receptors input box in the main window of the RCNM. The user is required to enter the receptor name, land use, daytime baseline L10 or Leq, evening baseline L10 or Leq, and nighttime baseline L10 or Leq. The baseline levels indicate the sound level at a receptor before any construction noise contributions. Baseline levels are only necessary if the desired noise criteria limits are based on *relative* increases in noise level. If the desired noise criteria limits are *absolute* noise levels, then the user should insert a placeholder number other than zero.

When entering information for more than one receptor, it may be desirable to copy information already entered. An entire receptor row may be highlighted and copied to another row, where copying multiple rows requires the selection of the same number of rows when pasting (this same functionality also applies to editable cells). Note: Entire rows may be selected by clicking on the row number.

Again, the RCNM will only calculate results for the receptor displayed in blue type in the Input Data portion of the main page. The results for other receptors may be displayed by selecting the desired receptor in the Receptor window; to select a receptor, click in any

cell in the row. Up to 100 receptors may be included in any case. Information for receptors is saved in the case file ([name].cas).

3.2.2 Equipment

Core equipment noise data are stored in the RCNM and are accessible by a pull-down menu in the main page, as in Figure 8.

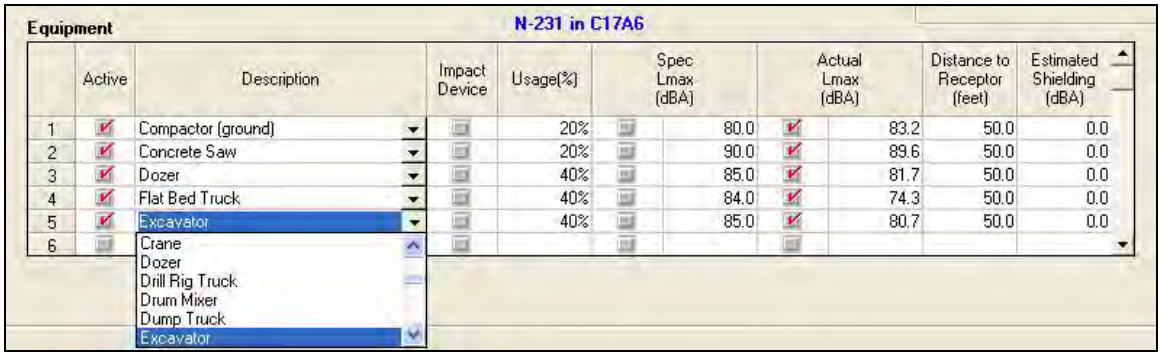


Figure 8. Equipment dialogue box, with pull-down menu shown

As discussed in Section 3.1.4, new pieces of equipment may be added to a case and saved in an equipment file ([name].equ). When the user-defined equipment file is opened through the <Options> / <Modify the Equipment List> menu, user-defined equipment will appear in the equipment pull-down menu. The user activates and inactivates chosen equipment types by ticking and unticking the "Active" checkbox. The user is required to specify:

1. The type of reference emission levels to use ("Spec", if applicable, or "Actual", [the default is "Actual"]);
2. Distance to Receptor – that is, the distance between each type of equipment and the receptor being analyzed (the default distance is 50 feet); and
3. Estimated Shielding (in dBA) associated with each type of equipment (can leave the default value of 0.0 when not considering shielding). **NOTE: A Best Practices document is presented in Appendix A showing how to determine Estimated Shielding using several Rules of Thumb developed from experience at the CA/T project.**

When entering information for more than one piece of equipment, it may be desirable to copy information already entered. An entire equipment row may be highlighted and copied to another row, where copying multiple rows requires the selection of the same number of rows when pasting (this same functionality also applies to editable cells). Note: Entire rows may be selected by clicking on the row number.

The user may analyze up to 20 pieces of equipment at one time, and they may be included in any combination of different or identical equipment types.

3.2.3 Noise Metric and Noise Limit Criteria

While a case is open, the user can choose a noise metric (for baseline levels, noise limits, and calculated results) and enter the noise limit criteria for a local area. The user may edit the Lmax and L10 or Leq day, evening, and night noise limit criteria for a residential, commercial, or industrial area. Daytime, evening, and nighttime may represent any time periods the user wishes, but they are typically defined as 7 AM to 6 PM, 6 PM to 10 PM, and 10 PM to 7 AM, respectively. The criteria, used together with the baseline sound levels, define the noise limits for each receptor. CA/T Noise Limit Criteria are used as a default [1], but users may input their own criteria. The RCNM offers a metric pull-down menu and two or three command buttons to the right of the Receptor input dialogue box.

- Metric Pull-Down Menu

A pull-down menu allows the user to choose between the L10 or Leq metric, as in Figure 9. The chosen metric represents that used for the baseline levels, noise limits, and calculated results. For the noise limits and calculated results, Lmax values are also included.

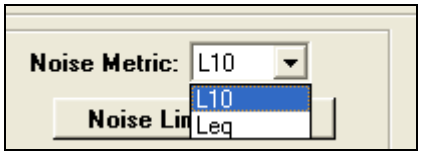


Figure 9. Noise Metric pull-down menu

- Noise Limit Criteria Pop-up Dialogue Box

A pop-up dialogue box allows the user to specify Noise Limit Criteria information for an area being studied in a case, as in Figure 10. The flexibility of the Noise Limit Criteria allows RCNM users to incorporate criteria based on local noise ordinances and baseline levels measured for each receptor.

