READINGTON LEBANON SEWERAGE AUTHORITY

RL101: Plant Upgrade Study

Basis of Design Report

DRAFT

December 2024

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1 BACKGROUND

The Readington Lebanon Sewerage Authority (RLSA) was established in 1976 to service the sewerage needs of Readington Township, Lebanon Borough, and the Round Valley Recreational Area. Wastewater is conveyed to the RLSA 's Plant via gravity sewers and two (2) remote pump stations. A schematic diagram of the RLSA's collection system is provided in **Figure 1** below.

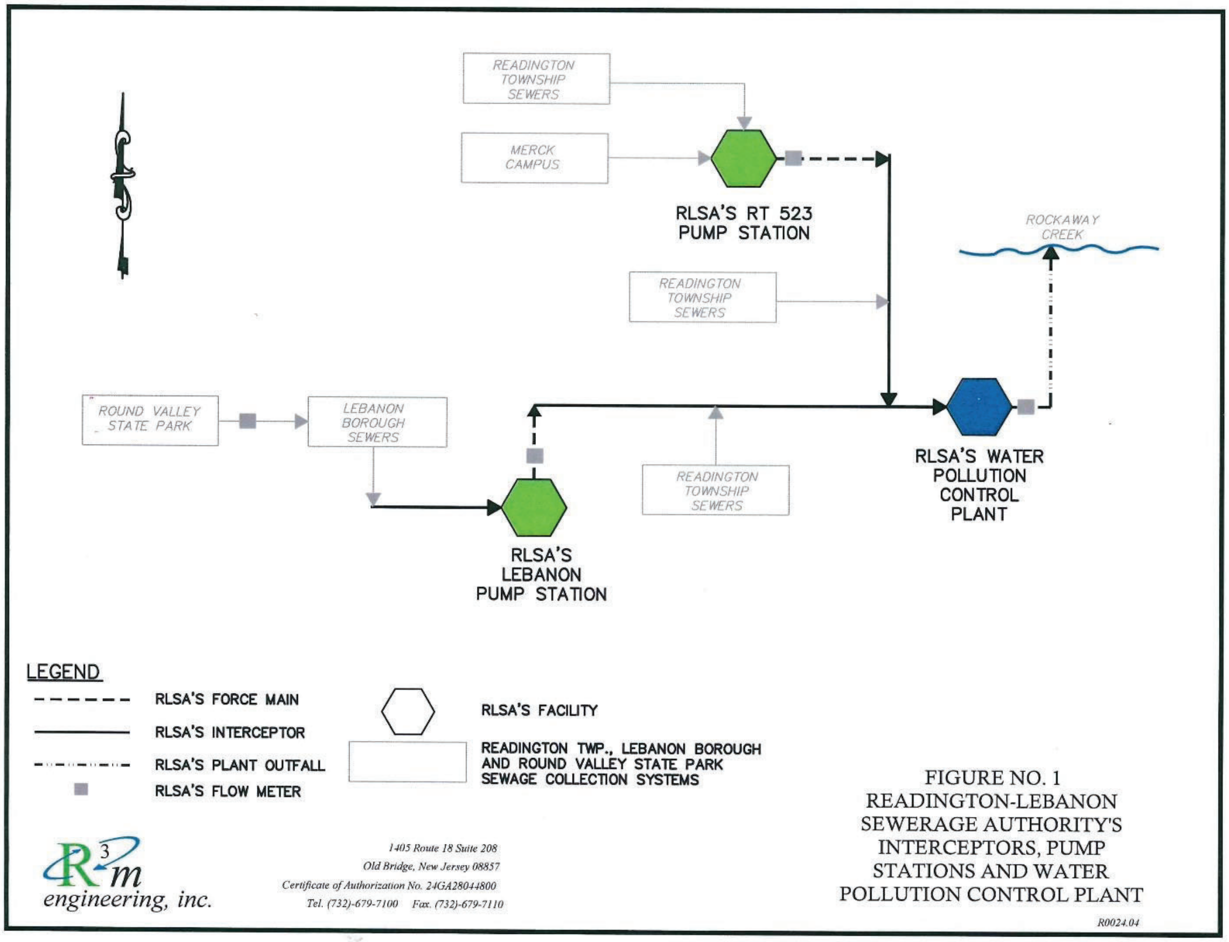


Figure 1 - RLSA Interceptors, Pump Stations, and Plant

1.1 Original Plant

The RLSA Wastewater Treatment Plant (Plant) was constructed in the 1980s under Contract 81-2, and designed to treat an average daily flow (ADF) of 0.8 MGD and a peak flow of 2.0 MGD. In accordance with the Plant's New Jersey Pollutant Discharge Elimination (NJPDES) Permit issued at that time, the Plant was designed to provide secondary treatment via the construction of an oxidation ditch with final clarifiers and post aeration.

Influent wastewater from the surrounding service area flows to the Plant's Influent Pump Station. From the Influent Pump Station, wastewater is pumped to an Oxidation Ditch where the organic content in the sewage is bio-degraded by microorganisms (activated sludge) in an oxygen-rich environment. Effluent from the Oxidation Ditch flowed to two (2) thirty four

(34) foot diameter final clarifiers for solids removal. Treated effluent from the clarifiers had previously been conveyed to the chlorine contact tank before cascading down a series of steps within a downstream aeration manhole to increase the oxygen content prior to discharging to the Rockaway Creek. The solids entrained within the clarifiers were then returned to the head of the oxidation ditch or wasted to an aerobic digester/thickener for further processing and discharged onto sand drying beds to reduce their water content prior to hauling to an approved land application site.

1.2 2000 Plant Expansion

Increases in projected regional growth within the RLSA service area resulted in the need to expand and upgrade the Plant to treat an average design flow of 1.6 million gallons per day (MGD) and a peak flow of 5.14 MGD. The facilities constructed under Contract 98-1 included:

- Replacement of pumps at the Influent Pump Station
- Addition of a second 12-inch parallel Force Main
- Construction of Oxidation Ditch No. 2
- Abandonment of Clarifiers No. 1 & 2
- Construction of Clarifiers No. 3 & 4
- Construction of Splitter Boxes No. 1 and 2
- Construction of a Chemical Storage and Metering Facility
- Provisions for the Addition of Future Tertiary Filtration
- Construction of Cascade Aeration and Ultraviolet Disinfection Facilities
- Abandonment of the Chlorine Contact Tank
- Abandonment of the Polishing Pond
- Construction of a Sludge Dewatering Facility
- Demotion of the existing Polishing Pond
- Addition of a Standby Power Generator
- SCADA System Upgrades

The solids handling process changed with the addition of a belt filter press dewatering system to dewater the solids in lieu of the previous sand drying beds. With this improvement biosolids are no longer land applied but dewatered and collected in a roll off container for transport to the Stony Brook Regional Sewerage Authority for ultimate disposal.

1.3 Proposed Upgrades

The proposed Plant upgrades are required to achieve the interim and final permit limits contained in the April 1, 2024 NJPDES Permit further discussed below. The purpose of this report is to outline the Basis of Design (BOD) of the recommended system upgrades and processes.

2 GENERAL DESIGN CRITERIA

2.1 Design Flow Rates

An evaluation of the design flow rates was performed, and the results were outlined in Technical Memo No. 1. The resulting Plant Design Flow Rates are as indicated in **Table 1** below.

Table 1: Plant Design Flow Rates

Minimum Flow	0.49	MGD
Average Dry Weather Flow	1.20	MGD
Maximum Dry Weather Flow	3.77	MGD
Average Wet Weather Flow	3.07	MGD
Peak Hour Flow	5.51	MGD

2.2 NJPDES Permit Requirements

The RLSA Plant operates under NJPDES Permit No. NJ0098922, issued by the New Jersey Department of Environmental Protection (DEP) on April 1, 2024. The permit includes three (3) phases identifying distinct average influent Plant flows and increasingly rigorous effluent quality requirements: Initial, Interim and Final.

The Initial and Interim permit phases effluent discharge limits are based on an average design flow of1.2 million gallons per day (MGD), and the Final permit phase effluent discharge limits are based on an average design flow of 1.45 MGD. The Interim permit phase limits will become effective on June 1, 2029. The Final permit phase would become effective if and when the average influent Plant flow exceeds 1.2 MGD for three (3) consecutive months calculated on an annual basis.

In addition to the traditional effluent discharge limits for Total Suspended Solids (TSS), Carbonaceous Biochemical Oxygen Demand (CBOD), pH, Oil & Grease, E-Coli and chronic toxicity, the Initial, Interim and Final permit phases also include seasonal effluent limits for Nitrogen and Phosphorus.

The NJPDES Permit limits and current RLSA effluent data were reviewed and it was determined that the Plant typically achieves the Initial permit phase seasonal effluent limits for Nitrogen and Phosphorus; however, modifications to the RLSA's biological activated sludge process would be required to achieve the effluent discharge limits in the Interim and Final permit phases – specifically for Total Phosphorus (Total-P).

Furthermore, the April 2024 NJPDES Permit requires that the RLSA remove phosphorus biologically rather than chemically (with the use of polymer or metal salts for coagulation). Biological process modifications are discussed in Section 5 of this report.

3 INFLUENT PUMP STATION & SCREENINGS

The existing Influent Pump Station was constructed in the 1980's and was upgraded with the 2000's Plant Expansion. The existing pump station features a comminutor, a bypass channel with a manually cleaned bar rack, two (2) wet wells, two (2) centrifugal pumps and two (2) 12-inch force mains, each equipped with a magnetic flow meter. Technical Memo No. 2 includes the detailed evaluations performed to address existing pump station deficiencies and to handle projected peak hour flows.

This existing Influent Pump Station is in excess of forty (40) years old and has reached the end of its estimated useful life. In addition, the currently installed pumps do not have the capacity to handle the projected maximum influent flows.

Based on the delineation of freshwater wetlands on the Plant site performed by Van Cleef Engineering Associates, the existing IPS is located within the 50-foot wide wetlands transition area required by the NJDEP. The construction of a permanent aboveground structure is not permissible within the freshwater wetlands transition area and therefore extending the existing dry well and wet well of the existing pump station is not a feasible alternative due to this environmental constraint.

The proposed Influent Pump Station will be a dry well/wet well style pump station. The Pump Station will be located adjacent to the existing Pump Station to minimize gravity sewer modifications yet remain outside of the wetlands buffer transition area. The design of the pump station will provide adequate capacity to meet projected average and peak flow requirements with provisions for future expansion, if required.

3.1 Proposed Pump Station Structure

3.1.1 Building Foundation & Substructure

The proposed Pump Station Structure will have a footprint of approximately 44 feet by 35 feet and extends approximately 45 feet below grade. The below grade structure of the pump station will be a cast in place concrete structure. The depth of the pump station was dictated by the invert elevations of the influent gravity sewers. The location of the pump station was selected to minimize the length the existing influent gravity sewers would need to be extended and, in turn, minimize the depth of the new influent pipe and influent channels.

The foundation of the proposed pump station is expected to be similar to that of the existing Pump Station. Soil borings will be taken during the detailed design phase to confirm foundation requirements.

The wet well side of the influent pump station will include a screenings room constructed at grade. A stairway will be provided to access the below grade influent channels and wet wells.

The dry well side will extend two floors below grade and will include a control room constructed at grade. The intermediate level, one floor below grade, will house the magnetic flowmeter and bypass piping fittings. The lower level of the dry well will house the pumps, process piping, gate and check valves. The floor of the upper level and intermediate levels will include grated openings above the pumps to facilitate their removal and maintenance.

The lower-level floor will be sloped, and a sump pump will be provided to accommodate washdown and other maintenance activities.

Plan and section views of the proposed Influent Pump Station are provided in **Attachment A.**

3.1.2 Architectural and Superstructure

The above grade pump station superstructure will be designed to match the appearance of the existing Pump Station. The exterior walls will be constructed of reinforced concrete block with a dryvit stucco exterior finish. The roof of the building will be a cast in place concrete structure with tapered insulation and a thermoplastic single ply-roofing system. Roof drains and leaders will be provided for drainage. Equipment hatches will be provided in the Screenings Room roof to facilitate future removal and replacement of the mechanical bar screens.

Fiberglass-Reinforced Plastic (FRP) double doors will be provided at the entrance of the Dry Well. A single FRP man door and an overhead coiling door will be provided for access to the Wet Well. There will be no direct access between the Dry Well and Wet Well spaces as this arrangement will allow for the dry well to be considered an Unclassified Area per National Fire Protection Association (NFPA) Standard 820. Windows will be provided on both the dry and wet well to provide additional daytime illumination.

3.1.3 Heating & Ventilation

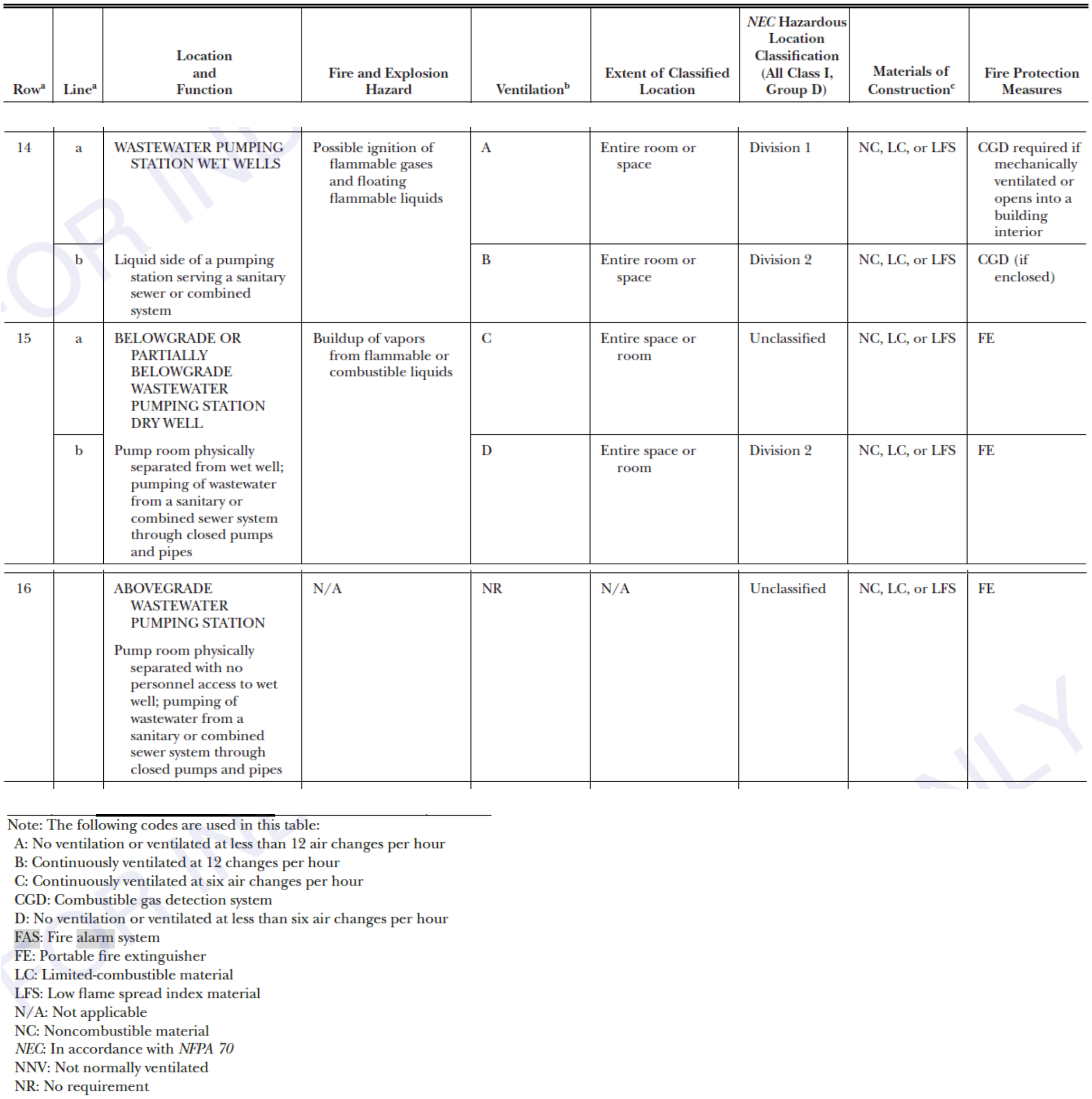
The Pump Station will be ventilated per the requirements of NFPA 820, referenced in **Table 2.**

- The Wet Well will be ventilated at 12 air changes per hour, classifying the location as a Class 1 Div. 2 Group D Hazardous area.
- The Dry Well will be ventilated at 6 air changes per hour, resulting in an unclassified National Electrical Code (NEC) Hazardous area designation.

For both the dry well and wet well, roof mounted supply and exhaust fans will be provided. The layout of ductwork will be arranged to sweep air across the headspace in the vertical and horizontal plane. Supply ductwork will be provided to supply air to the top of each headspace. Exhaust ductwork will be provided to extract air from the bottom of each headspace where hydrogen sulfide and other gases tend to accumulate. RLSA staff noted that odor is not an issue at this location, therefore, odor control will not be provided.

Natural gas service is not available at this location; therefore, electric unit heaters will be used. Electric 480V unit heaters will be provided on all three levels of the dry well and will be thermostatically controlled. Explosionproof unit heaters will be provided in the wet well side of the Pump Station to prevent the equipment from freezing.

Table 2: Excerpts from NFPA 820 Table 4.2.2



Row[a]	Line[a]	Location and Function	Fire and Explosion Hazard	Ventilation[b]	Extent of Classified Location	*NEC* Hazardous Location Classification (All Class I, Group D)	Materials of Construction[c]	Fire Protection Measures
14	a	WASTEWATER PUMPING STATION WET WELLS	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1	NC, LC, or LFS	CGD required if mechanically ventilated or opens into a building interior
	b	Liquid side of a pumping station serving a sanitary sewer or combined system		B	Entire room or space	Division 2	NC, LC, or LFS	CGD (if enclosed)
15	a	BELOWGRADE OR PARTIALLY BELOWGRADE WASTEWATER PUMPING STATION DRY WELL	Buildup of vapors from flammable or combustible liquids	C	Entire space or room	Unclassified	NC, LC, or LFS	FE
	b	Pump room physically separated from wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes		D	Entire space or room	Division 2	NC, LC, or LFS	FE
16		ABOVEGRADE WASTEWATER PUMPING STATION Pump room physically separated with no personnel access to wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	N/A	NR	N/A	Unclassified	NC, LC, or LFS	FE

Note: The following codes are used in this table:
A: No ventilation or ventilated at less than 12 air changes per hour
B: Continuously ventilated at 12 changes per hour
C: Continuously ventilated at six air changes per hour
CGD: Combustible gas detection system
D: No ventilation or ventilated at less than six air changes per hour
FAS: Fire alarm system
FE: Portable fire extinguisher
LC: Limited-combustible material
LFS: Low flame spread index material
N/A: Not applicable
NC: Noncombustible material
NEC: In accordance with *NFPA 70*
NNV: Not normally ventilated
NR: No requirement

3.1.4 Site Work & Landscaping

Following construction of the new Influent Pump Station, a new paved driveway will be provided for access to the Pump Station. A reinforced concrete pad will also be provided adjacent to the wet well for a screenings roll off container lay down area. Following the construction of the Pump Station, the surrounding area will be graded, seeded and restored to pre-construction conditions.

The proposed location of the Influent Pump Station interferes with the 6-inch underdrain system for the previous polishing pond. This piping will need to be relocated to accommodate the construction of the new Pump Station.

Site lighting will also be expanded to provide illumination to the new driveways and work areas around the pump station. Additionally, new sections of electrical ductbank will need to be constructed and extend from the Administration Building to the new Pump Station to provide raceways for power and instrumentation wiring.

3.2 Influent Gravity Sewer Modifications

Influent wastewater flows to the existing Influent Pump Station via a 30-inch interceptor sewer which combines with an 8-inch combined storm drain and a 12-inch gravity sewer at RLSA MH #1, located upstream of the existing Influent Pump Station. Sewage Treatment Plant (STP) MH #1 is located between RLSA MH #1 and the Existing Influent Pump Station. A new section of 30-inch gravity sewer will be constructed between STP MH #1 and the new Influent Pump Station. STP MH #1 will also provide a location for the insertion of plugs to temporarily divert flows to the New Pump Station during startup and testing.

3.3 Screenings Removal & Disposal

The lower level of the wet well will be provided with two channels to convey wastewater to the wet wells. Slide plates will be provided to isolate each channel. Wastewater will mainly flow through one channel equipped with a mechanically cleaned bar screen. The second channel will serve as a bypass and will be equipped with a comminutor. The second channel will be designed with provisions for the installation of a second mechanically cleaned bar screen and washer compactor in the future, if necessary. The mechanical bar screen is designed to remove rags and other debris from the influent wastewater stream and transport them to the upper level of the Pump Station for discharge into a washer/compactor. The solids processed by the washer/compactor are extruded through the discharge chute to be discharged to a roll off container to be located on a concrete pad adjacent to the Pump Station.

The basis of design screenings equipment is the FelxRake system manufactured by Duperon Corporation or an approved equal. The Duperon mechanically cleaned bar screen is a front-raked/front-return, rear-discharge unit, with multiple rake bars mounted to chains located on each side of the self-contained frame. The design can be totally enclosed for odor control and improved hygiene. The multiple rakes and variable speed drive serve to increase screenings removal capacity, includes an automatic jam protection system.