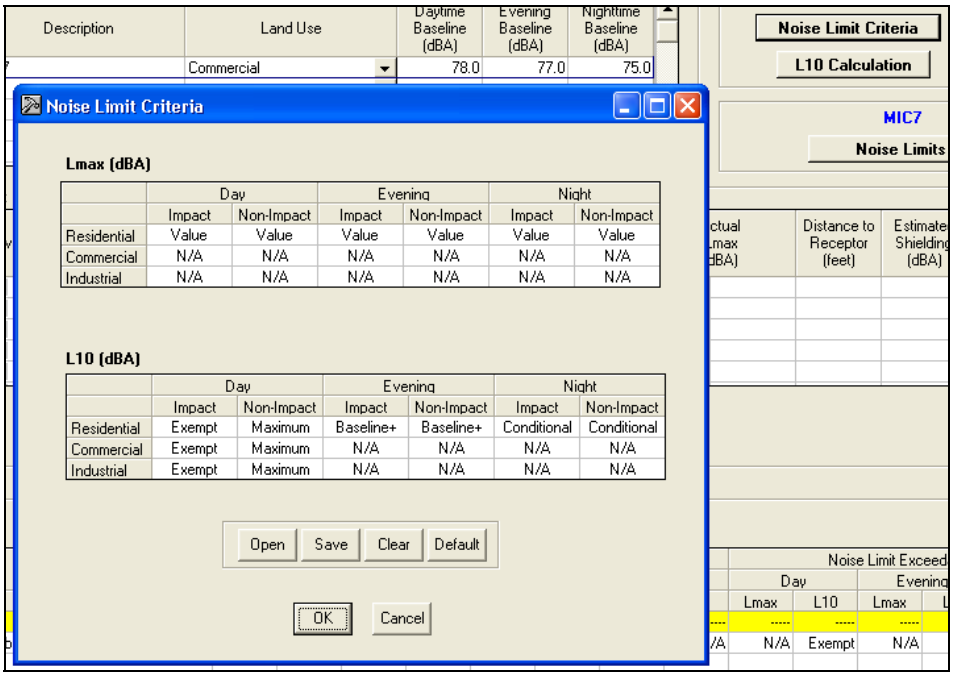


Figure 10. Noise Limit Criteria pop-up dialogue box

The user may populate this dialogue box with Noise Limit Criteria information derived from CA/T Construction Noise Control Spec. 721.560 [1] by clicking on the "Default" command button and clicking "Yes" when asked to load information from the default file, which is stored in the RCNM (see Table 2).

Table 2. Default Noise Limit Criteria

	Daytime (7 AM to 6 PM)		Evening (6 PM to 10 PM)		Nighttime (10 PM to 7 AM)	
Land Use	**L10 Limit (dBA)**	**Lmax Limit (dBA)**	**L10 Limit (dBA)**	**Lmax Limit (dBA)**	**L10 Limit (dBA)**	**Lmax Limit (dBA)**
Residential	maximum of 75 and baseline + 5 for non-impact* and exempt for impact**	85 for non-impact and 90 for impact	baseline + 5	85	if baseline <70 then baseline +5; if baseline ≥70 then baseline + 3	80
Commercial	maximum of 80 and baseline + 5 for non-impact and exempt for impact	N/A	N/A	N/A	N/A	N/A
Industrial	maximum of 85 and baseline+5 for non-impact and exempt for impact	N/A	N/A	N/A	N/A	N/A

* Non-impact equipment is equipment that generates a constant noise level while in operation.

** Impact Equipment is equipment that generates impulsive noise. Impulse Noise is defined as noise produced by the periodic impact of a mass on a surface, of short duration (generally less than one second), high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition.

Otherwise, the user may clear any information present in the dialogue box and specify new data in each cell. Clicking on the "Clear" command button will prompt the user to set all the cells in the dialogue box to Not Applicable (N/A), as in Figure 11. By clicking "Yes," the user will populate all cells with N/A; by clicking "No," the dialogue box will return to the data present before the user clicked "Clear."

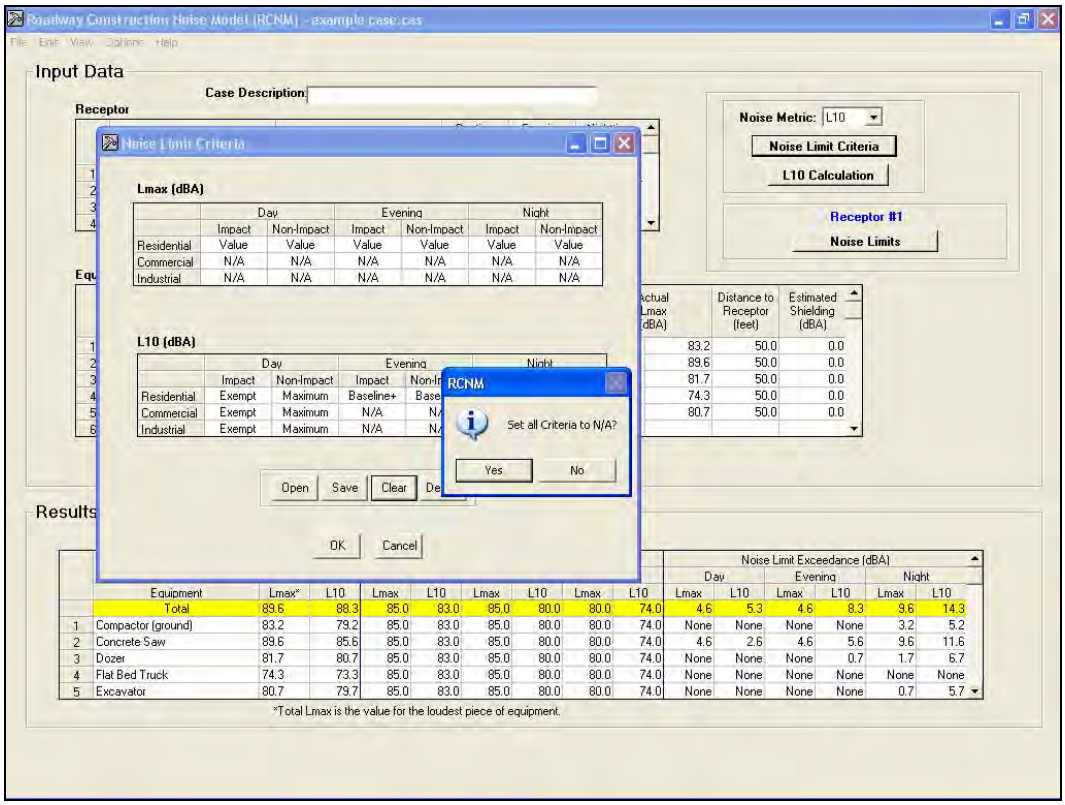


Figure 11. The Noise Limit Criteria "Clear" command button

Clicking on any cell in the Noise Limit Criteria dialogue box reveals a Noise Limit Criteria pull-down menu. Click on this pull-down menu to access the six options, as in Figure 12.

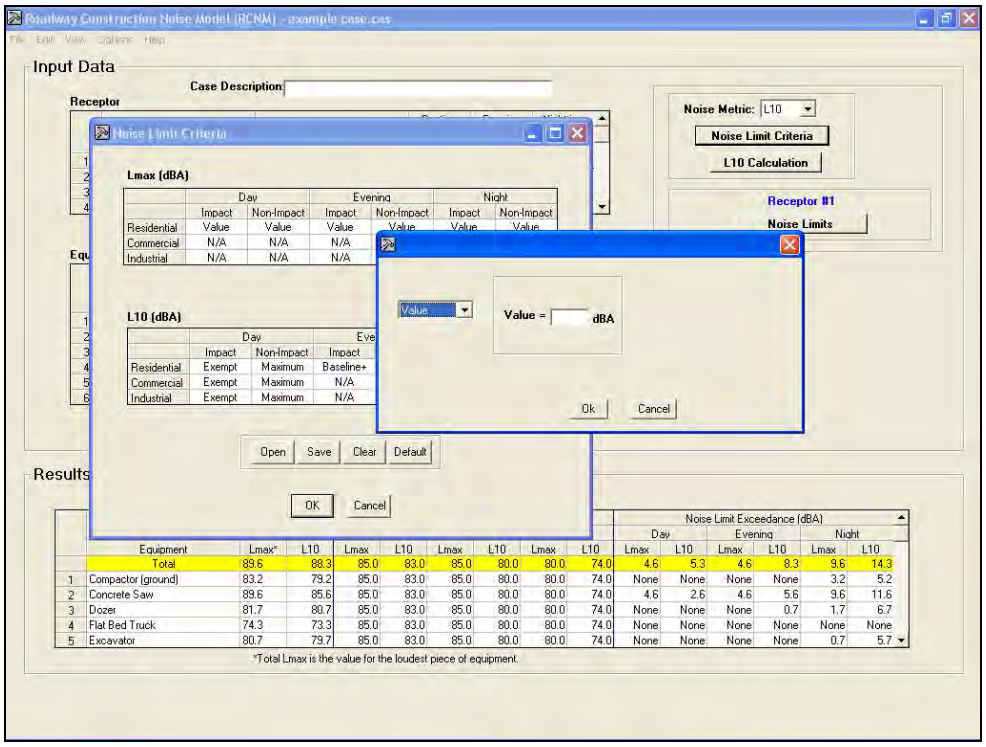


Figure 12. Noise Limit Criteria pull-down menu

Through these six options, the user specifies what Noise Limit Criteria changes, if any, are desirable in each cell. The six cell options are:

i. Exempt (for the specified metric and land use, the equipment is exempt from noise limits)
ii. N/A (for the specified metric and land use, the equipment does not have applicable noise limits)
iii. Value (user is prompted to enter a value for which the noise level should not exceed), as in Figure 13:

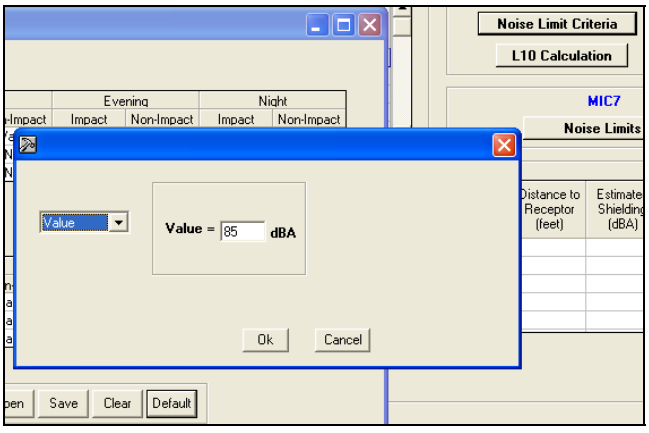


Figure 13. Noise Limit Criteria "Value" dialogue box

iv. Maximum (set value for which a noise level should not exceed to the maximum of two possible levels: A user-defined level or the Baseline level plus some user-defined increment), as in Figure 14:

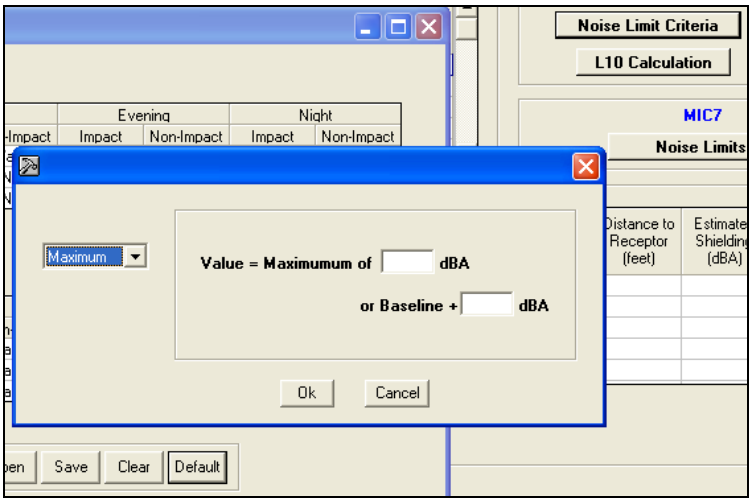


Figure 14. Noise Limit Criteria "Maximum" dialogue box

v. Baseline + (set value for which a noise level should not exceed to the Baseline level plus some user-defined increment), as in Figure 15:

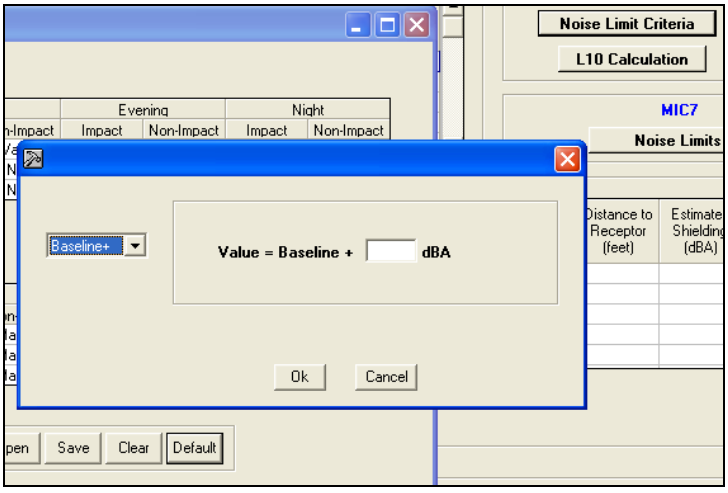


Figure 15. Noise Limit Criteria "Baseline +" dialogue box

vi. Conditional (set conditional value for which a noise level should not exceed; the user is prompted to enter the following information: 1. a comparison value, i.e., "If Baseline < [value], then …"; 2. an increment value to add to the baseline level if the baseline level is *less than* the comparison value; 3. an increment value to add to the baseline level if the baseline level is *greater than or equal to* the comparison value), as in Figure 16:

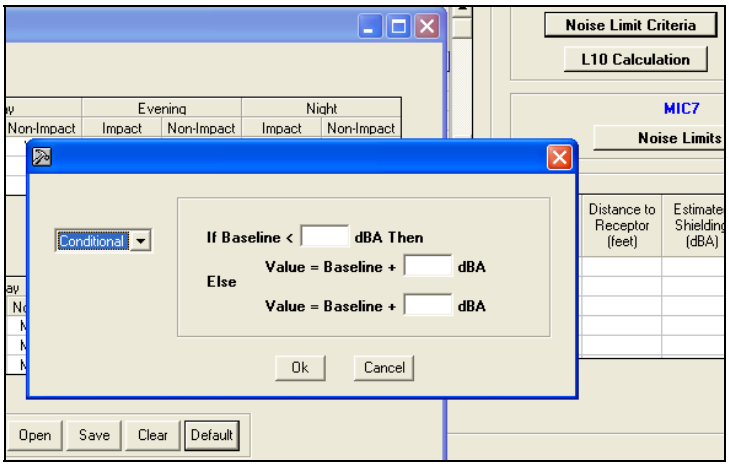


Figure 16. Noise Limit Criteria "Conditional" dialogue box

To see the current value of a cell, simply hold the mouse pointer over the cell. Once the user has specified values for all the cells in the Noise Limit Criteria dialogue box, these criteria can be saved in a criteria file ([name].cri) by clicking on the "Save" command button. The user will be prompted to give the criteria file a name. These criteria can thereafter be loaded into any case by clicking on the "Open" command button.