The design of the Duperon Screen does not require a submerged lower bearing, requiring less maintenance than a typical chain driven multirake bar screen. Design parameters for the proposed mechanically cleaned bar screen is summarized in **Table 3** below.

Table 3: Mechanical Screen Preliminary Design Basis

Item	Design Basis
Design Max Flow Rate, MGD	5.51
Maximum Rated Flow, MGD	
At velocity of 2 feet per second, MGD	11.75
At velocity of 3 feet per second, MGD	17.50
Headloss	
At 2 Feet Per Second Channel Velocity, inches WC	0.64
At 3 Feet Per Second Channel Velocity, inches WC	1.42
Screen Overall Length, feet	42
Total Screen Width, feet	2.83
Screen Field Width, feet	2.83
Screen Field Height, feet	11
Bar Spacing, Inches	0.38 (3/8)
Rake Cleaning Interval	
At Low Speed, second	43
At High Speed, seconds	7
Installation Angle (From Vertical)	5°

A screenings washer/compactor will be provided to remove organic matter from the screenings. The organic matter contained in the wash water will be returned to the screen channel. The washed and compacted screenings will then be transferred to an outdoor container via the washer/compactor screw conveyor. A Duperon washer/compactor, or an approved equal, will be provided to remove organic matter from the screenings. The washed and compacted screenings will then be transferred to an outdoor container via a washer/compactor discharge chute. The portion of the washer/compactor discharge chute located exterior to the building will be heat traced and insulated to prevent freezing. A flexible discharge chute will be provided to guide screenings into the disposal container. Design parameters for the proposed washer/compactor is summarized in **Table 4** below.

Table 4: Washer/Compactor Preliminary Design Basis

Item	Design Basis
Electrical	
Motor Voltage	480V / 3Ø / 60Hz.
Paddle Drive Motor Size	1 HP
Washwater Use, gpm	10
Washwater pressure, psi	50
Material of construction:	304L SS
Location (indoor or outdoor?)	Indoor

The mechanical bar screen channels will be equipped with dual mechanical floats to trigger the mechanical screen to operate when the headloss across the screen reaches a predetermined value. A timer will also be provided to periodically clear the screen field. The mechanical bar screen and washer/compactor will share a relay based common control panel. This control panel will be located in the Pump Room upper level with a local control station at the equipment.

3.4 Bypass Comminutors

The basis of design comminutor equipment is the Taskmaster Series manufactured by Franklin Miller or an approved equal. Comminutors are slow speed grinders that typically consist of two sets of counterrotating assemblies, with blades which are mounted vertically at the pipe discharge into the wet well. The blades on the rotating assemblies are provided with close tolerances to chop materials entrained within the wastewater as they pass through the unit. This chopping or cutting action reduces the potential for large solids, rags or plastic that could clog the downstream submersible pumps. The Taskmaster series grinder features cutter cartridges which minimize maintenance and assembly time. A photograph of the proposed comminutor is shown in **Figure 2** below.

Figure2: Proposed Comminutor

The comminutor would be provided with a submersible motor and drive, and a current sensing automatic reversing controller. The characteristics of the proposed comminutor is provided in **Table 5**.

Table 5: Comminutor Preliminary Design Basis

Item	Design Basis
Franklin Miller Taskmaster Grinder	Model TM8540D
Number Required	1
Revolutions per Minute, rpm	60
Drive Type	Electric, Submersible
Rated Power, horsepower	3
Voltage, VAC	230/460
Cutting Chamber, inches	39.1" by 12"
Materials of Construction	
Housing	Ductile Iron
Cutters	4140 H.T.

3.5 Mechanical Pumping Equipment & Piping

The proposed Influent Pump Station was designed in accordance with the requirements of N.J.A.C. 7:14A-23.10 and recommendations from the Hydraulic Institute and the Basis of Design Pump Manufacturer. The Pump Station is designed to provide an efficient use of space while providing adequate room for future expansion, should the need arise.

3.5.1 Proposed Pumps

In accordance with regulatory requirements, the new pump station will be designed to include a total of three (3) variable speed pumps to provide n+1 redundancy; that is, two pumps to be operational with one pump held in standby. The pump station is also designed with room for the addition of a fourth pump in the future, if required.

Using the projected average and peak design flowrates noted above, and the system curve developed from the proposed force main arrangement, the following operating points were developed:

- Average Daily Flow (ADF): 1,007 gpm (1.20 MGD) @ 51 feet TDH
- Design Peak Hour Flow: 3,826 gpm (5.51 MGD) @ 59 feet TDH

The regional representative of Flygt Pumps was consulted to select a pump recommended for this application. For this application Flygt recommended their Model NT3202.185MT dry-pit submersible pumps, each equipped with a 60 hp motor. The proposed pump characteristics are shown in **Table 6** and the system head curve is shown on **Figure 3**. The dry pit submersible pumps provide a compact pump and motor package that avoids the need for a connecting drive shafts that the existing Pump Station is currently equipped with. The Influent Pumps will also be provided with Variable Frequency Drives with bypass contactors. A 1-ton monorail hoist will be provided on the Pump Station Upper Level to facilitate removal and installation of the pumps.

Table 6: Proposed Influent Pump Preliminary Design Basis

Item	Design Basis
Flygt Model Number	NT3202.185MT
Number Required (n+1)	3
Operating Points:	
One Pump Operation (ADF)	1,000 gpm at 51 feet TDH
One Pump Operation (Full Speed)	2,222 gpm at 55 feet TDH
Two Pumps in Operation (Full Speed)	3,800 gpm at 59 feet TDH
Rated Power, horsepower	60
Nom. Impeller Diameter, inches	13.58
Max Impeller Diameter, Inches	14.80
Rated Speed, rpm	1,170
Voltage, VAC	460
Phase	3
Suction Diameter; inches	12
Discharge Diameter; inches	8
Force Main Velocity	
@ Minimum Flow	0.5 ft/sec
@Average Flow	1.6 ft/sec
@ Peak Flow	6.1 ft/sec

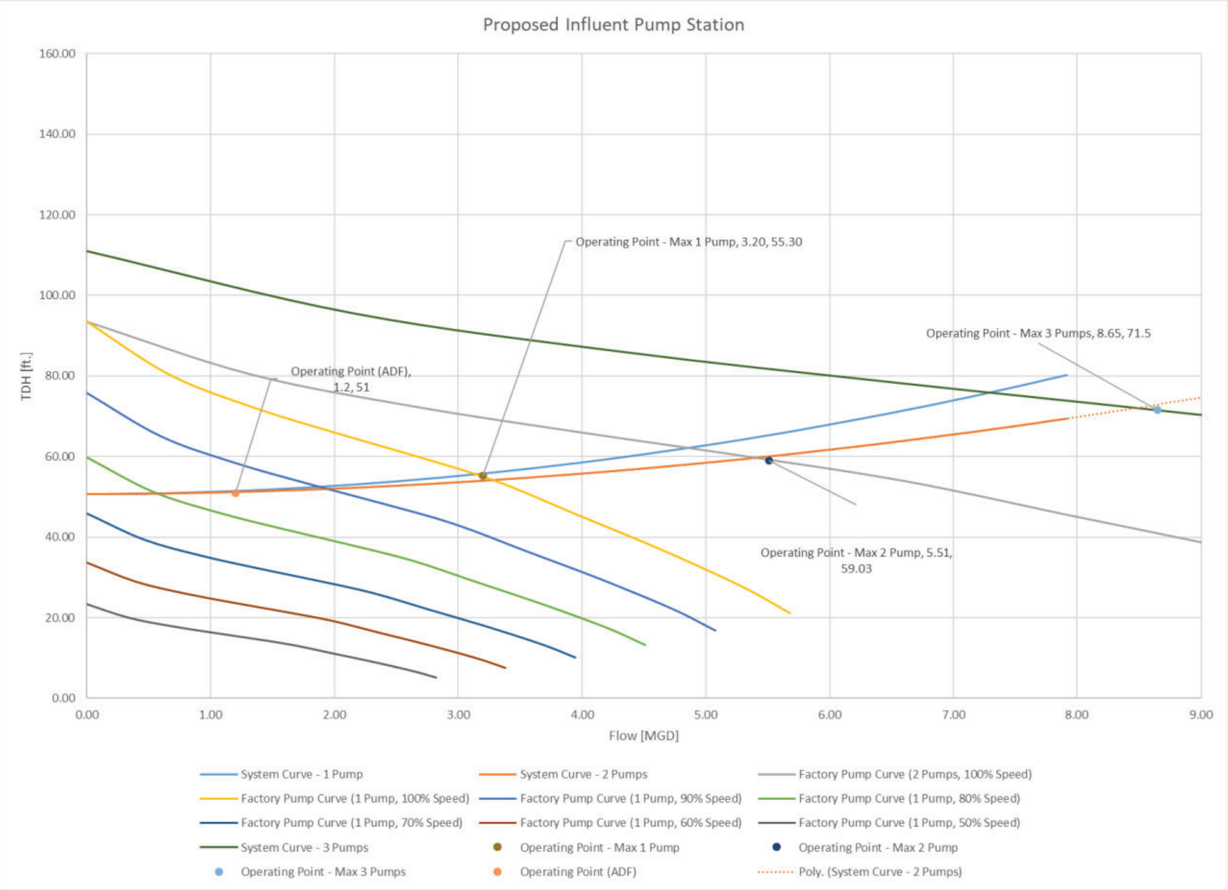


Figure 3 - Proposed Influent Pump Station - Pump and System Curves

3.5.2 Piping & Force Main

The pump suction will feature an inlet bell, an isolation valve and ductile iron piping. Only the inlet bell and a blind flange for future pump #4 will be installed in the wet well wall ad provided with a blind flange.

The discharge piping from each of the three pumps will be equipped with check valves and isolation gate valves. The piping will combine into a common discharge header to be metered prior to exiting the Pump Station. The discharge header within the Pump Station will be equipped with an emergency bypass connection. The discharge piping for the future pump will not be furnished or installed.

Site constraints, and the arrangement of downstream grit removal and oxidation ditches processes, prevent the re-use of the two (2) existing 12-inch force mains. A new single 16-inch, Class 53, cement lined ductile iron pipe (CLDIP) force main is proposed for this project.

The proposed force main will be routed along the North side of the Plant and will vary in depth to avoid numerous underground utility conflicts. A tee fitting with a gate valve will be provided to allow for the connection to a future flow attenuation tank, if required. The force main will discharge at the proposed grit removal facility and will be equipped with slide gates to bypass the grit equipment for maintenance, as required. The proposed grit removal facilities are outlined in Section 4.

The design parameters for the proposed force main are provide in **Table 7**.

Table 7: Force Main Preliminary Design Basis

Item	Design Basis
Diameter, inches	16
Material of Construction	Cement Lined Ductile Iron Pipe
Pressure Class	53
Internal Diameter, inches	16.54
Velocity, feet per second	
At average design flow (1.20 MGD)	1.60
At peak flow (5.51 MGD)	8.53

3.5.3 Wet Well Sizing

The design of the Wet Well was developed in accordance with recommendations from ANSI/HI 9.8 American National Standard for Pump Intake Design and recommendations from the Pump Manufacturer. The following elements had an influence in the design of the wet well:

- Screenings Channel Design
- Pump Selection and Minimum Submergence Requirements
- Pump and Inlet Bell Spacing Requirements
- Desired Cycle Times

In order to determine the size of the required wet well, cycle time and active wet well volumes were calculated based on a lead lag operational sequence per ANSI/HI 9.8 American National Standard for Pump Intake Design. Active wet well volume is defined by the volume between the highest start level and lowest stop level in the pump wet well as shown in **Figure 4,** with recommended cycle times for wastewater pumping stations between five and thirty minutes. For this application, a wet well cycle time of 15 minutes was used. Based on the proposed pump size and desired cycle time, the minimum wet well working volume was calculated to be approximately 3,500 gallons.

To allow for periodic cleaning of the wet well by operations personnel, the wet well will be divided by a common wall provided with an isolation sluice gate. This will allow taking one of the wet wells out of service while maintaining flow through the pump station. The Wet Wells will feature an access ladder and sloped sidewalls to prevent grit and debris accumulation.

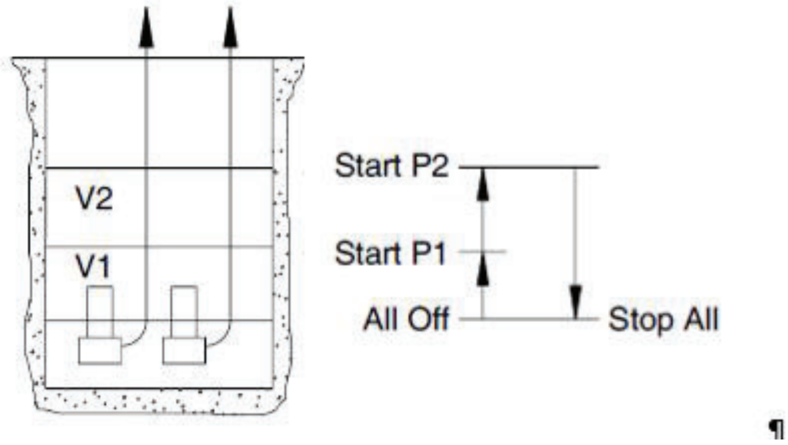


Figure 4 - Lead Lag Operational Sequence

3.6 Instrumentation and Control

The basis of design is to provide a functioning pump station control panel, capable of monitoring and operating the pump station. The pump station will include a programmable logic controller (PLC) for supervisory control and remote monitoring. The Pump Control Panel will be a NEMA 4X stainless steel enclosure equipped with an Human Machine Interface (HMI) touch screen display. The Influent Pump Station PLC will be connected to the Plant SCADA system via fiber optic cabling to relay statuses and alarms. The PLC specificized shall be GE/Emerson Rx3i, or equal.

The pump control system is designed to operate mainly in an automatic mode of operation, with capability for local, in-hand control of the pumps. The pumping system will be designed with remote monitoring of the system only. There is no remote control of any pump station equipment. Pumps shall operate in a lead-lag configuration. The primary method of control is via analog ultrasonic level sensor with backup float switch system.

An electromagnetic flow meter will be provided on the force main within the intermediate level of the Pump Station on the main header to measure pump station effluent flow. Isolation valves and bypass piping will be provided to allow for servicing of the flow meter. A flow transmitter will be provided to output data measured by the flowmeter to the plant SCADA network to be viewed at the local HMI display in the dry well upper level or remotely.

Type:	Electromagnetic
Make/Model:	Endress + Hauser ProMag W500, or equal
Size:	16-inch
Range of Calibration:	600 - 19,000 gpm.
Maximum Pressure Rating:	150 psi.

3.7 Abandonment of Existing Pump Station

Following the startup and testing of the new Influent Pump Station, the existing Pump Station will be decommissioned and abandoned in place. The influent sewer to the existing Pump Station will be sealed and the existing force mains drained back into the wet well and pumped to the new Influent Pump Station. The pump station structure, mechanical and electrical system will remain in place. The main electrical feeders between the Main Distribution Panel and the existing Pump Station Distribution Panel will be disconnected as the conduit ductbank will need to be utilized for the feeders for the New Influent Pump Station. Water service to the building will be demolished. Following the decommissioning of the Pump Station, the building will not have any electrical or water service. The lighting, heating, and ventilation circuits could be connected to the new Influent Pump Station distribution panel if requested by the Authority.

4 GRIT REMOVAL

4.1 Grit Removal Equipment

The Plant does not currently have grit removal equipment. Grit removal is being provided under this Project to reduce wear on pumps and other mechanical equipment. The basis of design grit removal is to provide a mechanical vortex grit removal system with a grit classifier. The basis of design equipment is the SpiraGrit system model SG9-5.5 by Lakeside Equipment Corporation shown o **Figure 5**.

The Grit removal equipment will be located on the North East side of the Plant, adjacent to Oxidation Ditch No. 2. The pumps in the Influent Pump Station will pump wastewater up to a point just upstream of the grit removal equipment, and will then flow by gravity to the Anaerobic Selector and Oxidation Ditches.

Only one grit removal system will be provided. The design of the influent and effluent channels of the system will be designed to allow for the installation of stop gates to bypass the grit equipment should the unit need to be taken out of service for maintenance or repairs.

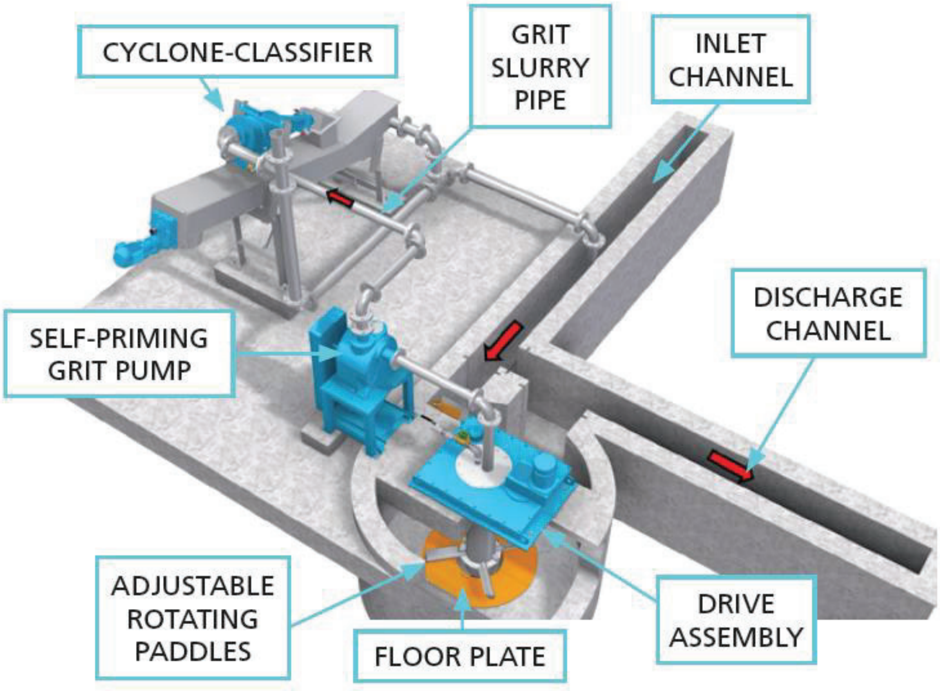


Figure 5 - SpiraGrit System Overview

The SpiraGrit system features 304 stainless steel components mounted within a cast-in-place concrete structure. Most of the mechanical equipment such as grit pumps, stirrer motors and drive assembly are located at grade outside of the tank. The design parameters for the Basis of Design SpiraGrit vortex grit removal system are provided in **Table 8.**

Table 8: Grit Removal System Preliminary Design Basis

Item	Design Basis
Peak Design Flow	5.5 MGD
Grit Removal @ Peak Design Flow	
Upper Grit Chamber Diameter	9'-0"
Lower Grit Chamber Diameter	3'-0"
Water Fluidization Requirement	20 gpm @ 50 psi
Grit Pump Type	Self-Prime
Grit Pumping Flow Rate	250 gpm
Electrical	
Motor Voltage	480V / 3Ø / 60Hz.
Paddle Drive Motor Size	0.75 HP
Grit Pump Motor Size	1.0 HP

The SpiraGrit system will be paired with Lakeside's Type "W" grit classifier equipped with a cyclone separator as shown on **Figure 6**. The design parameters for the Basis of Design SpiraGrit classifier are provided in **Table 9.** The cyclone increases the grit capture efficiency of the unit while reducing equipment size. A flexible discharge chute will be provided to direct collected grit into a container.

Table 9: Grit Classifier Preliminary Design Basis

Item	Design Basis
Number of units:	1
Total Grit Processing Capacity, CF/hr.	30
Grit Slurry Capacity (each), gpm:	250
Washwater Use, gpm	20
Washwater pressure, psi	50
Material of construction:	304L SS
Location	Indoor

Figure 6 - Lakeside Type "W" Grit Cyclone Classifier

The SpiraGrit mechanical vortex grit separator and grit cyclone classifier will be controlled via a PLC based control system mounted in a common NEMA 4X enclosure.