The user returns to the Noise Limit Criteria dialogue box by clicking "Ok", and returns to the case by clicking "Ok" again.

- L10 Calculation (this button is present if the L10 metric is chosen)

By clicking on the "L10 Calculation" command button, the user can specify the adjustment factor used to calculate L10, as in Figure 17. By clicking the "Default" command button, the user automatically calls for an adjustment factor of 3 dBA, a value empirically derived from extensive CA/T Project data [2].

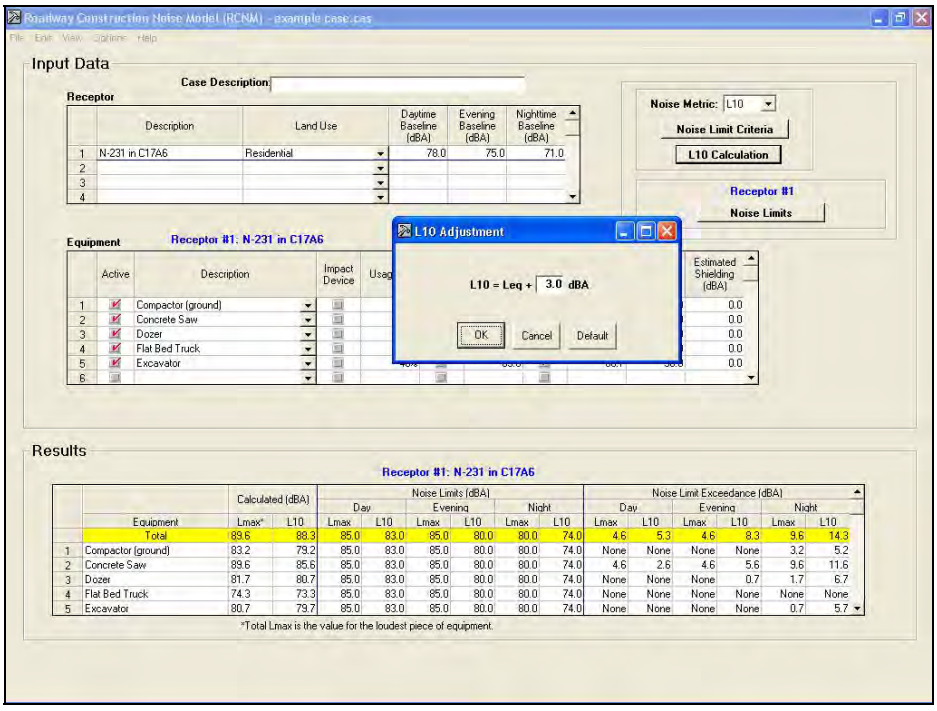


Figure 17. L10 Adjustment dialogue box

- Noise Limits

The "Noise Limits" command button opens a display window that looks exactly like the "Noise Limit Criteria" dialogue box, except that it is not editable, and the only button in the opened window is "Ok". The values in the cells are based on the criteria set in the Noise Limit Criteria window and the baseline levels for the selected receiver, as in Figure 18. (If a receiver is not selected, the dialogue box is unavailable for viewing.)

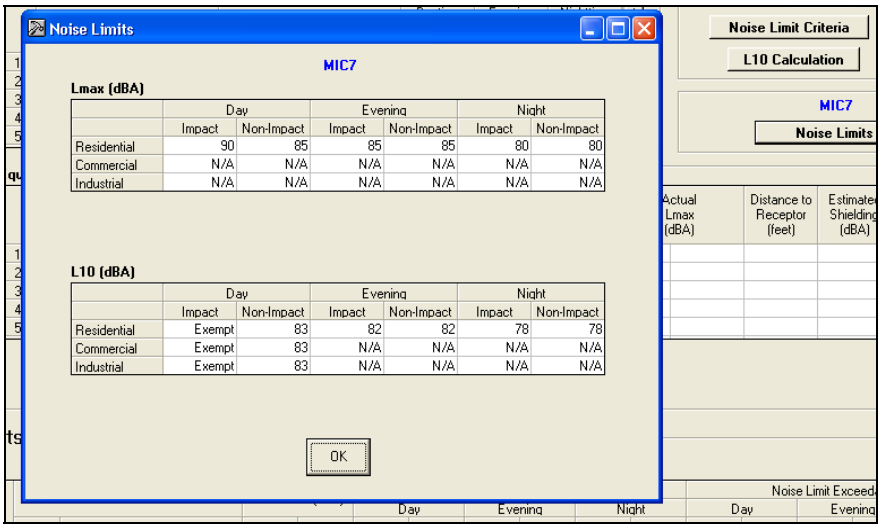


Figure 18. Noise Limits display window

Again, these limits may be changed by the user through the Noise Limit Criteria data entry window.

4 Results

Once the data for one receptor and up to 20 pieces of equipment have been specified in the Input Data portion of the main screen, the RCNM will automatically calculate the Results readout displayed in the bottom portion of the main screen, as in Figure 19. Any changes to the Input Data will automatically cause the RCNM to update the Results. The results for only one receptor will be displayed at a time; results for other receptors can be displayed by selecting the desired receptor in the Receptor window (click in any cell in the desired receptor row). Results for up to 100 receptors can be saved in a case. If Noise Limit Criteria information has been specified, the corresponding results (limits and exceedance values) will be updated as well.