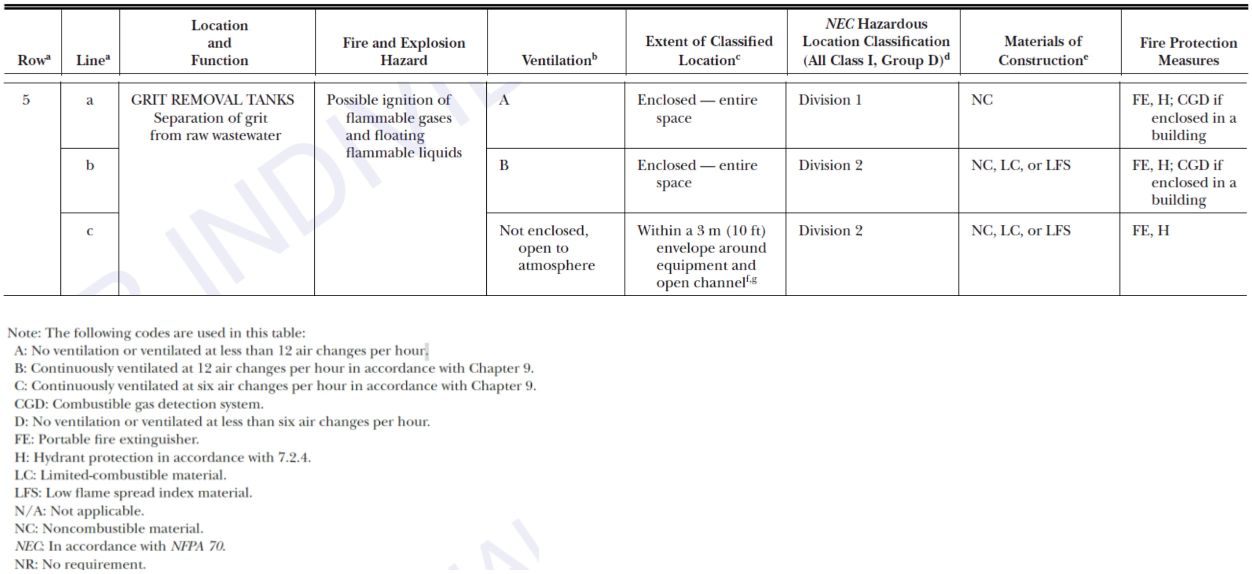
Fiber optic cabling will extend between the Administration Building and the Grit Removal Facility to connect to the Plant SCADA system.

4.2 Building Enclosure

The equipment manufacturer does not require that the SpiraGrit system be installed within an enclosure. However, several installation references that we reached out to in similar geographic locations have the equipment located with a building enclosure. Therefore, we are recommending the grit removal equipment be installed within a heated building enclosure.

The proposed building structure will be a pre-engineered building 28 feet wide by 40 feet long. The building will feature an Electrical/Control room and a Process Room, each with man doors to the exterior. The Process Room will feature an overhead coiling door for access to the grit disposal container. Locating the grit removal and classifying equipment within the building enclosure would require not only heating, but also ventilation at 12 air changes per hour. This would designate the process area space as Class I, Div. 2, Group D per NEC (**Table 10**) and would require gas a gas detection system be installed.

Table 10: Excerpts from NFPA 820 Table 5.2.2



Row[a]	Line[a]	Location and Function	Fire and Explosion Hazard	Ventilation[b]	Extent of Classified Location[c]	*NEC* Hazardous Location Classification (All Class I, Group D)[d]	Materials of Construction[e]	Fire Protection Measures
5	a	GRIT REMOVAL TANKS Separation of grit from raw wastewater	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed — entire space	Division 1	NC	FE, H; CGD if enclosed in a building
	b			B	Enclosed — entire space	Division 2	NC, LC, or LFS	FE, H; CGD if enclosed in a building
	c			Not enclosed, open to atmosphere	Within a 3 m (10 ft) envelope around equipment and open channel[f,g]	Division 2	NC, LC, or LFS	FE, H

Note: The following codes are used in this table:
A: No ventilation or ventilated at less than 12 air changes per hour.
B: Continuously ventilated at 12 air changes per hour in accordance with Chapter 9.
C: Continuously ventilated at six air changes per hour in accordance with Chapter 9.
CGD: Combustible gas detection system.
D: No ventilation or ventilated at less than six air changes per hour.
FE: Portable fire extinguisher.
H: Hydrant protection in accordance with 7.2.4.
LC: Limited-combustible material.
LFS: Low flame spread index material.
N/A: Not applicable.
NC: Noncombustible material.
NEC: In accordance with *NFPA 70*.
NR: No requirement.

Removable Fiberglass Reinforced Plastic (FRP) covers will be provided on the wastewater channels and Spiragrit equipment to control the humidity within the room. Ducted exhaust fans will be provided to ventilate the covered channels. The concrete channels will also be provided with protective coatings applied above the waterline to prevent concrete decay due to exposure to H2S. The current design of the building does not include Odor Control, which could be included if requested by the Authority. Plan and section views of the proposed Grit Removal Facility are provided in **Attachment A.**

5 OXIDATION DITCH

The RLSA's two (2) oxidation ditches (ODs) are a racetrack configuration and vary in footprint size, volume, and geometry.

- OD No. 1 equipment was manufactured by Lakeside Equipment Corporation and constructed in 1983 under Contract RLSA 81-2 – Sewage Treatment Plant.
- OD No. 2 equipment was manufactured by US Filter and began operation in 2000 following construction under Contract 98-01 – Wastewater Treatment Plant Expansion.

Since 2000, only OD No. 2 has been in operation, as flow projections from that time have not materialized, and OD No. 2 has the capacity to process the current average daily flow (ADF).

Both ODs are equipped with two (2) partially submerged horizontal brush aerators. The brush aerators transfer ambient air oxygen to the mixed liquor and maintain the mixed liquor flowing around the racetrack. OD No. 2's brush aerators are two speed 50/30 horsepower aerators, however the RLSA has reported that the lower speed is never used as it does not achieve the oxygen demand for biochemical oxygen demand (BOD) removal.

The current NJPDES permit requires that the Plant achieve total phosphorous effluent discharge requirements via enhanced biological phosphorous removal. Phosphorus removal is achieved biologically by creating an anaerobic selector zone upstream of aerobic conditions within the oxidation ditch, which promotes the growth of microorganisms which take up excess phosphorus which is removed via sludge wasting. A separate anoxic zone or ditch could also be provided to promote nitrogen removal, which is both required by the upcoming permit and would enhance the biological phosphorus removal process. When only one ditch is in service, cycling the rotor aerator speed up or down can also provide alternating anoxic-aerobic conditions to remove nitrogen biologically.

The construction of an external anaerobic selector zone and having two (2) operational ODs operating under anoxic and oxic conditions, along with state-of-the-art equipment was determined to be the best option to achieve permit effluent discharge limits and provide operational flexibility while also allowing the RLSA to maintain treatment operations during construction. A second ditch would also allow regular maintenance, which is currently not possible.

R3M performed a visual inspection of the visible structural condition of OD No. 1, which has been empty and exposed to the weather for over 20 years. Structural deterioration was observed, including separation of adjacent concrete slabs at the joints, joint filler deterioration, differential settlement, fine map cracking, and vegetative growth from gaps at the concrete joints. It was determined based on the condition of OD No. 1 and the more efficient footprint of OD No. 2 to demolish OD No. 1 and construct a new OD in its place with the same footprint as existing OD No. 2.

R3M contacted six (6) oxidation ditch system suppliers to request proposals for modifications to the existing ODs to achieve the anticipated permit limits. Considering cost, RLSA's familiarity with brush aerator equipment, minimal modifications needed to the ODs to accommodate Lakeside's horizontal aerator technologies, and expected performance of the proposed system, equipment provided by Lakeside Equipment was recommended.

5.1 Selected Process

The Basis of Design is to provide new Oxidation Ditches to operate with a Closed-Loop Reactor (CLR) Process. Lakeside's CLR process utilizes brush rotor aerators with 3-inch-wide stainless steel blades and pivoting control baffles downstream of the aerators to maintain the velocity of the mixed liquor between 1 and 2 feet per second and to direct the flow downward, creating a rolling motion. Lakeside recommended two tanks with the same volume as the existing OD No. 2 and an anaerobic selector zone with two (2) two-horsepower mixers to keep solids suspended. Lakeside's proposal also provided provisions for both a series and parallel operating configuration to achieve biological nitrogen and phosphorus removal and provide the RLSA with operational flexibility.

The Basis of Design oxidation ditch process includes two (2) 50-horsepower aerators per OD, an internal mixed liquor recycle (IMLR) pump (approximately 10 horsepower) to return mixed liquor from the aerobic to the anoxic ditch to enhance nitrogen removal, two (2) 15-horsepower mixers to keep solids in suspension in the anoxic ditch during aerator turndown, and two (2) two-horsepower mixers in the anaerobic selector zone. Instrumentation and controls to monitor dissolved oxygen (DO) and oxidation-reduction potential (ORP) in the ditch will fine tune the biological process by controlling aerator speed.

5.1.1 Parallel Operation

The parallel "cyclic" configuration would comprise two (2) separate ODs, each receiving influent wastewater and return activated sludge (RAS). The aerators within the ODs cycle on and off or up and down based on ORP and DO setpoints to develop alternating timed anoxic and aerobic conditions within the same ditch for nitrification and denitrification. The mixers and rotor aerators are designed to alternate so that when the aerator turns on, the mixers turn off.

The parallel operation was not recommended as the final configuration for the ditches, but it was recommended for construction sequencing. RLSA will need to operate one (1) ditch in a cyclic aeration mode until the influent flows increase and exceed the treatment capacity of that ditch (about 0.8 MGD). If OD No. 1 is constructed with the equipment to provide cyclic aeration and act as an anoxic zone, then the Authority could maintain its treatment capacity during the refurbishment of OD No. 2 in a parallel configuration. Later, as flows increase, OD No. 1 would operate as an anoxic ditch and OD No. 2 would operate as the aerobic ditch in a series configuration.

In the future, either ditch could be taken out of service for inspection or maintenance with the other operated in the parallel cyclic mode. Currently, with one functioning Oxidation Ditch, RLSA has no provisions for maintenance or repairs to Oxidation Ditch No. 2.

An anaerobic selector zone sized for a 1.5-hour hydraulic retention time (HRT) would therefore be constructed to convey flows to either OD No. 1 or OD No. 2. Discharge piping and effluent weirs will be provided for each Oxidation Ditch to convey flows to Splitter Box No. 2.

5.1.2 Series Operation

The series configuration includes an anaerobic selector zone for receiving influent wastewater and RAS and sized for a 1.5-hour HRT, followed by low anoxic (0.02 mg/L DO) conditions in the first oxidation ditch and aerobic (2 mg/L DO) conditions in the second oxidation ditch. The proposal includes an internal mixed liquor recycle (IMLR) from the aerobic ditch to the anoxic ditch to improve denitrification. ORP and DO sensors would confirm that anoxic and aerobic conditions are being met in the corresponding ditch and adjust aerator speed accordingly. A schematic of a series CLR system without the anaerobic selector zone is shown in **Figure 7.**

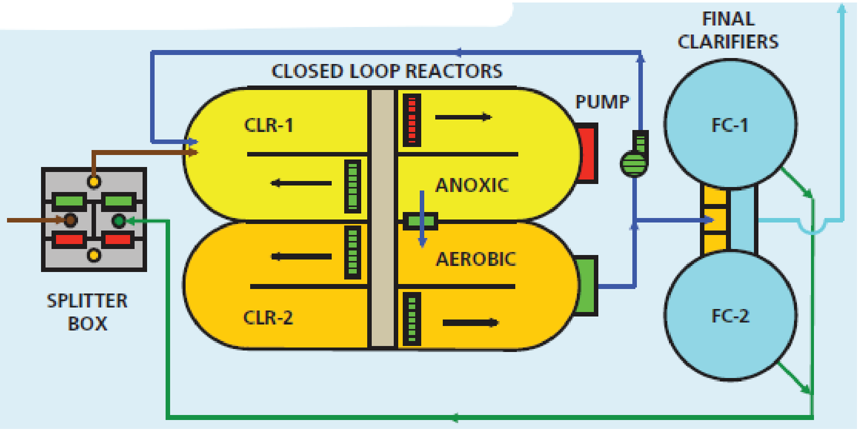


Figure 7 - Lakeside Closed Loop Reactor Series Configuration Schematic

5.2 Replacement of Existing Oxidation Ditch No. 1

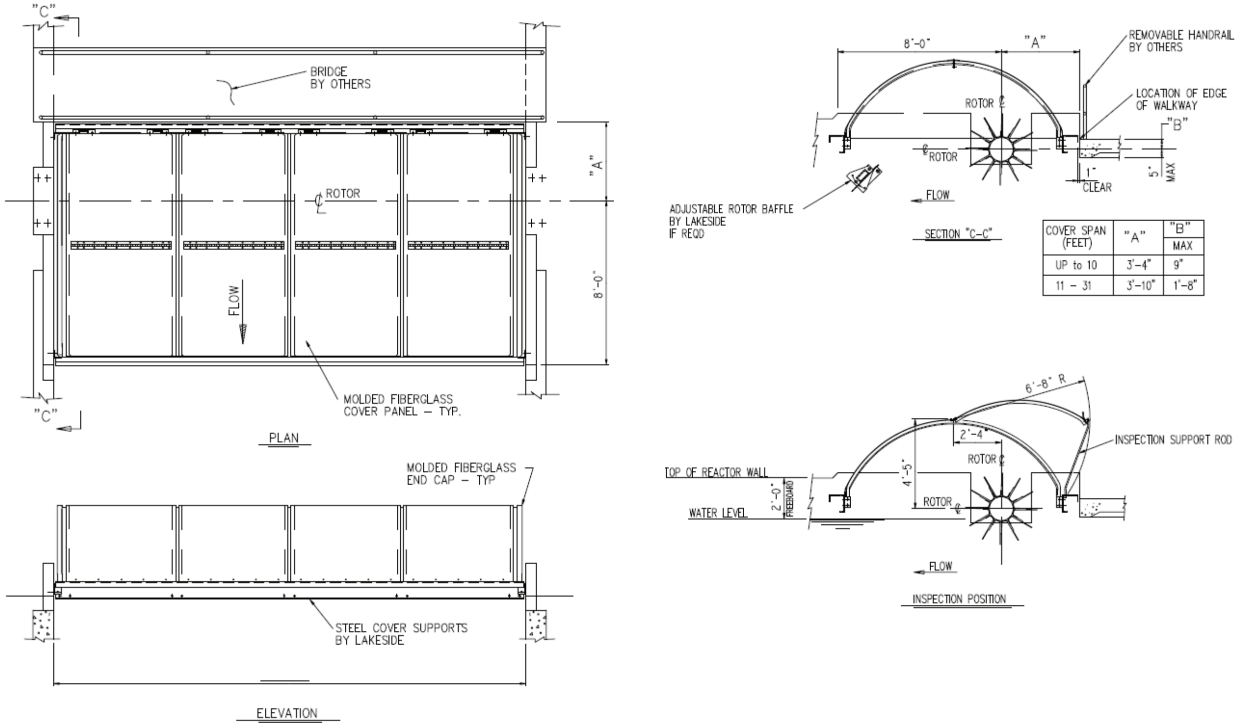
The chosen alternative for Oxidation Ditch arrangement was to demolish existing OD No. 1 and construct a new oxidation ditch similar in design to OD No. 2. The geometry of OD No. 2 is deeper, but has a smaller footprint than that of existing OD No. 1. Due to the increased depth, further excavation is required following its demolition, but some of this excavated material could be utilized for backfill around its smaller footprint. The perimeter underdrain system around Oxidation Ditch No. 1 will be replaced to accommodate the newer ditch design.

New successive ditches for the Closed-Loop Reactor process are normally constructed to share a common wall as shown in **Figure 7**. However, since Oxidation Ditch No. 1 must be constructed to maintain existing Plant operations during construction, the oxidation ditches must be spaced to provide adequate bearing support to prevent collapse of the sidewalls of Oxidation Ditch No. 2.

For the excavation, half of the excavation was assumed to be ripable shale based on a review of previous soil borings. No sheeting is expected to be required for this alternative as the excavation could be conducted at a 1:1 slope (also making use of OD No. 1's 1:1 sloped walls). A geotechnical evaluation will be performed during the detailed design phase to confirm existing soil conditions. This evaluation will include several new soil borings to be taken around the perimeter of the existing Oxidation Ditch No. 1.

5.3 Oxidation Ditch Equipment

The Lakeside horizontal brush aerator assembly provides oxygen to the biological mass, mixes microorganisms uniformly and adds mixing velocity to the channel to prevent solids from settling. The rotor's 3-inch-wide blades are 10 gauge AISI Type 304 stainless steel. The assembly also includes a large FRP rotor cover to prevent water from splashing out of the ditch which can freeze in the winter and a pivoting velocity control baffle downstream of the rotor. The assembly is shown in **Figure 8** and **Figure 9.**



COVER SPAN (FEET)	"A"	"B"
		MAX
UP to 10	3'-4"	9"
11 - 31	3'-10"	1'-8"

Figure 8 - Lakeside Rotor Aerator Assembly Diagram

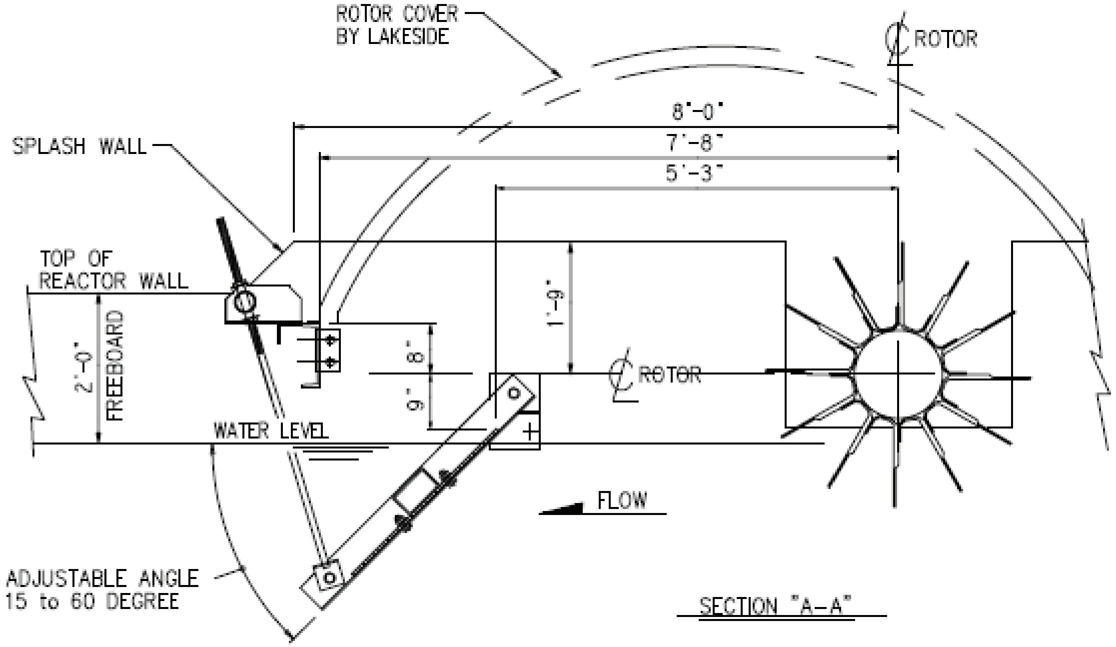


Figure 9 - Lakeside Rotor Aerator Assembly Diagram (2)

Based on initial calculations, two (2) 50-horsepower rotors per ditch would be sufficient to meet the oxygen requirements of the ODs. Variable frequency drives (VFDs) will be provided to enable the generation of anoxic, aerobic, or cyclic anoxic-aerobic conditions in each ditch.

Two (2) 15-horsepower submersible mixers would also be provided for anoxic ditch to provide mixing of the reactor when the aerator is turned down or off. When operating in series, it is not expected that these mixers will be required. Two (2) smaller 2-horsepower submersible mixers would also be provided for the separate anaerobic selector.

Instrumentation and controls will include permanently mounted probes for DO and ORP for and a PLC based control panel dedicated to each Oxidation Ditch. The control panel process information from the DO and ORP sensors and, with a feedback loop, adjusts the speed of the brush aerators as required to meet the desired parameters. The control panel will be located within the Administration Building Electrical Room.

5.4 Influent Gravity Sewer & Anaerobic Selector

A 36-inch cem emoval facility to the new anaerobic selector zone. The pipe is estimated to be approximately fifty (50) linear feet long and will be designed to have the minimum slope of 0.046 feet per 100 linear feet for a 36-inch pipe.

An anaerobic selector zone with mixers is recommended upstream of the oxidation ditches. The tank volume is sized to provide a 1.5-hour HRT at the final permit phase design flow which equates to approximately 90,000 gallons, or 30-feet long by 30-feet wide by 15-feet deep. The anaerobic selector has been designed to be partitioned into two halves via a sluice gate, which would allow the Authority to use only half of the tank at startup if influent flow conditions are similar to current flows.

The new anaerobic selector zone would replace the functionality of existing Splitter Box No. 1, receive both Plant influent and RAS and have the ability to direct flows to either new Oxidation Ditch No. 1 and existing Oxidation Ditch No. 2 to allow for parallel operation or to Oxidation Ditch No. 1 for series operation as outlined above.

5.5 Internal Mixed Liquor Recycle

The Internal Mixed Liquor Recycle (IMLR) is required for series operation of the Oxidation Ditches. Piping equipped with isolation gates will extend between existing Oxidation Ditch No. 2 and the new Oxidation Ditch No. 1, and provided with banana blade mixer pump to induce flow from the aerobic ditch (Oxidation Ditch No. 2) to the anoxic ditch (Oxidation Ditch No. 1) during series operation. The mixers and piping will act as an Internal Mixed Liquor Recycle (IMLR) system. Mixed liquor recycling of three (3) to four (4) times the average design flow is a method to enhance biological nitrogen removal, which will in turn enhance EBPR. The interconnecting pipe is designed for a flow of 5.8 MGD and will be approximately 18-inches in diameter. The mixer quoted as part of the Lakeside system package is a Landia POP-1 mixer (shown in **Figure 10**) with a 15-horsepower motor.

Figure 10 - Landia Submersible Mixer

5.6 Effluent Piping Modifications

Both oxidation ditches currently have an 18” effluent pipe which converge at a buried wye in the yard between the oxidation ditches and Splitter Box No. 2, at which point the piping increases to 24-inches. The length of 18-inch pipe from OD No. 1 is approximately sixty (60) linear feet and the length from OD No. 2 is approximately forty (40) linear feet. To minimize hydraulic losses and avoid submerging the oxidation ditch weir at peak flows with series operation of the Oxidation Ditches, the 18-inch segments of pipe must be replaced with 24-inch cement-lined DIP. This piping replacement will require bypassing flows from Oxidation Ditch No. 2 to Splitter Box No. 2 during construction of the upgrade. Plan and section views of the proposed Oxidation Ditches are provided in **Attachment A.**

6 CLARIFIERS

6.1 Anticipated Loading and Impact of Oxidation Ditch Modifications

Following treatment in the oxidation ditches, the final clarifiers separate the wastewater stream into a solids-rich underflow that is either wasted to the Sludge Holding Tanks or returned to the oxidation ditches as RAS, and a clarified overflow that is currently directed to cascade aeration and UV disinfection processes.

The RLSA has a total of four (4) Final Clarifiers at the Plant:

- Final Clarifiers No. 1 and No. 2 were constructed in the 1980s under Contract 81-2 as part of the original Plant. They are 34 feet in diameter with a 10-foot sidewater depth.

- Final Clarifiers No. 3 and No. 4 were constructed in the early 2000s under the 98-01 Plant Expansion Contract. They are 60 feet in diameter with a 14-foot sidewater depth.

As determined during discussions with the Authority, Final Clarifiers No. 1 and 2 are to be demolished as part of the Plant Upgrade to allow for the construction of an access road to the oxidation ditch and grit removal facility for maintenance.

Modifications to the oxidation ditches for BNR will require changes to the average operating MLSS concentration flowing to the clarifiers. Therefore, we have evaluated the impacts of increased flow and oxidation ditch modifications on the final clarifier surface overflow rate (SOR) and solids loading rates (SLR). Calculations were based on the Final permit influent flow and both Final Clarifiers No. 3 and 4 which will remain in service. Since the current influent flow rate only requires one (1) final clarifier in operation, the Plant staff operates only one (1) final clarifier.

Per Metcalf & Eddy, typical SOR for final settling following biological nutrient removal should be 400 to700 gallons/day/square foot (gpdpsf), with a peak value of 1,000 to1,600 gpdpsf, and SLR should be 24 to 36 pounds per day per square (lbs./d/sf) with a peak of 43.2 lbs./day/sf). Ten State Standards recommends a peak SOR of 1,000 gpdpsf based on the peak hourly influent flow and a peak SLR of 35 lbs./day/sf based on the maximum day influent flow plus RAS flow.

Final Clarifiers No. 3 and 4 have an inner diameter of 60 feet, equating to a combined surface area of 5,655 square feet, and a side water depth of approximately 14 feet. The final clarifiers also contain an up-flow current baffle on the tank inner wall to deflect upward velocities inward.

At 1.45 MGD, the SOR with one (1) of existing Final Clarifiers No. 3 or 4 in service would be 513 gallons/day/sf, and the SOR with both existing Final Clarifiers No. 3 and 4 in service would be 256 gallons/day/sf. At the peak-hour flow of 5.4 MGD, the SOR with both existing Final Clarifiers No. 3 and 4 in service the SOR would be 974 gallons/day/sf. These surface overflow rates are within the limits set by Metcalfe & Eddy, but no redundancy exists to provide a factor of safety at peak-hour flows.

The SLR will vary with oxidation ditch mixed liquor suspended solids content (MLSS), seasonal changes, and operation of other facilities at the Plant. Lakeside recommended an MLSS of 2,100 mg/L to achieve optimal EBPR removal during winter temperatures. All oxidation ditch manufacturers recommended an MLSS of below 3,000 mg/L to achieve optimal EBPR removal.

Table 11 presents calculations showing the SLR at the Final permit phase influent flow, at varying MLSS concentrations from 3,000 mg/L to 6,000 mg/L, with one (1), two (2), or three (3) final clarifiers in service. The third final clarifier was assumed to be the same size as existing Final Clarifiers No. 3 and 4. Values exceeding 35 lb/day/sf are italicized and colored red.

Table 11: Excerpts from NFPA 820 Table 5.2.2

MLSS (mg/L)		**3000**	**3500**	**4000**	**4500**	**5000**	**5500**	**6000**
		Solids Loading Rate at 1.45 MGD (lb/day/sf)						
Number of Final Clarifiers in Service	1	26	30	34	*38*	*43*	*47*	*51*
	2	13	15	17	19	21	24	26
	3	9	10	11	13	14	16	17

With one (1) of Final Clarifiers No. 3 and 4 in service, the solids loading rate would remain below 35 lbs./day/sf up to 4,200 mg/L MLSS at 1.45 MGD. Both final clarifiers together would remain comfortably within the Metcalfe & Eddy recommended range beyond 6,000 mg/L MLSS at 1.45 MGD.

The SLR at various MLSS concentrations was also calculated at the projected maximum-day flow as presented in Technical Memorandum No. 1 (**Table 12**). At the maximum-day flow, a peak RAS flow of 1.5 times the daily ADF was assumed.

Table 12 - Final Clarifier SLR at Projected Max. Day Flow and Varying MLSS Concentrations

MLSS (mg/L)		**3000**	**3500**	**4000**	**4500**	**5000**	**5500**	**6000**
		Solids Loading Rate at 3.77 MGD (lb/day/sf)						
Number of Final Clarifiers in Service	1	*46*	*54*	*62*	*69*	*77*	*85*	*92*
	2	23	27	31	35	*38*	*42*	*46*
	3	15	18	21	23	26	28	31

With two (2) Final Clarifiers in service, the solids loading rate would remain below 35 lbs./day/sf up to 4,000 mg/L MLSS at the max-day flow and peak RAS flow.

A third final clarifier would not be necessary to maintain solids loading rates within literature recommended ranges at average flows. Considering the low MLSS of the Lakeside system, the RLSA should not approach literature-recommended limits for solids loading rate. Therefore, a third final clarifier is not recommended.

7 UV DISINFECTION SYSTEM UPGRADE

The Ultraviolet Disinfection System installed at the plant currently consists of two (2) 800-watt vertical open channel UV modules. Each module has the capacity to treat 2.1 MGD which equates to a current total system capacity of 4.2 MGD. The design capacity of this project as outlined in Section 2.1 above is 5.51 MGD. Therefore, the UV system will need to be expanded. Two additional modules are recommended to be installed as shown in **Figure 11**. A third module is required to bring the UV system capacity to 6.3 MGD, with the fourth module to be held as a standby for n+1 redundancy.

The expansion of the UV disinfection system would also require a new Control Panel to be installed. This Control Panel would be integrated into the existing Plant SCADA System. The existing building control panel contains a GE/Emerson Versamax PLC, which is approximately 5 years old. The Versamax is a relatively modern PLC still supported by GE/Emerson and therefore, there is no need to replace this system at this time.

8 ADDITIONAL PROCESS MODIFICATIONS

8.1 Replace Chemical Piping & Feed Pumps

The chemical storage tanks, metering pumps and piping in the Chemical Room are currently abandoned. The chemical storage tanks will be inspected and evaluated for re-use during the design phase of the project. The chemical metering pumps and chemical feed piping would also be replaced. It is anticipated that chemical feed line injection points will include at the effluent weir of each oxidation ditch and at Splitter Box No. 2 located upstream of the Final Clarifiers. Spare chemical piping would also be provided.

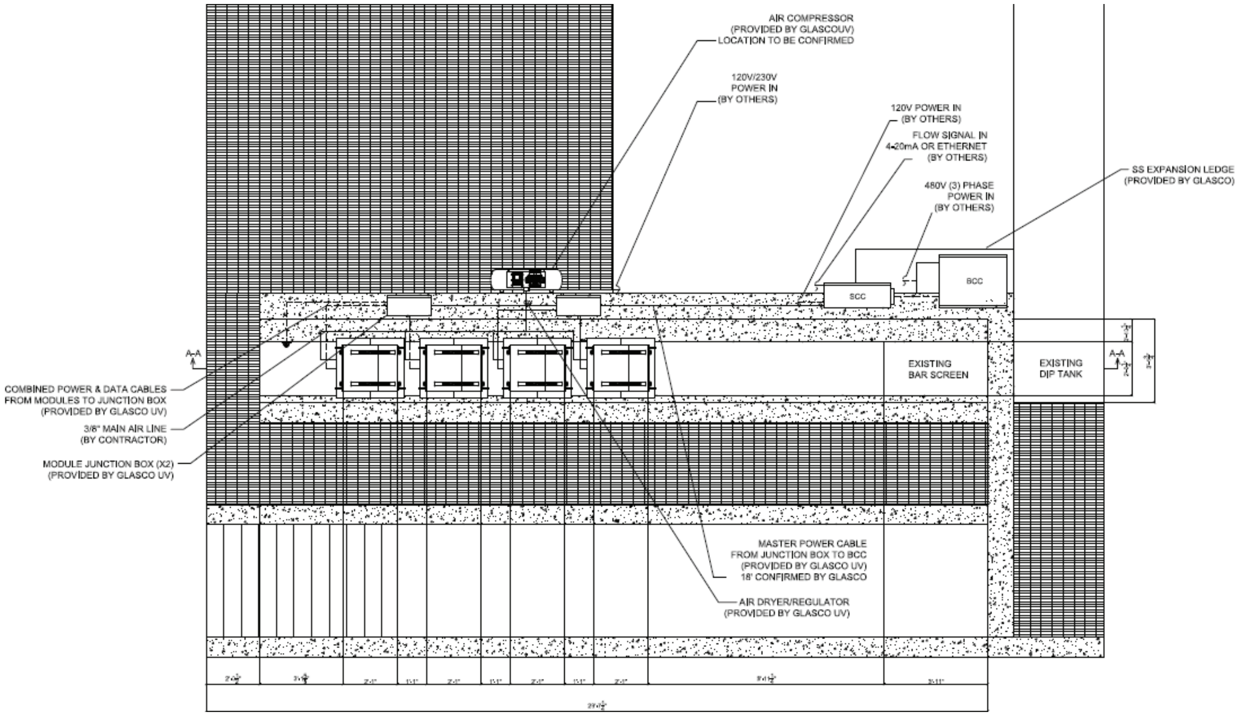


Figure 11 - UV System Expansion

Chemical addition rates were evaluated in Technical Memo No. 4. Since the biological process will provide for phosphorus removal, chemical addition is to be used for effluent polishing and require an alum dosage estimated at 10 to 18 gallons per day. During detailed design, the number of pumps to be replaced, the best alum injection location(s), and the number of lines to be replaced will be evaluated.

8.2 Clarifier Dewatering Pumps

Dewatering of the clarifiers is currently performed by isolating the clarifier, and then wasting/returning as much liquid as the pumps can draw down in the clarifier. A submersible pump is than deployed to dewater the last few feet of liquid within the clarifiers as the top of these clarifiers' sumps is approximately five (5) feet lower than the centerline of the sludge pumps suction piping.

Clarifiers No. 1 and 2 are to be demolished, along with their associated sludge pumps. Therefore, the replacement of these sludge pumps with self-priming, suction lift dewatering pumps would allow for the complete dewatering of clarifiers No. 3 & 4. Self-priming pumps, such as the Gorman-Rupp Super-T Series, develop a vacuum within the pump volute for priming the pump, which would then be able to drain the tanks completely through the return sludge pipe connected to the clarifier's sludge removal sump. The contents of the clarifier would then be pumped through a new 6-inch line to the existing 12-inch gravity drain line that runs on the east side of the Sludge Pump Station to the Influent Pump Station.

The pumps would be designed to completely dewater the clarifiers in approximately 24 hours. One tank draining pump would be provided for each clarifier. Design information for the pump is provided in **Table 13**. The proposed pumps can be upsized during the design phase to dewater the clarifiers at a faster, if requested by the Authority.

Table 13: Proposed Clarifier Dewatering Pump Preliminary Design Basis

Item	Design Basis
Gorman-Rupp Model Number	T3A3S-B
Number Required	2
Operating Point:	210 gpm at 8 feet TDH
Rated Power, horsepower	1.5
Rated Speed, rpm	1,750
Voltage, VAC	460
Phase	3
Force Main Velocity @ Design Flow (210 gpm)	2.4 ft/sec

8.3 Clarifier Sludge Pump Replacement & Piping Modifications

The RLSA currently pumps RAS to Splitter Box No. 1 continually, except for times when activated sludge is intermittently wasted to the Sludge Holding Tanks. The RLSA cannot currently simultaneously pump WAS to the Sludge Holding Tank and RAS to Splitter Box No. 1.

RLSA operations data from 2022 and 2023 indicates that operations personnel waste sludge 4 to 13 days per month. When wasting, the RLSA modulates a three-way valve between a return sludge and waste sludge pipe. Sludge is then allowed to thicken in the clarifiers for approximately three (3) to four (4) hours before pumping to the Sludge Holding Tank for approximately two (2) hours.

After the proposed oxidation ditch upgrades, RAS will be pumped to the anaerobic selector zone. An interruption of RAS pumping to the anaerobic selector zone of several hours can be expected to disrupt the performance of the EBPR process, as contact time between PAOs in the biomass and the incoming volatile fatty acids will be decreased. Therefore, piping modifications are be required to allow simultaneous pumping of WAS and RAS.

Recommended piping modifications to allow simultaneous pumping of WAS and RAS are shown in **Figure 12**. The modifications include adding a tee fitting at each 8-inch sludge pump discharge line that will direct flows to a new 6-inch isolation valve and pipe. These new 6-inch lines will connect to the existing exterior 6-inch WAS line running to the Sludge Holding Tanks. The existing check valves will be relocated upstream of the new tee and existing 8-inch piping will be cut and reused to minimize cost.

Due to the change in RAS piping length to the Anaerobic Selector, sludge pump replacement will be required to achieve the recommended pumping rates. The sludge pumps currently installed pump to nearby Splitter Box No. 1 but will need to pump to the anaerobic selector, which is to be located a further distance from the pumps. New RAS piping to the anaerobic selector zone will also be increased to 10-inch nominal diameter. The required RAS flow rate will also increase and equal the average daily influent flow rate. At peak influent flows, the pumps should be sized to return 1.5 times the design flow (the Final permit phase influent flow). VFDs will be provided for pump turndown when pumping WAS to the Sludge Holding Tanks. The basis of design for the pumps is indicated in **Table 14**. Refinement of the operating points for operational flexibility and best pump operation will be evaluated during the detailed design.

When both final clarifiers are in operation, this piping arrangement will allow the RLSA to continue RAS pumping operations from one of the final clarifiers while stopping RAS pumping from the second clarifier. The Plant operator would then wait for the sludge to thicken in this second clarifier before pumping WAS in order to prevent pumping a high volume of low-percent solids sludge to the Sludge Holding Tanks.

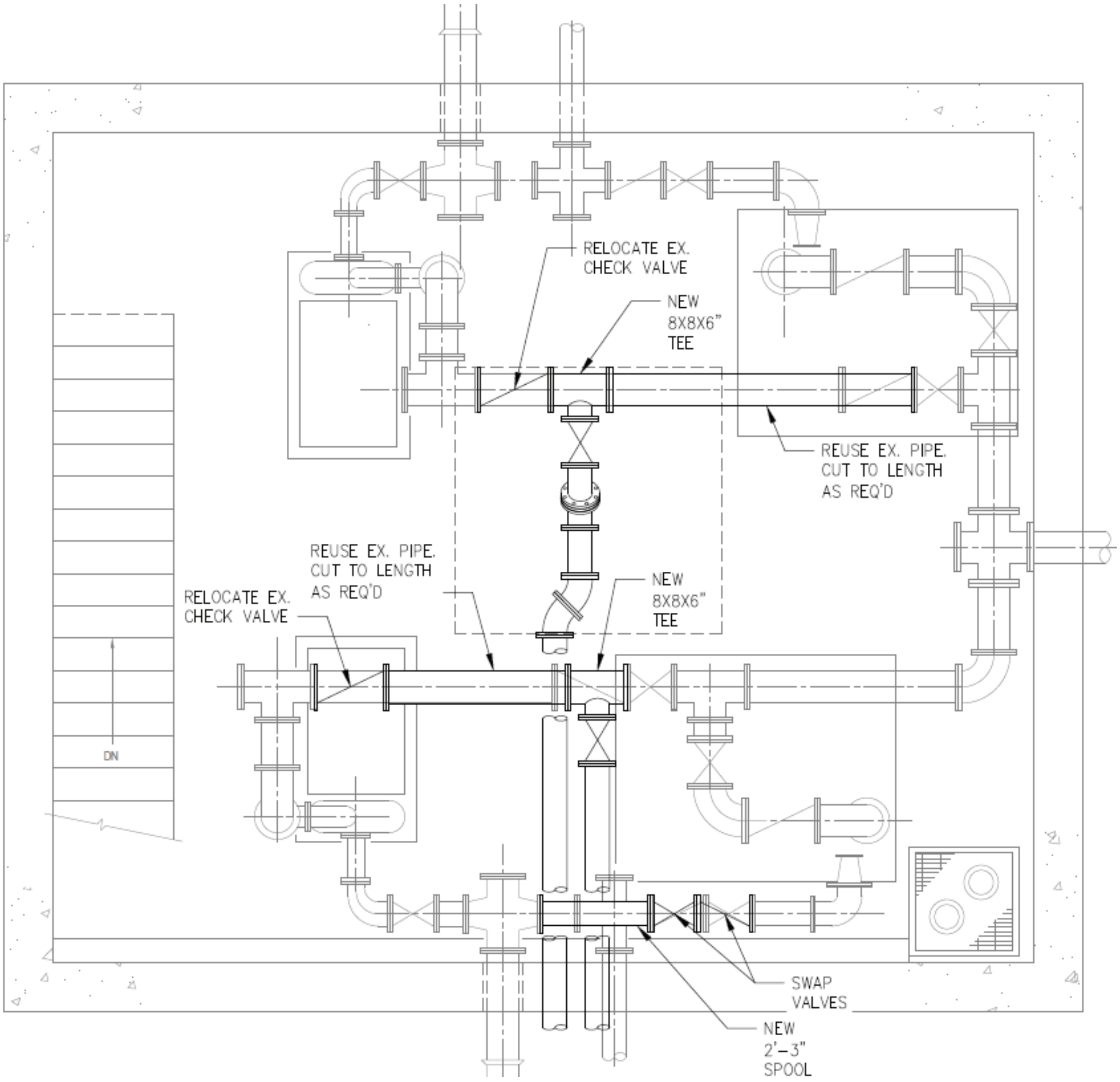


Figure 12 - Sludge Pump Station Piping Modifications

Table14: Proposed Sludge Pump Preliminary Design Basis

ITEM	CHARACTERISTICS
Flygt Model Number	NZ3153.095LT
Number Required	2
Operating Flow Rate:	
WAS Pumping (Reduced Speed)	250 gpm
RAS Pumping (1.0x ADF) (Reduced Speed)	1,000 gpm
RAS Pumping (1.5x ADF) (Full Speed)	1,500 gpm
Rated Power, horsepower	15
Nom. Impeller Diameter, inches	8.15
Rated Speed, rpm	1,755
Voltage, VAC	460
Phase	3
Suction Diameter; inches	8
Discharge Diameter; inches	8
Force Main Velocity @ 6-inch WAS @ 10-inch RAS, Average Flow @ 10-inch RAS, Peak Flow	 2.8 ft/sec 4.1 ft/sec 6.1 ft/sec

9 MASS BALANCE

A Plantwide mass balance for the Final permit phase influent flow is provided in the attached set of figures. Effluent BOD and TSS are based on the values in the Lakeside proposal for the oxidation ditch modifications. Influent parameters for BOD and TSS are based on operational data received from the RLSA. Belt filter press recycle stream parameters are based on a grab sample taken by RLSA in 2023 during dewatering operations. The Mass Balance diagram is provided in **Attachment A.**

9.1 Mass Balance impact on Dewatering Operations

Oxidation Ditch system suppliers projected a design waste sludge production of 1,770 to 2,400 dry lb per day at the Final Permit phase design flow or 0.61 to 0.83 dry tons of sludge per MG of influent flow. RLSA operations data from 2022 and 2023 indicates that the current Plant process is producing approximately 0.56 dry tons of sludge per MG of influent flow.

The RLSA appears to have the capability to dewater the anticipated sludge with one (1) belt filter press. RLSA operations data from 2022 and 2023 indicates that, on average, 5,130 dry pounds of sludge is dewatered per 6-hour shift of dewatering. Lakeside projects a waste sludge production of approximately 1,900 dry lb/day after the proposed upgrades. If the RLSA were to continue dewatering in 6-hour shifts, it would require approximately 2.6 shifts per week to process 1,900 dry pounds of waste sludge per day (or 13,300 dry pounds of waste sludge per week). The highest sludge production projection by an EBPR system supplier was 2,400 lb per day. If the RLSA were to continue dewatering in 6-hour shifts, it would require approximately 3.3 shifts per week to process 2,400 dry pounds of waste sludge per day (or 16,800 dry pounds of waste sludge per week). This increased dewatering requirement will result in increased electrical costs, as well as hauling and disposal costs.