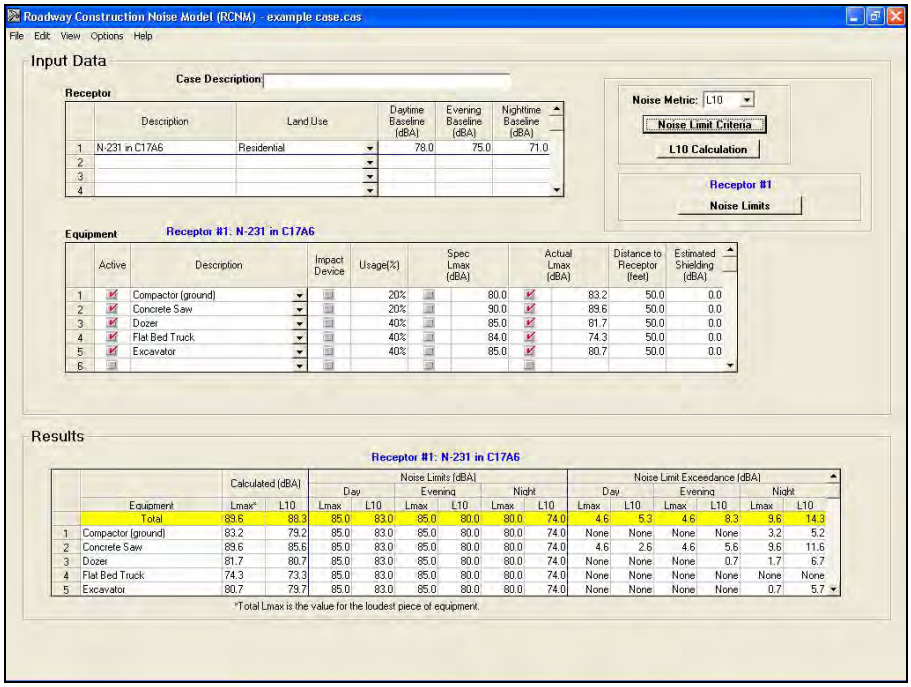


Figure 19. The RCNM main-page Results display

If there is insufficient input data for RCNM to compute a result, then a "Check Input Data" button will appear in the middle of the screen. Clicking on this button will provide the user with an indication of what additional input data are required.

The Results are presented in a read-only spreadsheet that contains the following fields, all applicable to the selected receptor:

- Equipment – the name/description of the equipment type
- Calculated Lmax – the calculated Lmax value for the equipment type. This is calculated from the "Spec" or "Actual" equipment Lmax, distance, and estimated shielding.

- Calculated Leq or L10 – the calculated Leq or L10 value (depending on what is selected in the Noise Metric pull-down menu) for the equipment type. This is calculated from the Calculated Lmax values, equipment usage factors, and selected adjustment factor.
- Day Lmax Noise Limit – the daytime Lmax noise limit for the equipment type.
- Day Leq or L10 Noise Limit – the daytime Leq or L10 noise limit for the equipment type.
- Evening Lmax Noise Limit – the evening Lmax noise limit for the equipment type.
- Evening Leq or L10 Noise Limit – the evening Leq or L10 noise limit for the equipment type.
- Night Lmax Noise Limit – the nighttime Lmax noise limit for the equipment type.
- Night Leq or L10 Noise Limit – the nighttime Leq or L10 noise limit for the equipment type.
- Day Lmax Noise Limit Exceedance – the daytime Lmax noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".
- Day Leq or L10 Noise Limit Exceedance – the daytime Leq or L10 noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".
- Evening Lmax Noise Limit Exceedance – the evening Lmax noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".
- Evening Leq or L10 Noise Limit Exceedance – the evening Leq or L10 noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".
- Night Lmax Noise Limit Exceedance – the nighttime Lmax noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".
- Night Leq or L10 Noise Limit Exceedance – the nighttime Leq or L10 noise limit exceedance for the equipment type. If the criteria limit was not exceeded, the value is "None".

The user may scroll down to view equipment results that are not visible, or the <View> / <Zoom +> menu may be used to zoom in on the Results display only (see Section 3.1.3). There is a row at the top of the Results display, highlighted in yellow, that calculates the total for all equipment combined. This row is always visible during scrolling of the Results spreadsheet. (Calculations for totals are explained in Section 5.3.)

Again, users may export a case's input information and results to a comma separated value (CSV) report file ([name].csv) by choosing the <Export Results> option from the <File> menu. The user can also save the case results to a text file (TXT), which saves the results to a space-separated text format ([name].txt). Results may be saved for a single receptor or all receptors in the case.

5 Calculations in the RCNM

The RCNM uses the primary equation described in the CA/T Construction Noise Control Specification 721.560 [1] for the construction noise calculations.

5.1 Metric Calculation

LmaxCalc = selected_Lmax – 20log(D/50) - shielding (1)

where

selected_Lmax is the "Spec" or "Actual" maximum A-weighted sound level at 50 ft., listed in Table 1 for all pieces of equipment, in dBA,
D is the distance between the equipment and the receptor, in feet,
shielding is the insertion loss of any barriers or mitigation, in dBA (see Appendix A).

Leq = LmaxCalc + 10log(U.F.%/100) (2)

where

U.F.% is the time-averaging equipment usage factor, in percent (see footnote 1 on p 7).

L10 = Leq + 3 dBA adjustment factor (3)

The RCNM calculates L10 by adding 3 dBA to the Leq, where the 3 dBA default L10 adjustment factor was empirically derived by comparing extensive CA/T construction noise data. This adjustment factor may be changed in the RCNM at the user's discretion.

5.2 Exceedance Calculation

Daytime Lmax Exceedance = LmaxCalc – Daytime Lmax Limit (4)

Daytime Leq or L10 Exceedance = Leq or L10 – Daytime Leq or L10 Limit (5)

Evening Lmax Exceedance = LmaxCalc – Evening Lmax Limit (6)

Evening Leq or L10 Exceedance = Leq or L10 – Evening Leq or L10 Limit (7)

Nighttime Lmax Exceedance = LmaxCalc – Nighttime Lmax Limit (8)

Nighttime Leq or L10 Exceedance = Leq or L10 – Nighttime Leq or L10 Limit (9)

5.3 Totals Calculation

The Total values in the Results section are determined in the following manner:

1) Total Leq = 10*log(Σ (individual equipment Leq values[3]))
2) Total L10 = 10*log(Σ (individual equipment L10 values[3]))
3) Total Lmax = Maximum among individual equipment Lmax values
4) Total noise limits and limit exceedances:
    a. Determine whether or not total is impact or non-impact
        i. If all the equipment is non-impact, label the total as non-impact.
        ii. If all the equipment is impact, label the total as impact.
        iii. If the equipment is mixed non-impact and impact, label the total as non-impact.

    b. Determine total noise limits and limit exceedances the same way as with individual pieces of equipment (see Section 5.2), only use the calculated total sound levels (Total Leq or Total L10) and the impact or non-impact label according to the criteria specified in i through iii.

[3] The Leq and L10 levels are energy averages.

6 References

[1] Construction Noise Control Specification 721.560, Central Artery/Tunnel Project, Massachusetts Turnpike Authority, Boston, MA, 2002.