10 HYDRAULIC PROFILE

A hydraulic profile was developed to aid in the design of the proposed upgrades and layout of the proposed equipment and is based on the equipment and upgrades recommended for this Project and is provided in **Attachment A**. The hydraulic profile is included in the attached set of figures. The hydraulic profile shown is based on the current design parameters outlined in this report, and will be refined during detailed design.

Various elevations from the RLSA's 2023 Van Cleef Survey of the entire treatment plant were used as inputs to the profile. The 100-year flood elevation in Rockaway Creek at RLSA's plant outfall was selected as the downstream point for modeling. The model was developed for the Final permit phase influent flow and peak hourly flow. The hydraulic model includes both existing Oxidation Ditch (OD) No. 2 and proposed new OD No. 1 operating in a series configuration, the proposed grit collection system, anaerobic selector, new intermediate piping, and new process return streams.

The following assumptions were made in the development of the hydraulic model:

- Effluent piping from OD No. 2 was replaced with a 24-inch pipe for the entire run to Splitter Box No. 2 as smaller pipe sizes would cause a significant head loss and submerged the OD No. 2 effluent weir at peak flows.
- The model also includes two (2) vertical feet of head for future tertiary cloth media filtration, as the Aqua Aerobics representative indicated that the head loss for a system at RLSA's plant would be 1.42 feet of water column, independent of flow rate.
- Two additional UV modules and associated head losses were added in the same channel as the existing UV modules in the UV Building.
- Both existing Final Clarifiers Nos. 3 and 4 were assumed to be in operation to process future flows.
- During a previous visit to the treatment plant, no adjustable weirs were observed to be installed in Splitter Box No. 2 at the outlets to Final Clarifiers Nos. 3 and 4. It is assumed that this normal operation will remain unchanged following the proposed upgrades.

The Ten States Standards recommends a freeboard of eighteen (18) inches for aeration processes. Therefore, the hydraulic profile reflects an increase of the top-of-concrete tank wall elevation for OD No. 2 by four (4) inches above the existing top-of-concrete elevation.

11 MISCELLANEOUS SITE WORK

11.1 New Access Road

Following the successful startup and testing of the new plant processes, several of the existing structures will be demolished to make room for a new road to access the Oxidation Ditches and Grit Removal Facility. Structures to be demolished include:

- Splitter Box No. 1
- Diversion Box No. 1
- Clarifier No. 1
- Clarifier No. 2
- Chlorine Contact Tank

To minimize Plant Upgrade construction costs, Splitter Box No. 1, Final Clarifiers Nos.1 and 2, and the Chlorine Contact Tank would be only partially demolished which would include the removal of existing mechanical and electrical equipment and the removal of the concrete structure approximately four (4) feet below grade. Holes would be placed in the bottom slabs of the remaining structures to allow for the free flow of groundwater in order to negate uplift of the structure. Following the partial demolition of these structures any voids would be back filled and a subbase prepared for the new access road. The adjacent areas would be graded, loamed and grass seeded.

The proposed access road would extend between Oxidation Ditches Nos. 1 and 2, and to the northside of Oxidation Ditch No. 2. The road would also provide access to the proposed grit removal facility and grit containers. A preliminary layout of the proposed access road is shown in the attached set of figures. The alignment of the access road will be further developed during detailed design.

11.2 Dewatering Building Re-Grading & Drainage Modifications

Surface runoff from the impervious asphalt pavement in front of the Dewatering Building is currently collected by the Plant Combined Storm Drainage (CSD) system and is conveyed to the head of the Plant, upstream of the Influent Pump Station.

To minimize the volume of stormwater runoff that could become contaminated with sludge that must be routed to the new Influent Pump Station, a trench-drain will be constructed between the Dewatering Building and the Storage Building to capture the stormwater runoff that could be contaminated with sludge during sludge conveyance to the container or due to leakage from the container.

The paved area will also be re-graded to effectively segregate the stormwater runoff from the stormwater/sludge trench drain runoff. The re-grading will allow for capturing the non-contaminated stormwater runoff which would be discharged to a stormwater retention basin prior to discharging to the Rockaway Creek via the current stormwater outfall. The proposed piping modifications are shown in **Attachment A**

11.3 Generator SPCC

The current standby generator does not meet current Spill Prevention, Control and Countermeasure (SPCC) requirements. SPCC regulations require fuel containers to have secondary containment and overfill prevention. Based on a review of available information, the belly tank of the generator is a double wall tank and meets this requirement. The SPCC regulations also require that loading/unloading areas be provided with secondary containment which is not presently provided. The RLSA's insurance underwriter indicated to the RLSA that the storm drain running near the Emergency Generator represents a risk for collecting diesel fuel in the event of a fuel leak or accidental discharge.

Based on the infrequent fuel delivery requirements for the generator, a drive-on temporary spill containment berm provides a cost-effective solution to the RLSA. The spill containment berm could be stored in the maintenance building adjacent to the re-fueling area and deployed by RLSA personnel prior to each fuel delivery. Based on conversations with the Authority's fuel provider, fuel deliveries occur every three to four years.

The berm system includes a foam filled top perimeter sidewalls that rise automatically based on the liquid level within the berm. These containment berm systems are available in various containment capacities and meet EPA Container Storage Regulation 40 CFR 264.175 and SPCC requirements.

11.4 Outfall Headwall Stabilization

Plant effluent is discharged through a 30 inch reinforced concrete pipe through a headwall structure into the Rockaway Creek at the north side of the RLSA Property. The outfall piping and headwall structure was constructed in the 1980's with the original construction of the Plant. The concrete headwall structure appears to be in relatively good condition; however, it has shifted, and requires stabilization.

RLSA staff noted that during severe weather events, the creek surcharges over the top of the outfall structure which has started to erode the bank. The replacement of gabions, and installation of new, additional gabions is recommended in addition to the stabilization of the headwall structure. These recommended improvements are further outlined in **Attachment A.**

The condition of the 30-inch effluent pipe is currently unknown. An inspection of this pipe is recommended to be performed during detailed design to identify any deficiencies and outline a repair strategy, if required.

Stormwater Retention Basin

The total area disturbed to construct this project is greater than 1 Acre, and will require construction of a stormwater retention basin to attenuate stormwater discharge following the project completion to match pre-existing runoff rates. The proposed location of the stormwater retention basin is in the area of the old polishing pond. The size and location of the stormwater retention basin will be determined during detailed design.

12 ELECTRICAL

12.1 Overview of Existing Electrical System

RLSA provided energy bills for the period between December 2023 and November 2024 for evaluation of the current electrical demand of the Plant. The Dewatering Building is powered by a separate utility feeder from the rest of the plant. RLSA does not sub-meter process energy consumption by unit operations or at any local load centers other than the Dewatering Process.

Monthly energy consumption is presented in **Table 15** and **Figure 13**. It should be noted that during this period, one of the brush aerators at Oxidation Ditch No. 2 was out of service, and temporarily replaced with alternate mixers. The data presented below may not accurately reflect normal Plant operations.

Table 15: Current Monthly Energy Consumption

	Dewatering Building		Main Plant		Total		Total
Max	5,920	kWh	72,320	kWh	78,240	kWh	$ 2,761.27
Average	4,810	kWh	58,444	kWh	63,254	kWh	$ 2,446.97
Min	2,720	kWh	41,280	kWh	44,000	kWh	$ 1,996.92

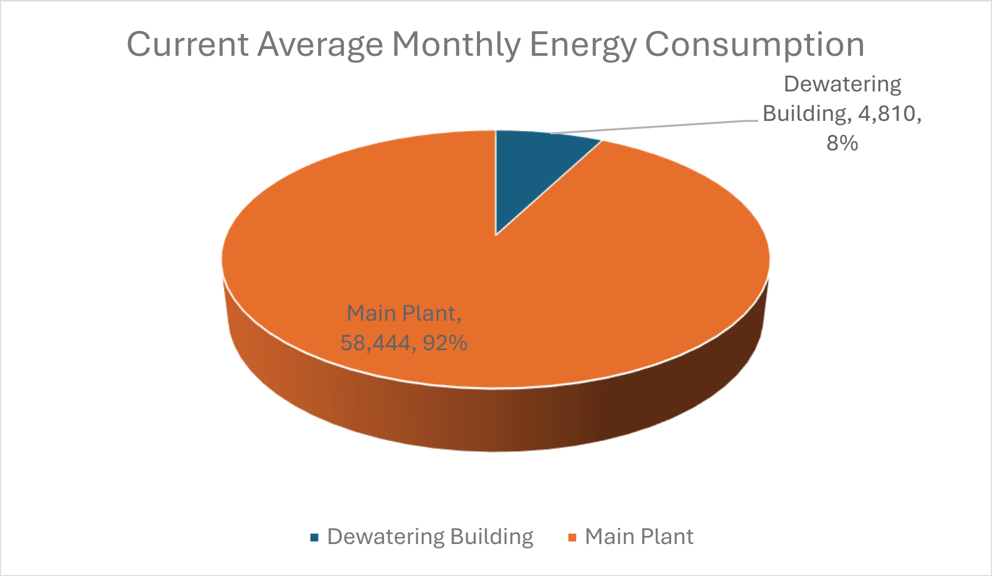


Figure 13 - Current Average Monthly Energy Consumption

Total cost for the 12-month billing period totaled $26,976.43 with a total yearly energy usage of 711,920 kWh. Monthly energy consumption ranges between 44,000 kWh and 78,240 kWh, with an average of 63,254 kWh.

12.2 Preliminary Load List – Proposed

The total proposed increase in overall load is estimated at approximately 240 kW. At this time no modifications to the incoming service or standby generator is expected to be required. The load list and impacts to the RLSA's electrical system will be further evaluated during detailed design.

12.3 New Influent Pump Station

The Existing Influent Pump Station is powered from the Main Distribution Panel (MDP) located in the Electrical Room of the Administration Building. A conduit ductbank extends between the Administration Building and the Influent Pump Station. Limited information is available regarding this ductbank, and additional field investigations are required to confirm as-built conditions. It is unlikely that the existing ductbank will have adequate spare capacity required to accommodate additional feeders for the New Influent Pump Station, therefore, a new ductbank will be required.

The New Influent Pump Station electrical system will be very similar to the Existing Pump Station. New Electrical feeders and breaker will be installed to connect the new Pump Station 480 Volt distribution panel to the MDP located in the Electrical Room of the Administration Building. The existing and proposed Influent Pump Stations will not be able run simultaneously, however, the existing Distribution Panel should be able to accommodate the lighting loads from both pump stations. The loads for the Site Lighting will be incorporated into the new Influent Pump Station.

The New IPS Distribution Panel will distribute power to various equipment and low voltage lighting panels. The motor starters for the screenings equipment will be located in their respective control panels. The VFDs for the Main Sewage Pumps will be wall mounted adjacent to the Pump Control Panels.

12.4 Grit Removal

The proposed grit removal system will be powered from the Main Distribution Panel located within the Administration Building Electrical Room. A new breaker will be added in the MDP and a ductbank will be installed between the Administration Building and the new Grit Building. The Grit Building will have a 480V panelboard, transformer, and 120V lighting panel located along with the grit equipment control panels in a small electrical/control room of the Grit Building. Motor starters for the grit equipment will be located within their respective control cabinets.

12.5 Oxidation Ditch

Oxidation Ditch No. 1 and 2 are both powered from MCC No. 2 located within the Electrical Building of the Administration Building. MCC No. 2 is powered from the Main Distribution Panel which is also located in the Electrical Building. The MCC buckets for the existing oxidation ditch rotors each contain a two speed motor starter with a selector switch on the front of the MCC Bucket.

The proposed oxidation ditch equipment will be VFD controlled. The two speed motor starters will be removed from the MCC bucket, and a VFD with bypass contactor will be retrofitted in the existing bucket. The proposed Oxidation Ditch system will be fully automated with feedback loops controlling the mechanical equipment and will require a new control panel for the process. Each Oxidation Ditch will have a dedicated control panel which will be located within the Electrical Room of the Administration Building.

12.6 Adding Dewatering Building to Backup Generator Power.

The Plant has two metered connections from the Jersey Central Power & Light (JCP&L) electrical grid. One metered connection serves the dewatering building, and the other metered connection serves the Administration Building and the remaining Plant Processes. The RLSA Plant is equipped with an 800KW standby generator which is connected to an Automatic Transfer Switch (ATS) located upstream of the MDP located within the Electrical Room of the Administration Building. Since the Dewatering Building received power from a separate electrical feeder, it is not backed up by the standby generator system.

Currently RLSA dewaters only one day per week. Following the Plant Upgrades Project, the new process will require RLSA to dewater more frequently. RLSA has requested that the Dewatering Building be provided with backup generator power to be able to keep up with sludge dewatering during utility power outages. To accomplish this, another set of feeders will be added between the Generator Main Breaker to the Dewatering Building. A Manual Transfer Switch will be added at the Dewatering Building. An automatic transfer switch could be provided in lieu of a manual transfer switch if requested by the Authority.

13 SCADA

The Plant SCADA system, represented in **Figure 14** was installed under the 2000 improvements contract and has largely remained intact from that contact installation through the present day.

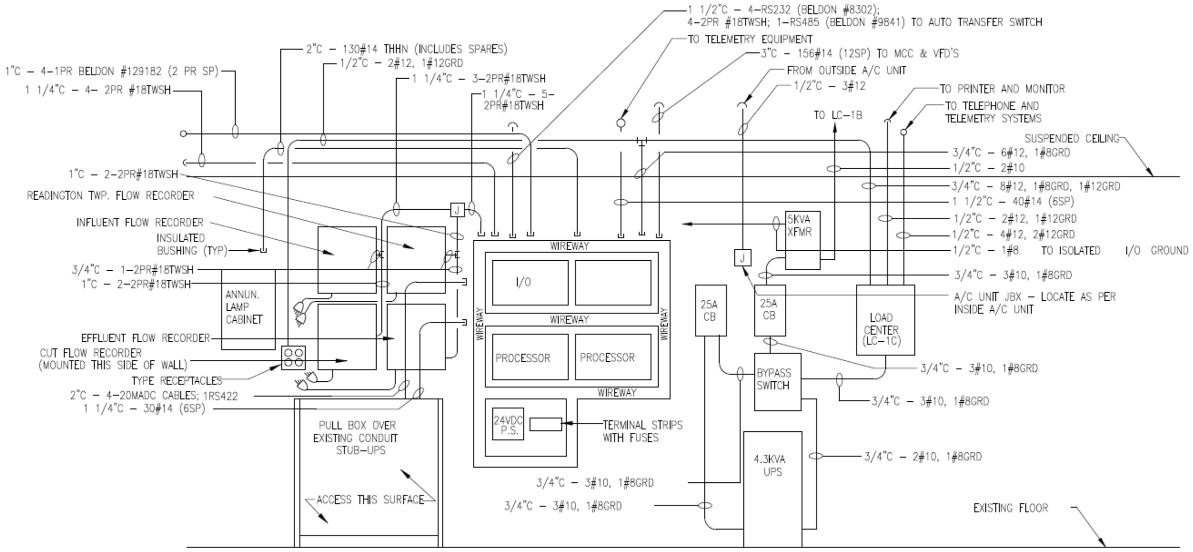


Figure 14 - Existing SCADA System

At the heart of the system is a redundant pair of GE/Emerson 90-30 PLCs paired with GE Fanuc Genius I/O cards. These PLCs and I/O cards are considered obsolete by the manufacturers and are no longer in production nor receive any official support. This makes finding replacement parts exceedingly difficult. The UPS is also original to the 2000 improvements contract and has exceeded useful life.

The existing system should be upgraded to the GE/Emerson Rx3i PLC with new modern I/O cards, networking equipment, and UPS backup. The Rx3i was manufactured as a modern upgrade to the 90-30 PLCs. Both are compatible with the plant's current SCADA software platform, GE Cimplicity. The existing 90-30 PLC programming can be ported to the Rx3i with relative ease. The proposed system would be housed inside a new standalone enclosure with an HMI touchscreen on the front door to allow for additional means to interact with Plant SCADA.

The existing Auto Dialer is a RACO Chatterbox, which is also obsolete and no longer supported by the manufacturer. It is our understanding that the Auto Dialer currently installed is no longer fully functional, and RLSA does alarm notifications via the Plant's Cimplicty SCADA software. However, it is also understood the notification system via Cimplicity is erratic. The Auto Dialer shall be upgraded to a remote terminal unit with cellular communications and modern notification features. Possible replacement units include Mission Communications, Sensaphone, or equal.

14 PERMITS

The permits noted below will be required to allow for the construction on the Plant Upgrade Project:

A. **NJDEP Division of Water Quality:** The current Plant will be upgraded to provide enhanced biological phosphorous removal. In addition, a new influent pump station, mechanically cleaned bar screen and grit removal system will be constructed at the Plant. Therefore, a Treatment Works Approval will be required from the NJDEP for this project.

B. **Soil Erosion and Sediment Control:** It is anticipated that the work for the installation of steps noted above will result in a disturbance of an area greater than 5,000 square feet and therefore an application for Hunterdon County Soil Erosion and Sediment Control certification will be required for this project.

C. **Water Quality Management Plan (WQMP) Consistency Determination:** The work under this project will not result in any increased flows or transfer of flows from one system to another and therefore, the need for a NJDEP determination of the projects consistency with the existing WQMP's is not anticipated.

D. **Bureau of Water Allocation and Well Permitting**: Construction related water use (groundwater dewatering) at rates exceeding 70 gallons per minute is considered regulated and any withdrawal of ground and/or surface water with a diversion in excess of 100,000 gallons per day for a period of more than 30 days in a consecutive 365-day period would require a Temporary Dewatering Permit from the Bureau of Water Allocation and Well Permitting. For diversions in excess of 100,000 gallons per day for a period of less than 31 days in a consecutive 365-day period a short-term water use permit would be required. This will be evaluated during detail design

E. **The NJDEP Stormwater Management Rules:** N.J.A.C 7:8 requires that the design of any development that disturbs at least one (1) acre of land or increases impervious surface by at least ¼ acre must incorporate nonstructural stormwater management strategies to the maximum extent practicable. Such development is defined by the Rules as a "major development." Major developments must meet the groundwater recharge, stormwater runoff quality and quantity standards through the use of structural and nonstructural Best Management Practices (BMPS's). Based on the improvements proposed for the Plant Upgrade, Green Infrastructure BMPs will be required. To meet this requirement, a combination of grass swales, vegetative filter strips, infiltration basins, bioretention basins or other stormwater strategies may need to be incorporated into the stormwater management design.

F. **NJDEP Flood Hazard Area Permit:** RSLA would like to add gabions on the upstream side of the existing outfall of the Rockaway Creek (presently only on the downstream side). Rock armoring may also be necessary above the outfall pipe to prevent future soil erosion during extreme creek water levels. These modifications would need to satisfy the requirements of the Flood Hazard Area Control Act Rules N.J.A.C. 7:13.

   An Individual Permit would most likely be required for this work and any modifications to the existing stormwater outfall (headwall) located within the floodway of the Rockaway Creek.

G. **Freshwater Wetlands Permit:** Based on the wetland's delineation performed for the RLSA by Van Cleef Associates, and the proposed layout for the Plant Upgrade construction work, there will be no need for a Freshwater Wetlands permit as the wetlands near the area of disturbances are classified as a man made ditch with ordinary resource value.

H. **US Army Corps of Engineers (USACE) Permit:** The USACE's jurisdiction for non-tidal waterways extends to the ordinary high-water mark for navigable waterways. When adjacent wetlands are present the Corp's jurisdiction extends beyond the ordinary high-water mark to the limit of the adjacent wetlands. Since modifications are proposed at the existing outfall (headwall) within the floodway and wetlands of the Rockaway Creek a General Permit may be required for this work. During the design phase and prior to submitting a permit application, a Jurisdictional Determination request will be submitted to confirm the Corp's jurisdiction over the wetlands and waters in question.

The list of permits required will be further refined during the detailed design phase.

15 CONSTRUCTION SCHEDULE

Figure 15 presents a preliminary schedule and sequencing for the proposed Plant Upgrades based on current recommendations and sequencing will be reviewed with the Authority prior to proceeding with detailed design.