[2] Thalheimer, Erich. "Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project". Noise Control Engineering Journal, Vol. 48, No. 5, pp 157-165, September - October 2000.

[3] "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", Environmental Protection Agency, ONAC 550/9-74-004. Washington, DC, March 1974.

[4] "Power Plant Construction Noise Guide". Bolt, Beranek, and Newman Inc. and Empire State Electric Energy Research Corp., Report No. 3321. New York, NY May 1977.

Appendix A: Best Practices for Calculating Estimated Shielding for Use in the RCNM

This Appendix presents some simplified shielding factors for use in the RCNM. These suggestions are "rules of thumb" based on experience gathered by CA/T construction noise experts working in the field [2].

1) If a noise barrier or other obstruction (like a dirt mound) just barely breaks the line-of-sight between the noise source and the receptor, use 3 dBA.

2) If the noise source is completely enclosed OR completely shielded with a solid barrier located close to the source, use 8 dBA. If the enclosure and/or barrier has some gaps in it, reduce the effectiveness to 5 dBA.

3) If the noise source is completely enclosed AND completely shielded with a solid barrier located close to the source, use 10 dBA.

4) If a building stands between the noise source and receptor and completely shields the noise source, use 15 dBA.

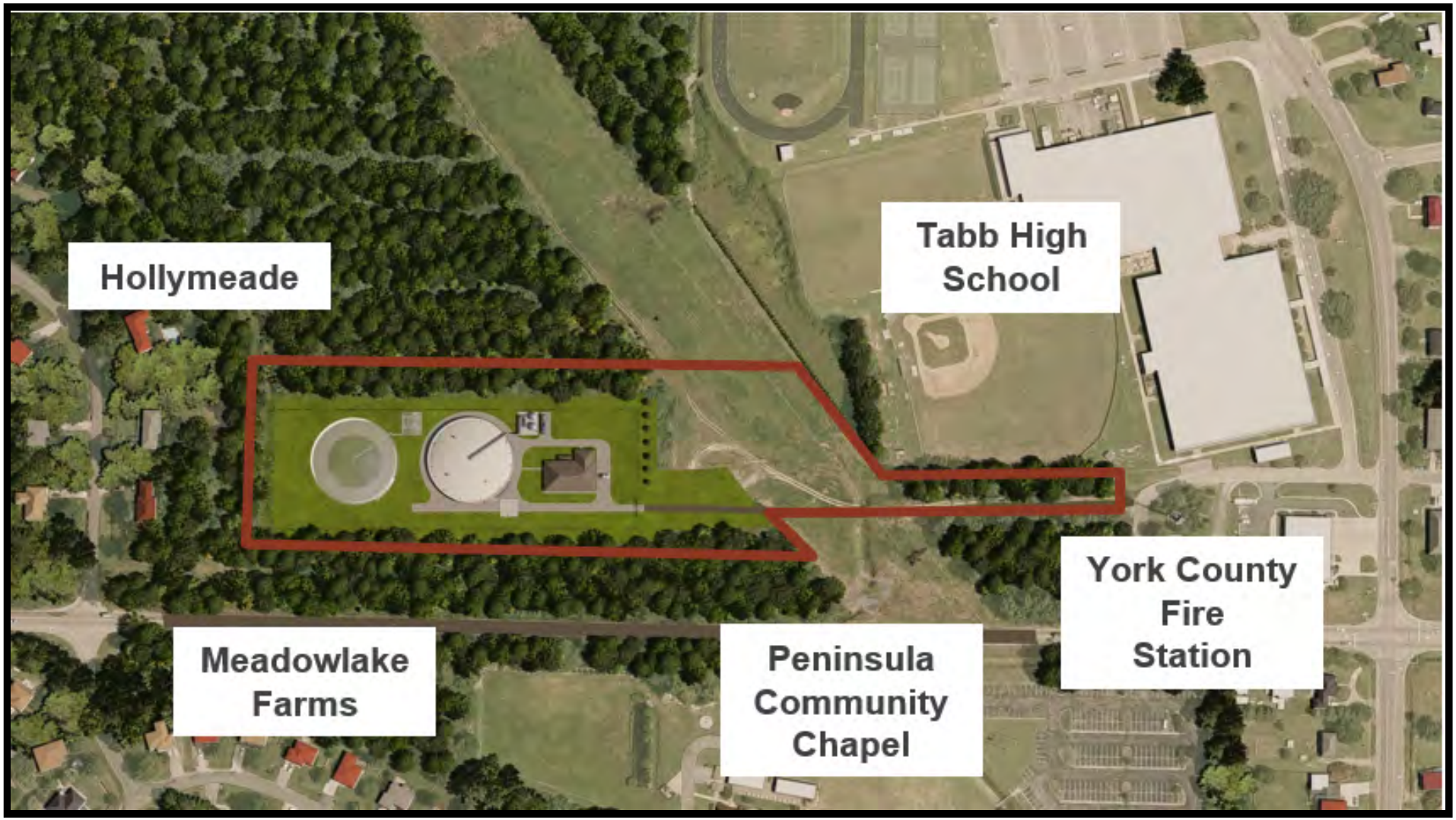
5) If a noise source is enclosed or shielded with heavy vinyl noise curtain material (e.g., SoundSeal BBC-13-2" or equivalent), use 5 dBA.

6) If dilapidated windows are replaced with new acoustical windows, or quality internal or exterior storm sashes, use an incremental improvement of 10 dBA for an overall Outside-to-Inside Noise Reduction (OINR) of 35 dBA.

7) If work is occurring deep inside a tunnel using the "top-down" construction method (i.e. cover the tunnel work with concrete roadway decks to allow surface traffic and then excavate underneath the roof deck), use 12 dBA.

Appendix C: Sensitive Structures in the Surrounding Area

APPENDIX C - FIGURE 1



Appendix D: Preliminary Geotechnical Report

SEE APPENDIX B OF THE TABB PRESSURE REDUCING STATION AND OFFLINE STORAGE FACILITY – PRELIMINARY ENGINEERING REPORT

Appendix E: Preliminary Risk Register

SEE APPENDIX M OF THE TABB PRESSURE REDUCING STATION AND OFFLINE STORAGE FACILITY – PRELIMINARY ENGINEERING REPORT

Appendix M: Risk Register

TABB PRESSURE REDUCING STATION AND OFFLINE STORAGE FACILITY
PROJECT RISK REGISTER
August 28, 2020

Hazen

Impact \ Probability	1	2	3	4	5
5	9,20-23, 42, 43	3, 39-41	8,32		
4	6, 10, 25, 26, 28, 29	1, 2, 7, 11, 19			
3	5,14, 24, 27, 44	16	4, 12, 13, 15, 30,31,33-38	18	17
2					
1					

Risk Number

High Risk

Mitigation Plan Req'd

Low Risk

Impact Rankings

5	Highly Impactful
4	
3	
2	
1	Not Impactful

Probability Rankings

5	Highly Probable
4	
3	
2	
1	Not Probable

Risk management planning looks to identify potential risks and risk mitigations that may negatively impact the project schedule. This includes cost, schedule, scope, quality and other related risks, such as environmental risk and community issues. Each high risk item is also assigned a specific contingency plan which details how the risk will be managed should it occur. Each risk is then assigned a probability and impact score that ranges between 1-5 with five representing the highest probability or impact. The probability and impact are then multiplied to obtain the risk score to help prioritize the risks. Details of scoring system shown on the 'Risk Matrix' tab.