ID	Task Mode	Task Name	Duration	Start	Finish
1		Engineering Design	285 days	Wed 2/26/25	Tue 3/31/26
2		Regulatory Review & Approvals	240 days	Wed 9/3/25	Tue 8/4/26
3		Project Financing Through NJ Water Bank	590 days	Wed 10/30/24	Tue 2/2/27
4		Bidding & Award	100 days	Wed 2/3/27	Tue 6/22/27
5		**Construction**	**555 days**	**Wed 6/23/27**	**Wed 8/8/29**
6		Pre Construction Meeting	0 days	Wed 6/23/27	Wed 6/23/27
7		**Submittals**	**125 days**	**Thu 6/24/27**	**Wed 12/15/27**
13		**Fabrication & Delivery of Major Equipment**	**140 days**	**Thu 12/16/27**	**Wed 6/28/28**
20		Mobilization	2 wks	Thu 6/15/28	Wed 6/28/28
21		**Construct NewInfluent Pump Station**	**140 days**	**Thu 6/29/28**	**Wed 1/10/29**
25		**Replace Oxidation Ditch No. 1**	**160 days**	**Thu 6/29/28**	**Wed 2/7/29**
29		**Retrofit Oxidation Ditch No. 2**	**70 days**	**Thu 2/8/29**	**Wed 5/16/29**
32		Install UV Modules	1 mon	Thu 6/29/28	Wed 7/26/28
33		Treatment Plant On-line	0 days	Wed 5/16/29	Wed 5/16/29
34		**Construct New Access Road**	**40 days**	**Thu 5/17/29**	**Wed 7/11/29**
35		Demolish Structures	1 mon	Thu 5/17/29	Wed 6/13/29
36		Paving & Grading	1 mon	Thu 6/14/29	Wed 7/11/29
37		Substantial Completion	0 days	Wed 7/11/29	Wed 7/11/29
38		Final Completion	0 days	Wed 8/8/29	Wed 8/8/29
39		NJPDES Permit Initial Phase End Date	0 days	Thu 5/31/29	Thu 5/31/29
40		NJPDES Permit Interim Phase Start Date	0 days	Fri 6/1/29	Fri 6/1/29

Project: RL101: Plant Upgrade
Date: Mon 12/23/24

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone	◆	External Milestone	◆	Manual Task		Start-only	[	Manual Progress	
Summary		Inactive Task		Duration-only		Finish-only	]		

Page 1

Figure 15 - Construction Schedule

16 CONSTRUCTION COST ESTIMATE

The preliminary construction cost estimate for the proposed Plant Upgrades based on current recommendations is $16,991,300.00 as itemized in **Table 16**. The estimated construction cost includes a 30% design contingency, 20% for Contractor's Overhead and Profit (OH&P), 3% for the Contractor's Bonding and Insurance and an allowance of $300,000.00 for unforeseen field conditions during construction. The estimate will be reviewed with the Authority prior to proceeding with the detailed design. **Table 17** provides the estimated equipment and structure costs for the Plant Upgrade Project.

Table16: Construction Cost Estimate

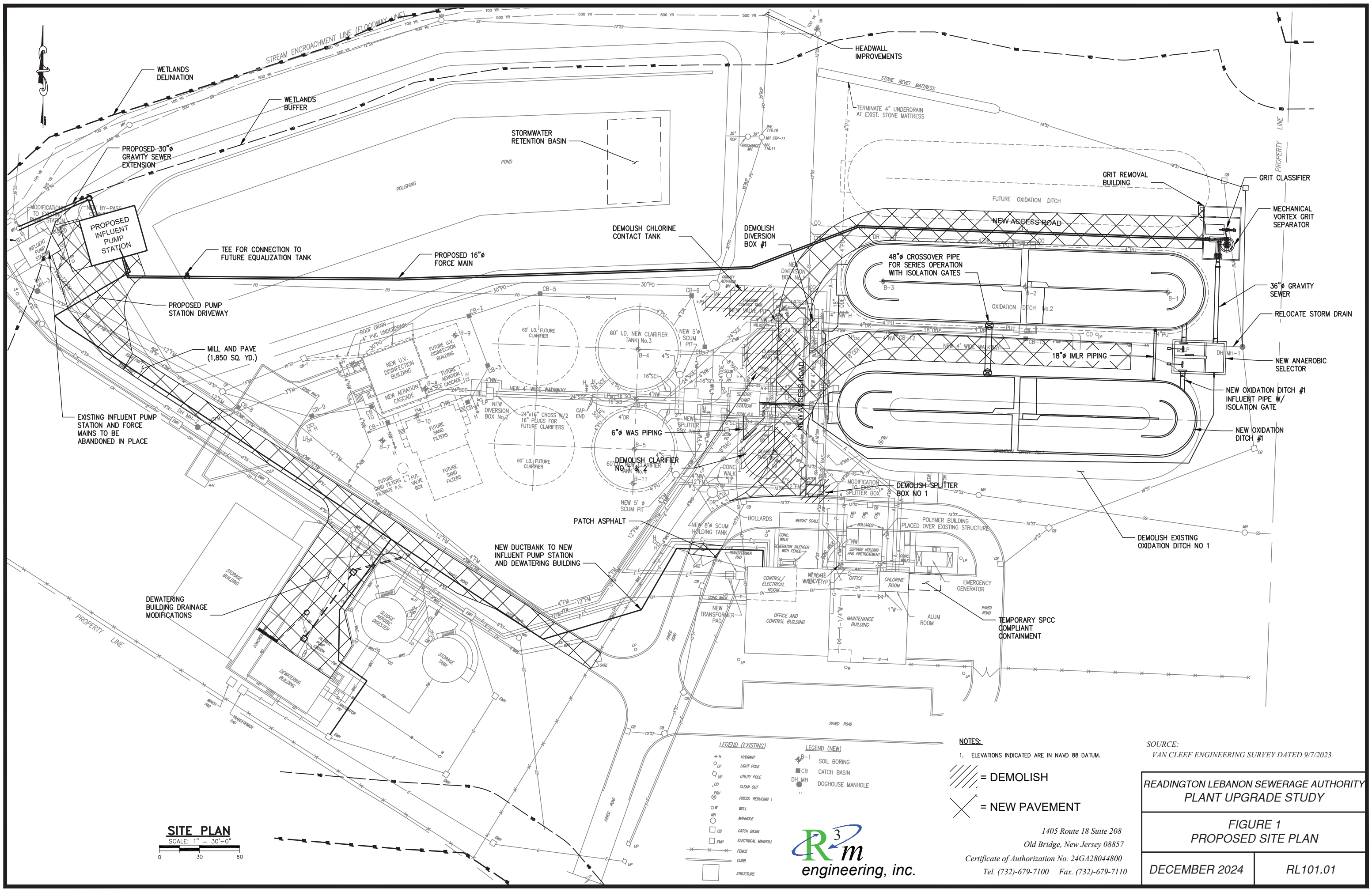
Item	Description	Qty.	Unit	Unit Cost	Extended Cost
1	**Mobilization**	1	L.S.	**$ 420,000**	**$ 420,000**
2	**General Site Work**	**1**	**L.S.**	**$ 1,390,000**	**$ 1,390,000**
	Demolition of Clarifiers, Splitter Box No. 1, CCT, Diversion Box & Distribution	1	L.S.	$ 258,000	$ 258,000
	New Access Road	1	L.S.	$ 300,000	$ 300,000
	Dewatering Building Re-Grading & Drainage Modifications	1	L.S.	$ 280,000	$ 280,000
	Generator SPCC	1	L.S.	$ 12,000	$ 12,000
	Outfall Headwall Stabilization	1	L.S.	$ 110,000	$ 110,000
	Site Lighting (Access Road)	1	L.S.	$ 180,000	$ 180,000
	Stormwater Retention Basin and Outfall	1	L.S.	$ 250,000	$ 250,000
3	**Influent Pump Station & Screenings**	**1**	**L.S.**	**$ 6,071,000**	**$ 6,071,000**
	Site Work & Landscaping	1	L.S.	$ 240,000	$ 240,000
	Building Foundation & Superstructure	1	L.S.	$ 1,940,000	$ 1,940,000
	Support of Excavation	1	L.S.	$ 100,000	$ 100,000
	Gravity Sewer Modifications	1	L.S.	$ 280,000	$ 280,000
	Screenings & Compacting Equipment	1	L.S.	$ 770,000	$ 770,000
	Mechanical Pumping Equipment & Piping	1	L.S.	$ 1,200,000	$ 1,200,000
	New Force Main	1	L.S.	$ 870,000	$ 870,000
	Heating & Ventilation	1	L.S.	$ 251,000	$ 251,000
	Electrical	1	L.S.	$ 420,000	$ 420,000
4	**Grit Removal**	**1**	**L.S.**	**$ 1,085,000**	**$ 1,085,000**
	Grit Removal & Processing Equipment	1	L.S.	$ 720,000	$ 720,000
	Support of Excavation	1	L.S.	$ 25,000	$ 25,000
	Building	1	L.S.	$ 340,000	$ 340,000
5	**Oxidation Ditch**	**1**	**L.S.**	**$ 6,000,000**	**$ 6,000,000**
	Influent Gravity Sewers - to Anaerobic Selector Zone and ODs	1	L.S.	$ 670,000	$ 670,000
	Anaerobic Selector Stuctural	1	L.S.	$ 380,000	$ 380,000
	Existing Oxidation Ditch #1 Demolition & Concrete Construction	1	L.S.	$ 2,150,000	$ 2,150,000
	Oxidation Ditch No. 2 Structural Modifications and Platform for IMLR	1	L.S.	$ 110,000	$ 110,000
	Oxidation Ditch and Selector Zone Process Equipment	1	L.S.	$ 2,310,000	$ 2,310,000
	Support of Excavation	1	L.S.	$ 50,000	$ 50,000
	Effluent Piping Replacement/Modification	1	L.S.	$ 330,000	$ 330,000
6	**UV Building Modifications**	**1**	**L.S.**	**$ 207,500**	**$ 207,500**
	Additional UV Modules	1	L.S.	$ 200,000	$ 200,000
	Remove Nested Parshall Flume	1	L.S.	$ 7,500	$ 7,500
7	**Additional Process Modifications**	**1**	**L.S.**	**$ 947,000**	**$ 947,000**
	Replace Chemical Piping & Feed Pumps	1	L.S.	$ 100,000	$ 100,000
	Inspect Chemical Tanks	1	L.S.	$ 10,000	$ 10,000
	RAS Pump/Piping Modifications	1	L.S.	$ 590,000	$ 590,000
	Clarifier Dewatering Pumps	1	L.S.	$ 127,000	$ 127,000
	Provide FRP Covers at Cascade Aeration	1	L.S.	$ 120,000	$ 120,000
8	**Electrical**	**1**	**L.S.**	**$ 200,000**	**$ 200,000**
	Add Dewatering Building to Generator	**1**	**L.S.**	$ 200,000	$ 200,000
9	**SCADA & Instrumentation**	**1**	**L.S.**	**$ 370,800**	**$ 370,800**
	SCADA Upgrade	1	L.S.	$ 370,800	$ 370,800
10	**Allowances for Unforeseen Conditions**	**1**	**L.S.**	**$ 300,000**	**$ 300,000**
11	**Total:**				**$16,991,300**

Table17: Estimated Equipment and Structure Cost

Item	Description	Equipment Cost	Structures Cost	Total Cost
1	Mobilization	$ -	$ -	$ 420,000
2	General Site Work	$ 12,000	$ 1,378,000	$ 1,390,000
3	Influent Pump Station & Screenings	$ 3,791,000	$ 2,280,000	$ 6,071,000
4	Grit Removal	$ 720,000	$ 365,000	$ 1,085,000
5	Oxidation Ditch	$ 3,310,000	$ 2,690,000	$ 6,000,000
6	UV Building Modifications	$ 207,500	$ -	$ 207,500
7	Additional Process Modifications	$ 827,000	$ 120,000	$ 947,000
8	Electrical	$ 200,000	$ -	$ 200,000
9	SCADA & Instrumentation	$ 370,800	$ -	$ 370,800
10	Allowances for Unforeseen Conditions	$ -	$ -	$ 300,000
11	**Total Construction Cost**	**$ 9,438,300**	**$ 6,833,000**	**$ 16,991,300**

ATTACHMENT A

Conceptual Drawings



NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

▨ = DEMOLISH

╳ = NEW PAVEMENT

SOURCE:
VAN CLEEF ENGINEERING SURVEY DATED 9/7/2023

R³m engineering, inc.

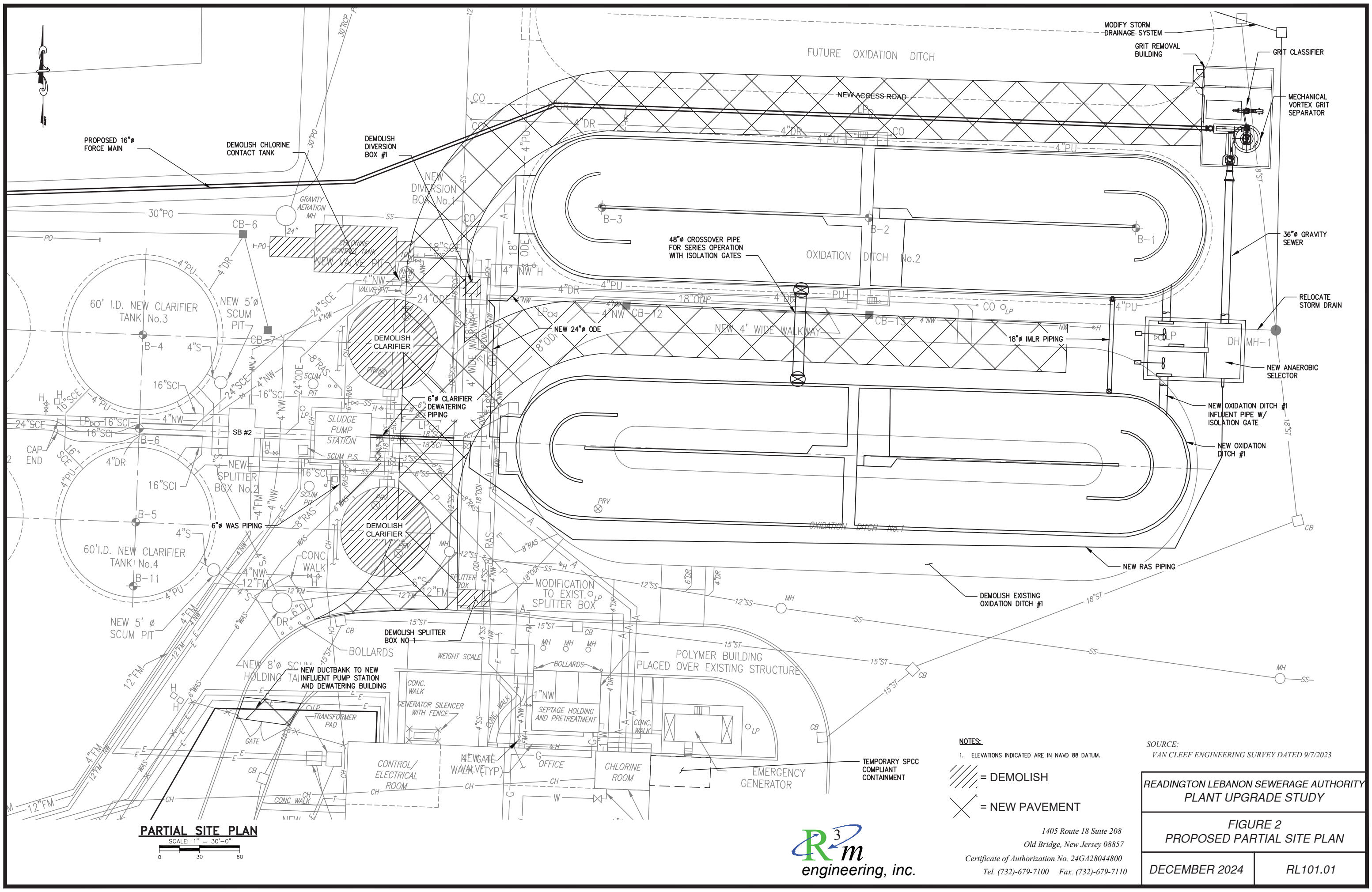
1405 Route 18 Suite 208
Old Bridge, New Jersey 08857
Certificate of Authorization No. 24GA28044800
Tel. (732)-679-7100 Fax. (732)-679-7110

READINGTON LEBANON SEWERAGE AUTHORITY
PLANT UPGRADE STUDY

FIGURE 1
PROPOSED SITE PLAN

DECEMBER 2024

RL101.01



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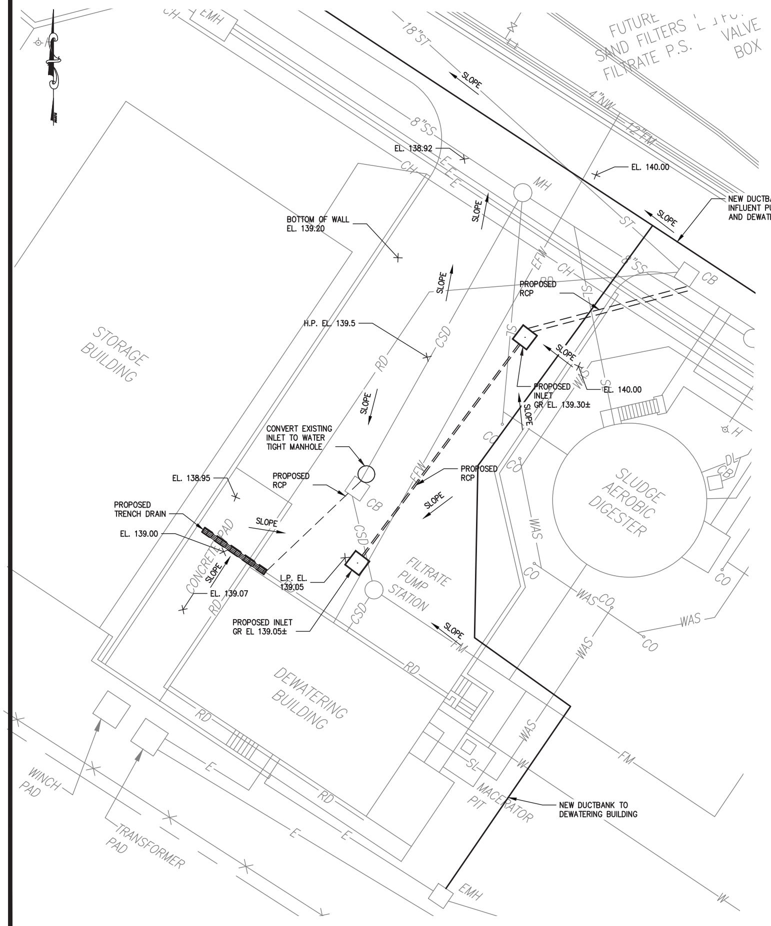
READINGTON LEBANON SEWERAGE AUTHORITY
PLANT UPGRADE STUDY

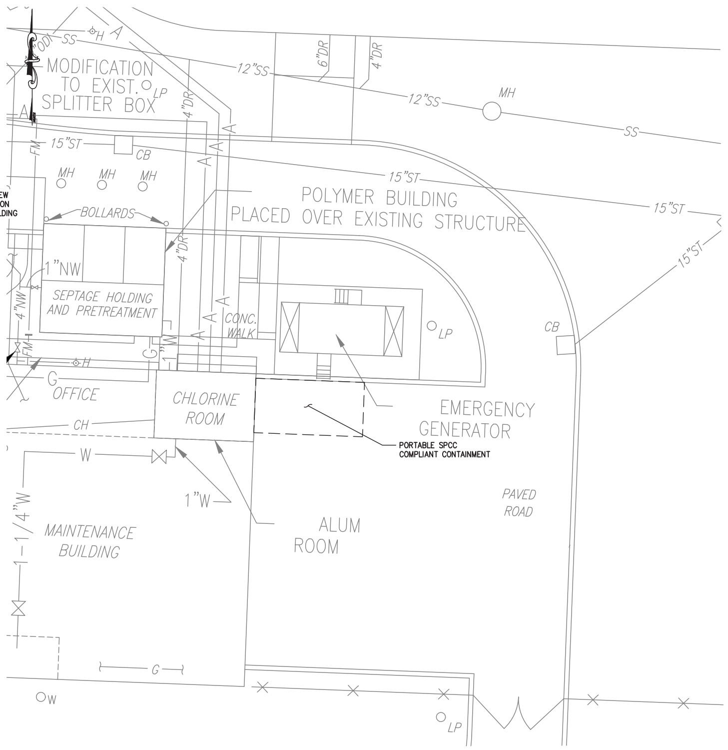
FIGURE 2
PROPOSED PARTIAL SITE PLAN

DECEMBER 2024
RL101.01



DEWATERING BUILDING PARTIAL SITE PLAN

N.T.S.



EMERGENCY GENERATOR PARTIAL SITE PLAN

N.T.S.

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.
2. EXTENT OF NEW PAVING NOT SHOWN FOR CLARITY.

SOURCE:
VAN CLEEF ENGINEERING SURVEY DATED 9/7/2023

engineering, inc.