Indicates Primary Risk Category

Risk ID	Risk Description	Probability (1,2,3,4,5)	Impact (1,2,3,4,5)	Risk Score	Mitigation Strategy	Contingency & Triggers	Risk Owner	Actions Taken	Commentary / Notes
		Estimate of the probability the risk will occur (1 = highly unlikely, 5 = almost certain) .	Estimate of the amount of impact or severity of the risk.	Probability x Impact. Once all risks have been entered, sort by this column to identify your biggest risks.	Proactive plans to lower the probability or to lower the impact ahead of time. It may require a more detailed plan written up separately.	Identify what would have to be done if the risk were to become reality, and how you would recognize that action is required. This may require a more detailed plan documented separately. Only shown for items in orange or red.	Identify who is responsible for tracking this risk and its changes in probability and impact.	Document what has been done, either to avoid or mitigate the risk	
Project Budget									
1	Construction costs exceeding CIP budget	2	4	8	Control and manage expectations. Minimize requirement changes. Updated EOPCC provided at milestones for review.		HRSD & Hazen		
2	Excessive Claims and Change Orders	2	4	8	QA/QC reviews during design to minimize changes later. Detailed design workshops to limit scope change later. Consider a contingency in the contract.		HRSD & Hazen		
Project Schedule									
3	Force Majeure	2	5	10	Unavoidable. Consider a "no exuses completion bonus"	Upon receipt of a force major claim, would need immediate meeting with GC and HRSD to discuss best methhod moving forward based on the severity and long term affects of the issue causing the force majeure	Hazen		
4	Other Project Related Delays	3	3	9	Consider a "no exuses completion bonus". Define completion dates up front (possibly separate completion dates). Liquidated damages must be in place. Clear language in place for claims process. Spend time on means and methods implementation into MOPO up front.		Hazen		
Project Quality									
5	Design Quality Lapse	1	3	3	PER and intermediate design milestones will elliminate this risk. Detailed review of milestones by client and internal QC processes		Hazen & HRSD		
6	Proof of Concept Liability	1	4	4	Define performance requirements clearly and establish in PER, utilize all limitations identified through topographic survey and geotechnical report.		Hazen		
7	Construction Quality Lapse	2	4	8	Include all performance testing requirements clearly upfront (i.e. tank watertight testing, pump performance testing). Ensure thourough and continuous inspection processes.		Hazen		
Project Safety									
8	Safety concerns during design and construction	3	5	15	Establish minimum standards (OSHA Compliance), site security after hours, safety training required for anyone visiting site, site check-in requirements	Any indication of a reported injury on the project site during design or construction would call for a meeting to explore the potential for further safety protocol or training to be required for all personnel on site	Hazen, HRSD, and Contractor		Seems like we should separate design safety and construction safety.
9	Safety concerns with the completed project	1	5	5	Rely on locality and HRSD policies and procedures. Design prevention by fencing and signage and security measures.	No trigger necessary; measures to be taken regardless. Many meetings with HRSD will be had to discuss the measures of safety required for the site. Look to similar sites for example.	Hazen & HRSD		
Aesthetics									
10	Project not meeting requirements	1	4	4	Engage stakeholders and community early and often. Capture desires early in design and provide realistic renderings as what to expect.		Hazen & HRSD		
Permitting / Third Party Approvals									
11	Delay in Site Plan Approval	2	4	8	Engage permitting agencies early and begin permitting during the preliminary engineering pahses where possible.		Hazen		
12	Delay in Erosion and Sedimentation Control Approvals	3	3	9	Engage permitting agencies early and begin permitting during the preliminary engineering pahses where possible.		Hazen		
13	Delay in Stormwater Management Approval	3	3	9	Engage permitting agencies early and begin permitting during the preliminary engineering pahses where possible.		Hazen		
14	Unexpected Environmental Impacts (i.e. tree removal or waters of the US wetlands)	1	3	3	Engage permitting agencies early and begin permitting during the preliminary engineering pahses where possible.		Hazen		
Impacts During Construction									
15	To existing vehicle traffic	3	3	9	Appropriate outreach/notification and signage if required.		Hazen		
16	To existing pedestrian traffic	2	3	6	Appropriate outreach/notification and signage if required.		Hazen		
17	To Business Access (Consider church, first responders station, and schools)	5	3	15	Engage stakeholders early and often. Perform detailed pre-construction assessment containing mitigation techniques	Receipt of any complaint that could have been prevented will be the cause for a meeting to explore alternative options to avoid disturbance.	Hazen		
18	To neighboring residents (noise, vibration)	4	3	12	Engage stakeholders early and often. Perform detailed pre-construction assessment containing mitigation techniques	Receipt of any complaint that could have been prevented will be the cause for a meeting to explore alternative options to avoid disturbance.	Hazen		
Community Claims or Complaints									
19	Claims / Complaints	2	4	8	HRSD Provisions, Community Engagement	Receipt of any complaint that could have been prevented will be the cause for a meeting to explore alternative options to avoid disturbance.	HRSD		
Design Approvals									
20	Untimely HRSD comments / approvals	1	5	5	Establish review schedule early and commit to responding		Hazen		
21	Untimely City comments / approvals	1	5	5	Establish review schedule early and commit to responding		Hazen		
22	Untimely VDOT approvals	1	5	5	Coordinate early and often		Hazen		
23	Untimely Environmental Reviews	1	5	5	Coordinate early and often		Hazen		
Utilities									
24	Utilities to work around & support / protect	1	3	3	Perform upfront site review and survey to capture all unknowns possible.		Hazen		
25	Unknown utilities uncovered during construction	1	4	4	Have contact list of possible utility stakeholders in the area in case there is an encounter		Hazen		
26	Delay in getting access to utilities needed for the site	1	4	4	Coordinate early and often		Hazen		
Site Conditions									
27	Unexpected Soil Conditions	1	3	3	Coorindate with GET early to confirm appropriate boring locations and proper analysis of samples. Obtain additional borings in specific locations of structural elements.		Hazen		
28	Unanticipated HAZMAT	1	4	4	Have contact list of possible utility stakeholders in the area in case there is an encounter		Hazen		
29	Site layout not compatible with actual conditions	1	4	4	Coordinate early for topographical survey and property lines / information. Identify specific conditions that could impact site layout. Wetlands, Environmental concerns, etc.		Hazen		
Third Party Interface-Coordination									
30	York County	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
31	VDOT	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
32	Dominion Power	3	5	15	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		DE is a hugh player and could be a show stopper as we are crossing their RW and constructing in that area.
33	Church Across Street	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
34	Residential Neighborhoods	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
35	First Responders Station	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
36	Schools	3	3	9	Coordinate early and often. Identify any third-party specific risks during pre-construction assessment and specific mitigation techniques for each. Have point of contact for entity.		Hazen and HRSD		
Community									
37	Opposition to Project	2	3	6	Coordinate early and often and openly with public. Receive input and offer feedback.		Hazen and HRSD		
38	Untimely stakeholder feedback	2	3	6	Have contact list of possible utility stakeholders in the area in case there is an encounter		Hazen		
Property Acquisition									
39	Initial Site layout not sufficient for construction	2	5	10	Hazen and HRSD coordinate during PER phase to ensure property meets needs of anticipated site layout.	Initial site layout design will indicate if need for further discussions with HRSD are needed to re-arrange site layout.	Hazen and HRSD		
40	Property acquisition is delayed	2	5	10	Commence acquisitions as early as possible. Have site alternatives available.	Any indication to Hazen that design may be delayed will be cause for Hazen to notify HRSD of the need for possible design time	Hazen and HRSD		
Systems Integration									
41	Delays with SCADA or other I&C	2	5	10	Coordination with HRSD and Hazen early on products and procurement. Coordination on schedule implementation with Construction	Any indication to Hazen that design or construction schedules may be delayed will be cause for Hazen to notify HRSD of the need for possible time or need to expedite products	Hazen and HRSD		
Warranty Items									
42	Operational Issues after acceptance	1	5	5	Require a demonstration period prior to acceptance for all critical equipment.		Hazen		
43	Repairs after acceptance	1	5	5	Extend warranty to desired timeframe		Hazen		
44	Vegetation and Landscaping	1	3	3	Warranty period modified as desired. Standard period is 1 year		Hazen		