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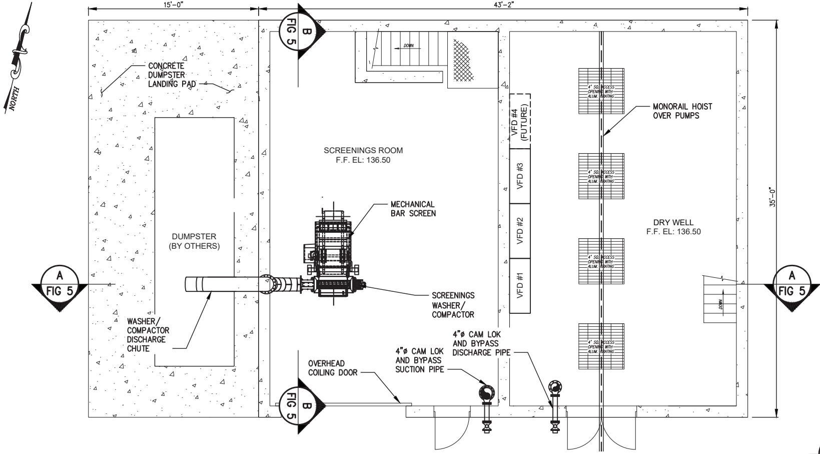
READINGTON LEBANON SEWERAGE AUTHORITY
PLANT UPGRADE STUDY

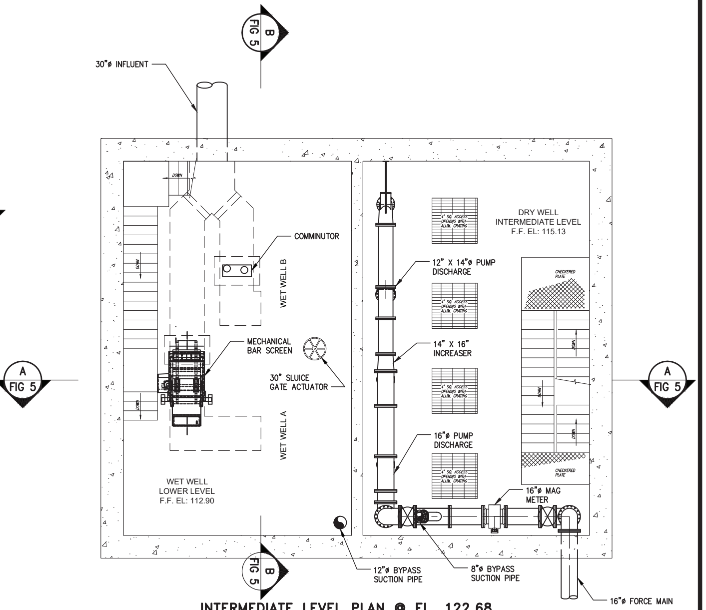
FIGURE 3
DEWATRTING & SPCC SITE PLANS

DECEMBER 2024 RL101.01



UPPER PLAN @ EL. 136.50

SCALE 1/4" = 1'-0"



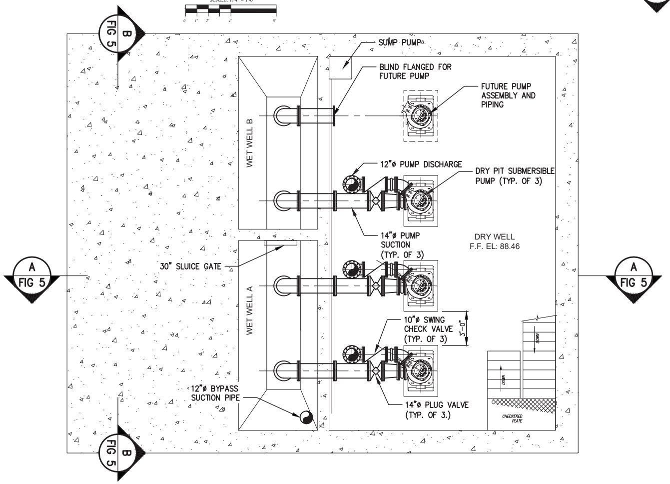
INTERMEDIATE LEVEL PLAN @ EL. 122.68

1/4"=1'-0"

SCALE 1/4" = 1'-0"

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.
2. EXTENT OF NEW ASPHALT DRIVEWAY NOT SHOWN FOR CLARITY.



LOWER LEVEL PLAN @ EL. 108.00

SCALE 1/4" = 1'-0"

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PLANT UPGRADE STUDY

FIGURE 4
INFLUENT PUMP STATION - PLANS

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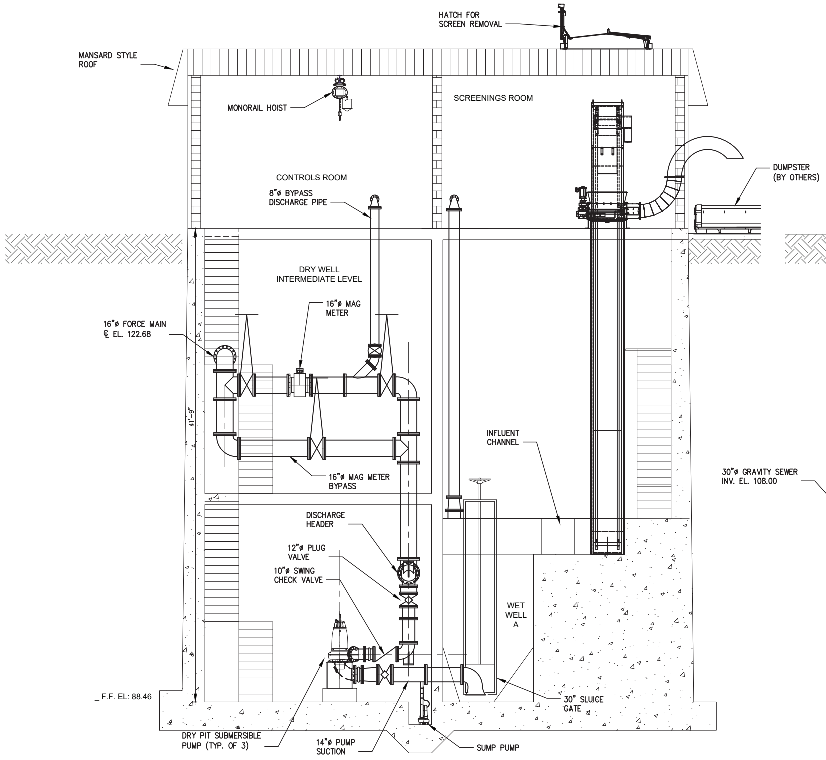
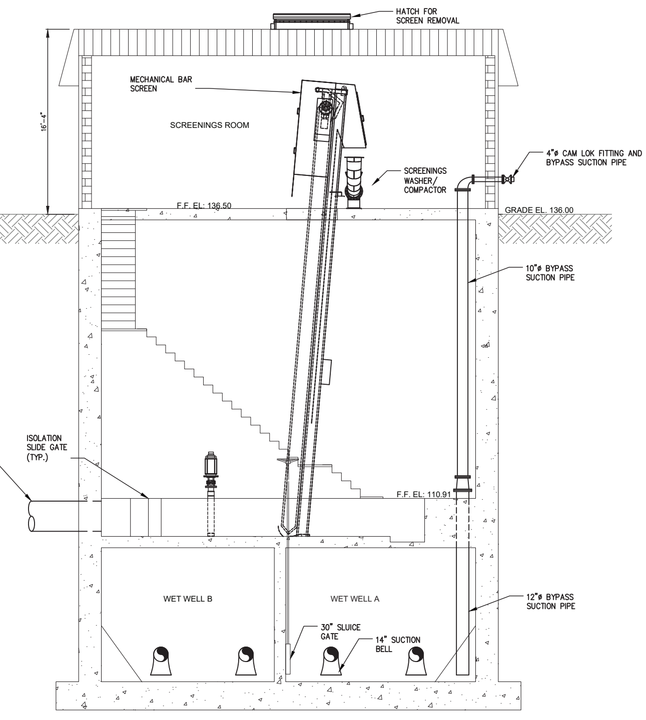


SECTION A–A

SCALE: 1/4" = 1'-0'

0 1' 2' 4' 8'



SECTION B–B

SCALE: 1/4" = 1'-0'

0 1' 2' 4' 8'

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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FIGURE 5
INFLUENT PUMP STATION - SECTIONS

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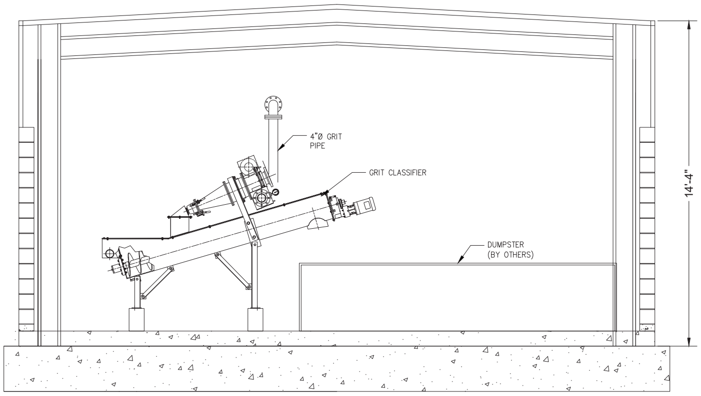
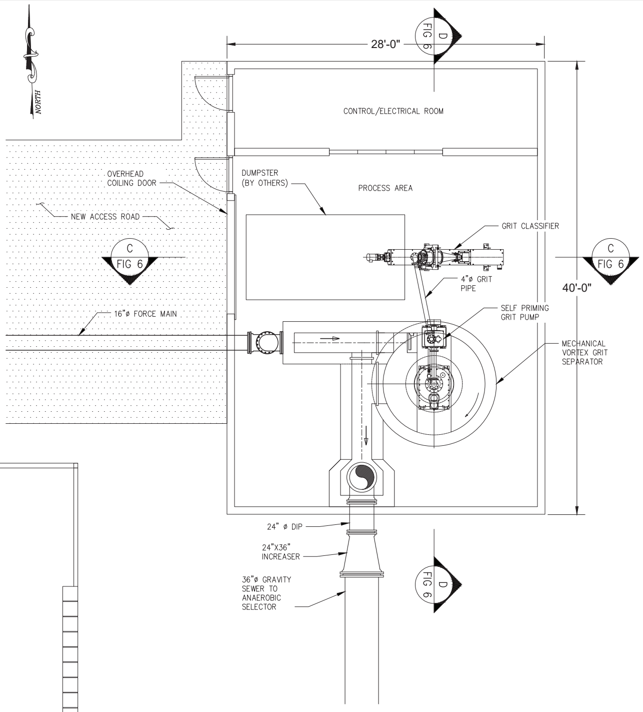


SECTION C–C

SCALE: 1/4" = 1'-0'

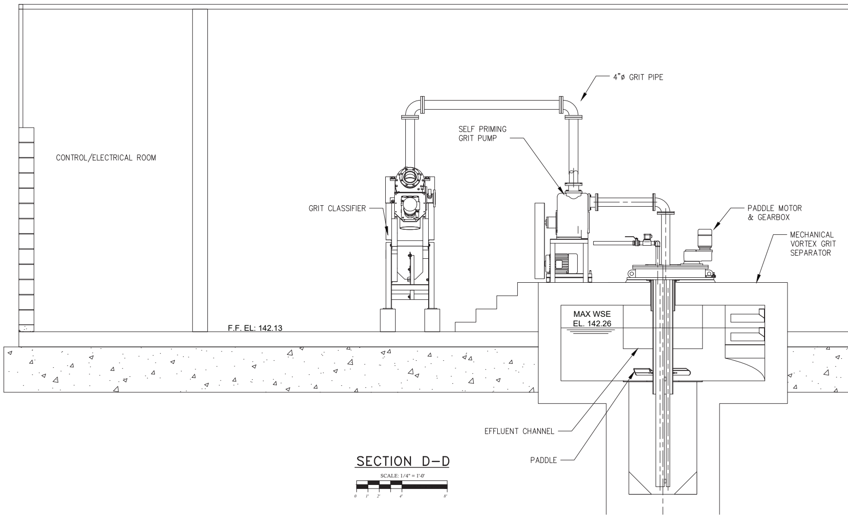


GRIT REMOVAL BUILDING PLAN

SCALE: 1/4" = 1'-0'

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.



SECTION D–D

SCALE: 1/4" = 1'-0'

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PLANT UPGRADE STUDY

FIGURE 6
GRIT REMOVAL - PLAN & SECTIONS

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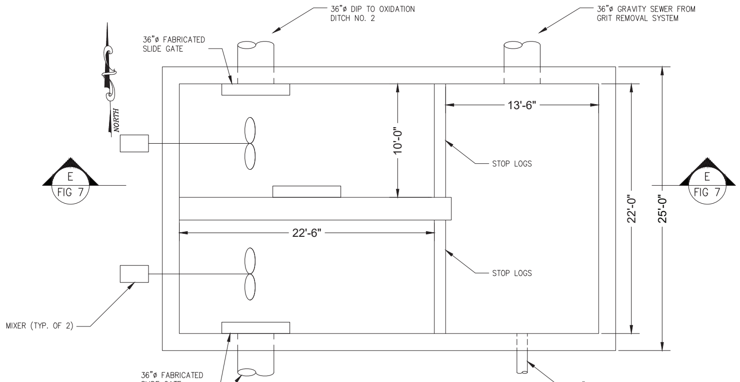
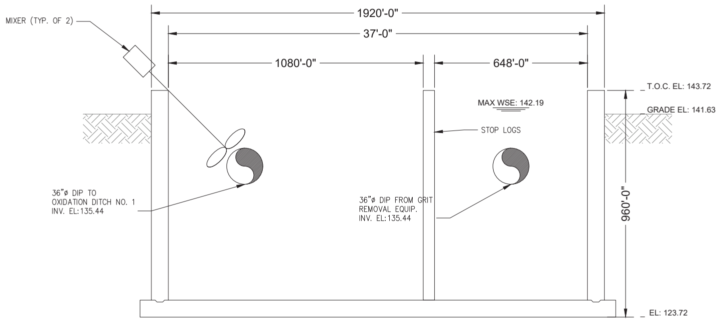


ANAEROBIC SELECTOR

SCALE: 1/4" = 1'-0"



SECTION E–E

SCALE: 1/4" = 1'-0"

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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PLANT UPGRADE STUDY

FIGURE 7
ANAEROBIC SELECTOR

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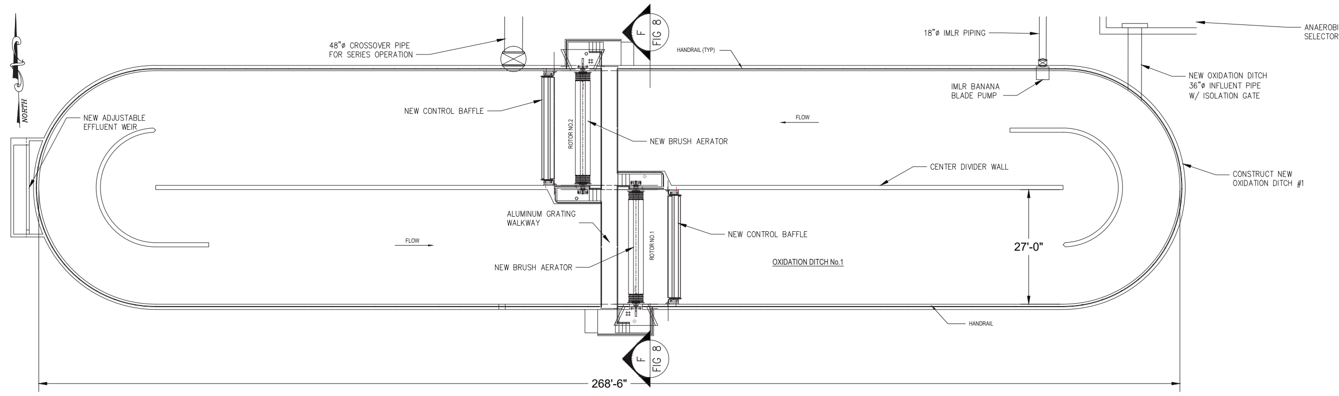
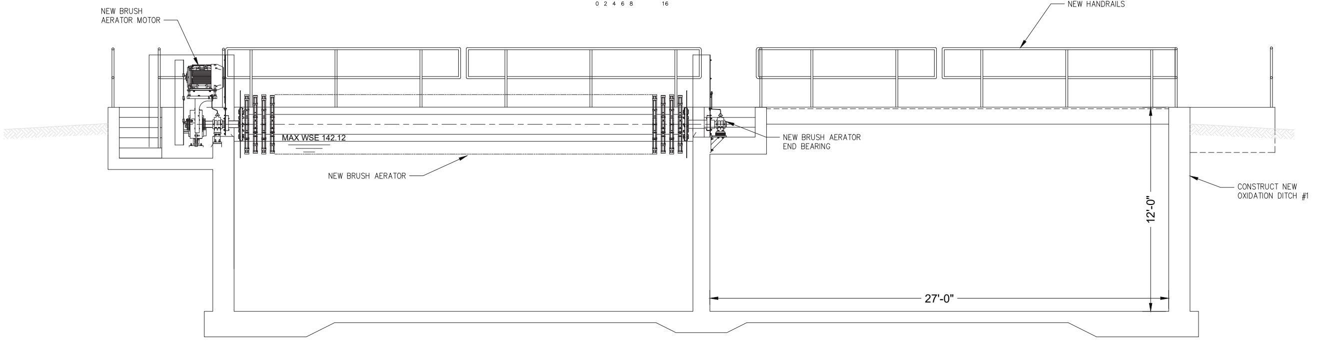


OXIDATION DITCH NO. 1

SCALE: 3/32" = 1'-0"
0 2 4 6 8 16



SECTION F–F

SCALE: 3/8" = 1'-0"
0 1 2 3 4

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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FIGURE 8
OXIDATION DITCH NO. 1

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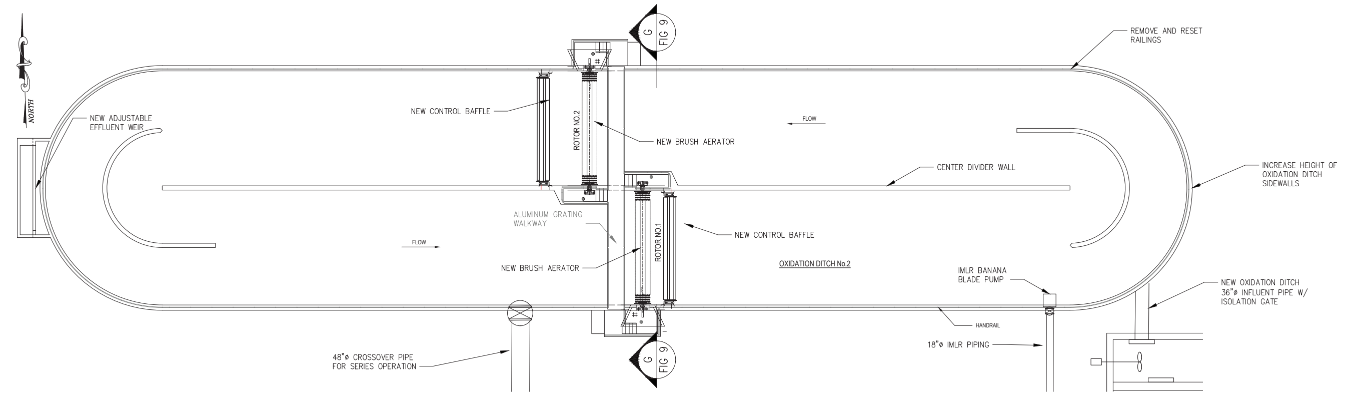
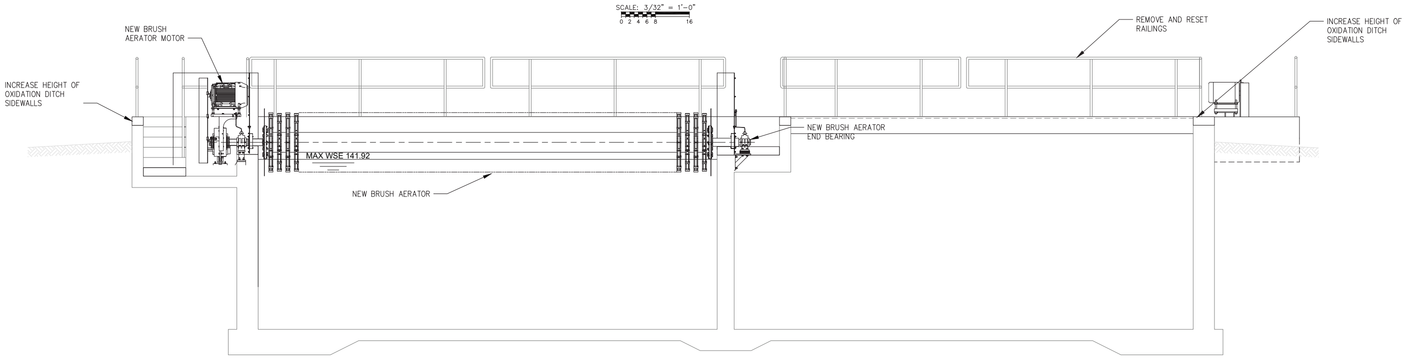


OXIDATION DITCH NO. 2

SCALE: 3/32" = 1'-0"
0 2 4 6 8 16



SECTION G–G

SCALE: 3/8" = 1'-0"
0 1 2 3 4

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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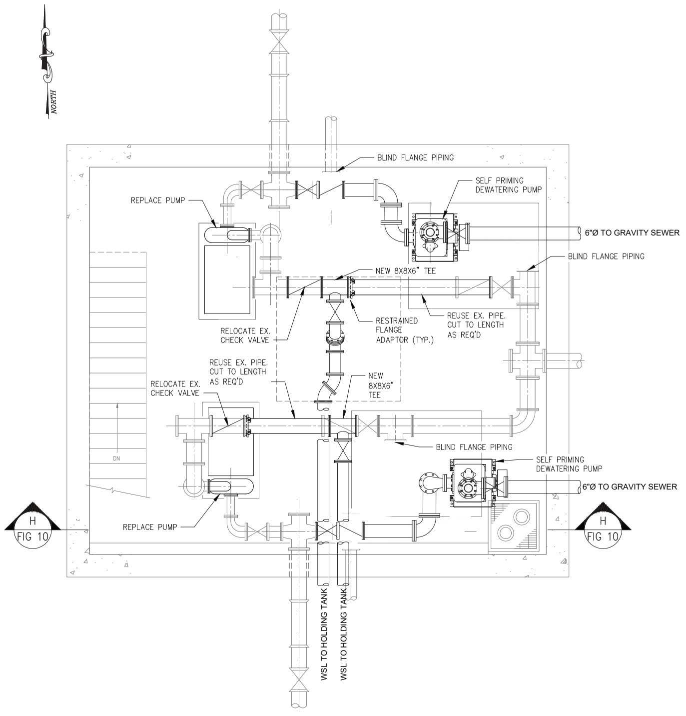
PLANT UPGRADE STUDY