TABB PRESSURE REDUCING STATION AND OFFLINE STORAGE FACILITY
RISK ASSESSMENT MATRIX
August 28, 2020

Hazen

*Use this matrix to 1) assess **probability** of risk occuring (1-5 according to criterion), 2) identify the **risk category**, and 3) assess the estimated **impact** of risk occuring (1-5 using the table below). Populate columns E, F, G accordingly in your risk register.*

Risk Number						
Impact	5	9,20-23, 42, 43	3, 39-41	8		
	4	6, 10, 25, 26, 28, 2	1, 2, 7, 11, 19			
	3	5,14, 24, 27, 44	16	12, 13, 15, 30-38	18	17
	2					
	1					
		1	2	3	4	5
		Probability				

High Risk
Mitigation Plan Req'd
Low Risk

Probability Rankings

5	*Highly Probable*
4	
3	
2	
1	*Not Probable*

Impact Rankings

5	*Highly Impactful*
4	
3	
2	
1	*Not Impactful*

	Risk Impact Definitions				
RISK CATEGORY	1	2	3	4	5
Project Budget	< 2% of Cost	2% - 5% of Cost	5% to 10% of Cost	10% to 15% of Cost	>15% of Cost
Project Schedule	< 2% of Time	2% - 4% of Time	4% - 6% of Time	6% - 10% of Time	>10% of Time
Project Quality	No Quality Concerns	Minor edits required to maintain quality with no impact on final quality	Minor lapse in quality, can be mitigated with other impacts	Major impacts that can be mitigated and slightly impact final product quality	Major quality concerns with unavoidable impact to final quality
Health & Safety	Potential for minor injury (non-reportable) or near miss	Minor injury, accident, or near miss (reportable)	Major injury or multiple minor injuries; minor traffic incidents	Multiple major injuries, minor injury to public	Significant injuries to public or any fatality
Aesthetics	No difference from anticipated aesthetic	Minor differences from anticipated aesthetics, can be mitigated without other impacts	Minor differences from anticipated aesthetic. Can be Changed with other impacts	Major differences to aesthetic that can be changed with other impacts	Major differences than anticipated aesthetic that cannot be changed
Third Party Approval & Coordination	No impact on project	Minor impact to project design schedule, <5% of time	Impacts project design schedule 5-10% OR results in need for minor redeisgn	Impacts project design scheule >10% OR results in need for major redesign	Impacts in design schedule >10% AND results in major redesign
Impacts During Construction	No impact on outside party	Intermittent minor impacts to outside parties	Consistently has minor impacts to outside parties	Intermittent major impacts to outside parties	Consistently has major impacts to outside parties
Public Relations & Community	No Complaints	Minor Complaints - Issues are Minor Inconveniences. No impact to schedule.	Consistantly receiving complaints for minor inconveniences	Consistantly receiving complaints for major inconveniences . Needs adjustments to design	Receiving complaints that could lead to claims process or damage. Major changes needed to design
Design Approval	No impact on project	Minor impact to project design schedule, <5% of time	Impacts project design schedule 5-10% OR results in need for minor redeisgn	Impacts project design scheule >10% OR results in need for major redesign	Impacts in design schedule >10% AND results in major redesign
Utilities	No unforseen utilities	Existing utilities found, no conflict	Existing utilities found, minor conflicts that can be worked around	Multiple utilities found resulting in relocation or minor design changes	Major utilities uncovered, will cause a change to design
Site Conditions	No impact on design or construction	Minor mpacts design or construction. no impact to schedule or cost	Minor Impacts design or construction. Impacts schedule or cost up to 5%	Major Impacts design or construction. Impacts schedule or cost greater than 5%	Major Impacts, causes a potentially permanent stoppage to design or construction
Property Acquisition	No impact on design or construction	Minor impact to site layout, no impact on schedule.	Minor changes to site layout resulting in impact of schedule less than 5%	Major changes to site layout impacting schedule greater than 5%	Property not obtainable or usable causing a stopppage to design
Systems Integration	Little to no effect	Minor issues onsite, does not effect operations of process	Effects parts of system operation but still operable	Effects process operations short term, <1 day offline	Effects process operations long term, > 1 day offline
Warranty Items	Little to no effect	Minor issues onsite, does not effect operations of process	Effects parts of system operation but still operable	Effects process operations short term, <1 day offline	Effects process operations long term, > 1 day offline