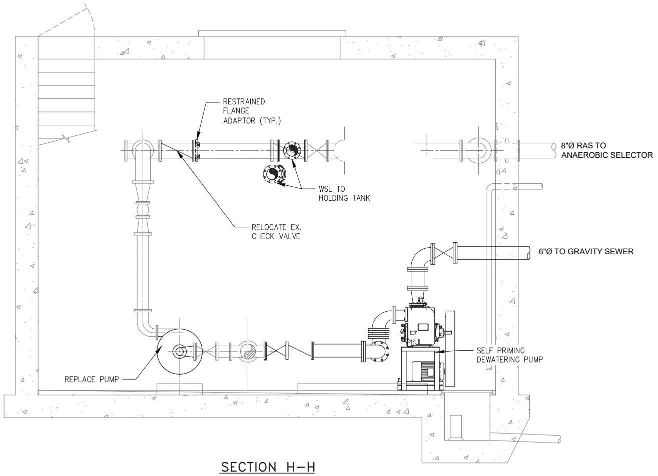
FIGURE 9
OXIDATION DITCH NO. 2

DECEMBER 2024 | RL101.01



SLUDGE PUMP STATION PLAN

SCALE: 1/2" = 1'-0"



SECTION H-H

SCALE: 1/2" = 1'-0"

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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PLANT UPGRADE STUDY

FIGURE 10
RAS PUMP STATION MODIFICATIONS

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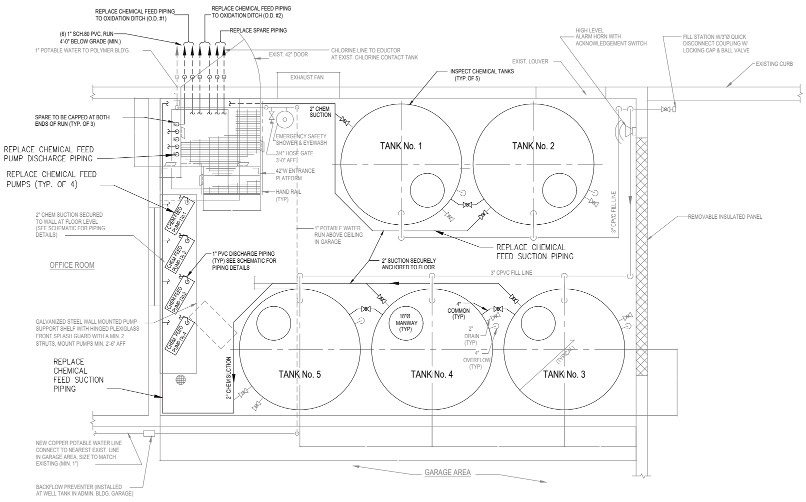

ALUM ROOM MODIFICATIONS PLAN

SCALE: 1/2" = 1'-0"

0 1 2 3 4

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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PLANT UPGRADE STUDY

FIGURE 11
ALUM ROOM MODIFICATIONS PLAN

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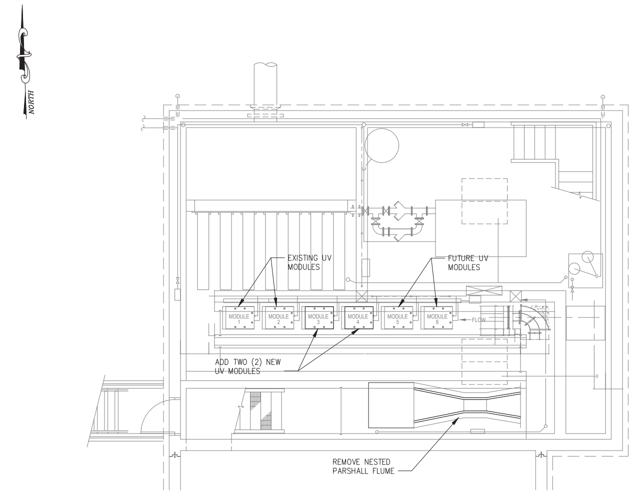

UV DISINFECTION BUILDING MODIFICATIONS PLAN

SCALE: 1/4" = 1'-0'

NOTES:

1. ELEVATIONS INDICATED ARE IN NAVD 88 DATUM.

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PLANT UPGRADE STUDY

FIGURE 12
ULTRAVIOLET DISINFECTION

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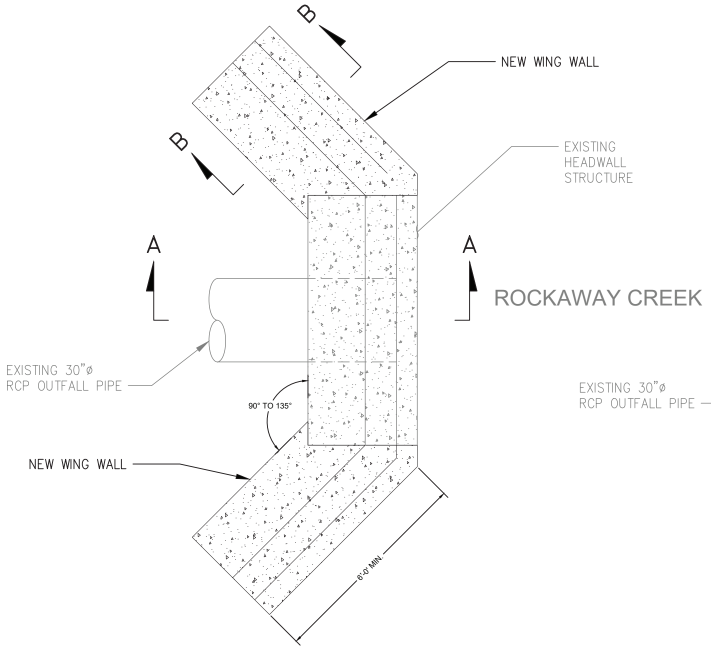
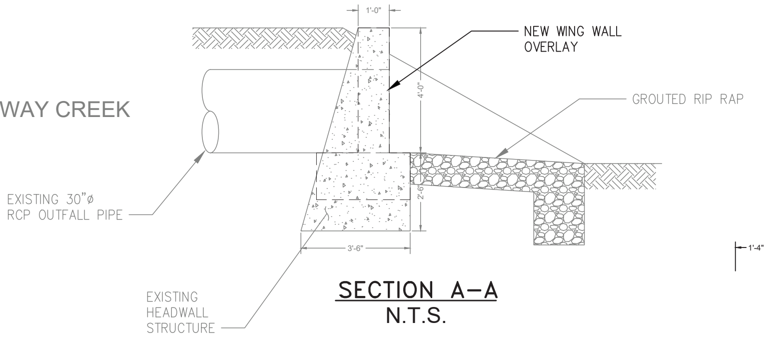
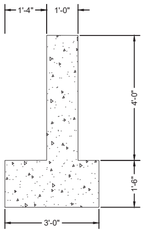


HEADWALL MODIFICATION PLAN
N.T.S.



SECTION A–A
N.T.S.



SECTION B–B
N.T.S.

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FIGURE 13
HEADWALL MODIFICATIONS

DECEMBER 2024
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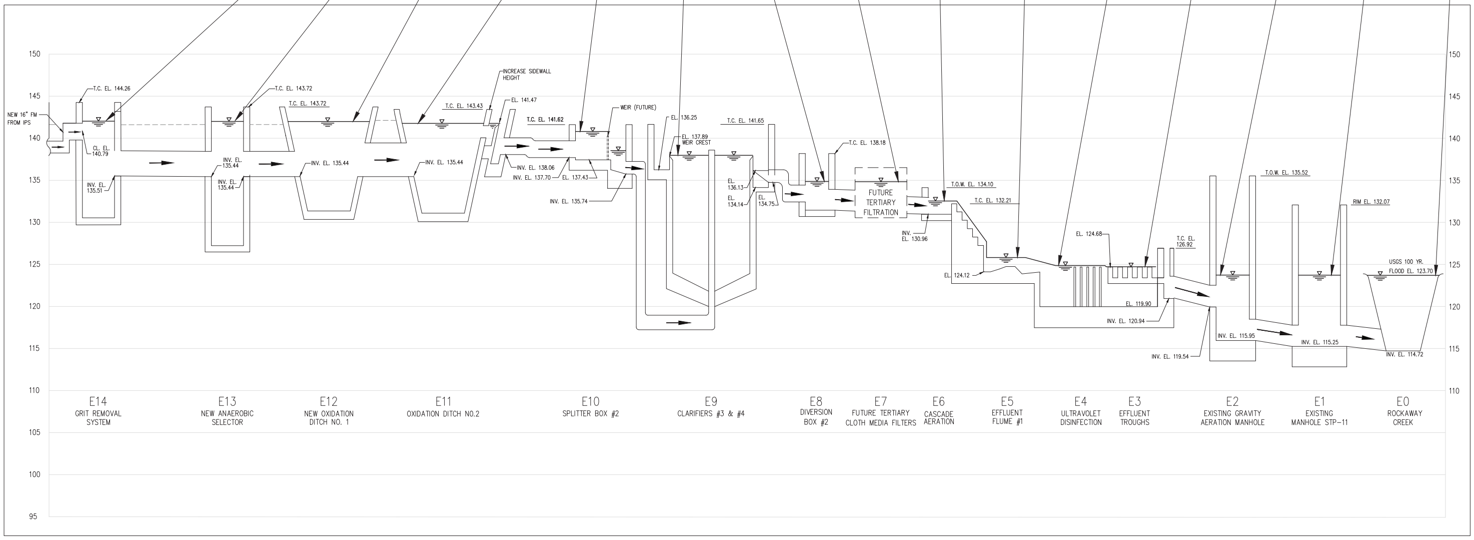
CONDITION	FLOW	GRIT REMOVAL SYSTEM	NEW ANAEROBIC SELECTOR	NEW OXIDATION DITCH NO. 1	OXIDATION DITCH NO.2	SPLITTER BOX #2	CLARIFIERS #3 & #4	DIVERSION BOX #2	(FUTURE) TERTIARY CLOTH MEDIA FILTERS	CASCADE AERATION	EFFLUENT FLUME #1	ULTRAVIOLET DISINFECTION	EFFLUENT TROUGHS	GRAVITY AERATION MANHOLE	MANHOLE STP-11	ROCKAWAY CREEK
ID		E14	E13	E12	E11	E10	E9	E8	E7	E6	E5	E4	E3	E2	E1	E0
Average Flow	1.45 MGD	142.03	142.00	141.99	141.77	138.53	137.97	134.86	134.83	132.54	125.82	124.86	124.72	123.73	123.72	123.70
Peak	5.40 MGD	142.26	142.19	142.12	141.93	139.70	138.02	136.20	135.88	132.96	126.76	126.06	124.77	124.18	123.93	123.70



HYDRAULIC PROFILE

N.T.S.

NOTES:

1. ALL ELEVATIONS SHOWN ARE NAVD 88 DATUM.
2. WATER SURFACE ELEVATIONS SHOWN ARE REPRESENTATIVE OF AVERAGE FLOW CONDITIONS. FOR ALTERNATE CONDITIONS, REFER TO TABLE.
3. WATER SURFACE ELEVATION E10 IS TAKEN UPSTREAM OF MANUAL BAR RACK. MANUAL BAR RACK NOT SHOWN IN THIS FIGURE FOR CLARITY.

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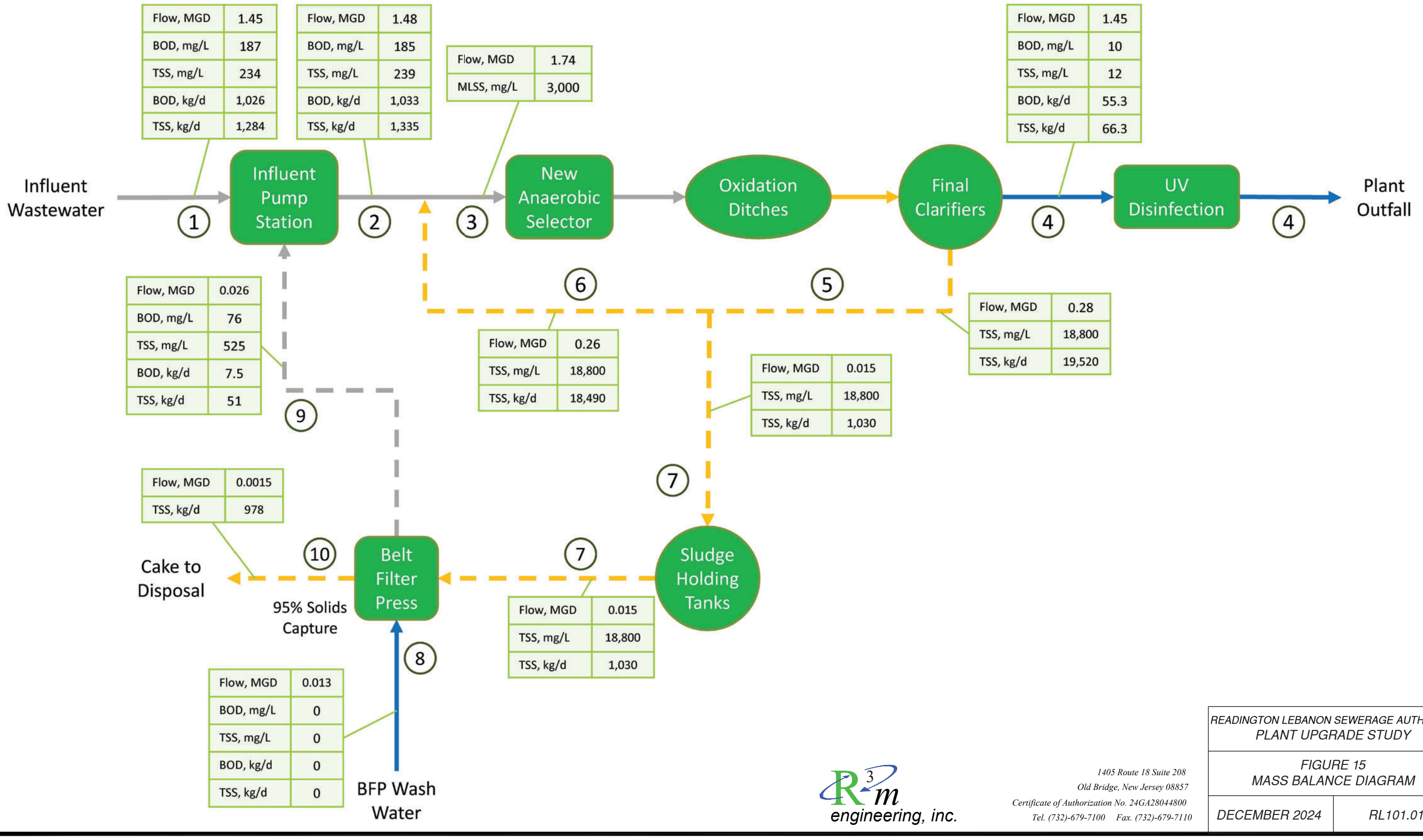
PLANT UPGRADE STUDY

FIGURE 14
HYDRAULIC PROFILE

DECEMBER 2024 *RL101.01*

Process Mass Balance Schematic



Flow, MGD	1.45
BOD, mg/L	187
TSS, mg/L	234
BOD, kg/d	1,026
TSS, kg/d	1,284

Flow, MGD	1.48
BOD, mg/L	185
TSS, mg/L	239
BOD, kg/d	1,033
TSS, kg/d	1,335

Flow, MGD	1.74
MLSS, mg/L	3,000

Flow, MGD	1.45
BOD, mg/L	10
TSS, mg/L	12
BOD, kg/d	55.3
TSS, kg/d	66.3

Flow, MGD	0.026
BOD, mg/L	76
TSS, mg/L	525
BOD, kg/d	7.5
TSS, kg/d	51

Flow, MGD	0.26
TSS, mg/L	18,800
TSS, kg/d	18,490

Flow, MGD	0.28
TSS, mg/L	18,800
TSS, kg/d	19,520

Flow, MGD	0.015
TSS, mg/L	18,800
TSS, kg/d	1,030

Flow, MGD	0.0015
TSS, kg/d	978

Flow, MGD	0.015
TSS, mg/L	18,800
TSS, kg/d	1,030

Flow, MGD	0.013
BOD, mg/L	0
TSS, mg/L	0
BOD, kg/d	0
TSS, kg/d	0

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FIGURE 15
MASS BALANCE DIAGRAM

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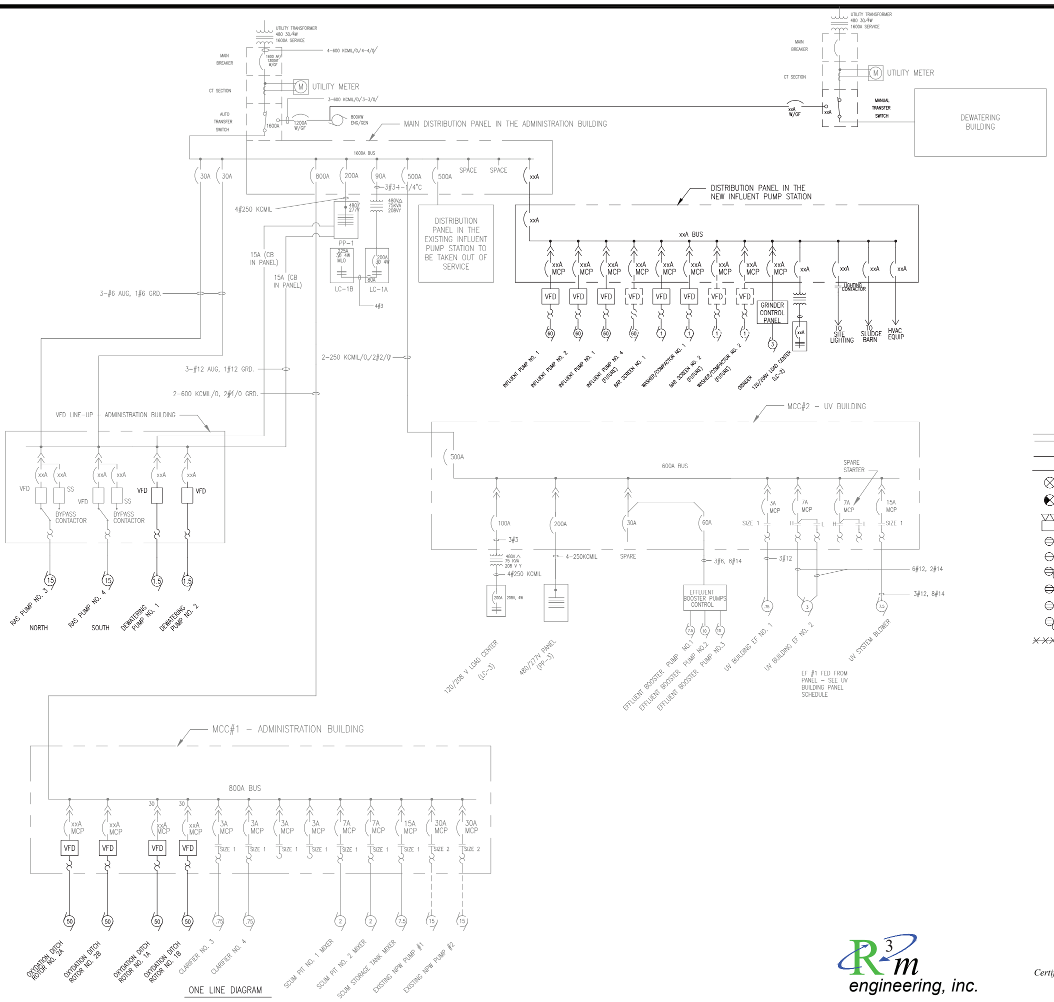

ONE LINE DIAGRAM

SYMBOL LIST

—	EXPOSED CONDUIT		SPECIAL RECEPTACLE – HIGHER VOLTAGE THAN 120V
—	CONCEALED CONDUIT		FLOAT SWITCH
—	GROUND CABLE		DISCONNECT
⊗	GROUND ROD	J OR JBX	JUNCTION BOX
	EXIT SIGN – DARK AREA REPRESENTS EXIT DIRECTION	$#	LIGHT SWITCH – # = CIRCUIT #
	EMERGENCY LIGHT	$3W	3 WAY LIGHT SWITCH
⊖#	DUPLEX RECEPTACLE # = CIRCUIT #	$2P	2 POLE LIGHT SWITCH
⊖#	SINGLE RECEPTACLE # = CIRCUIT #		2#12 IN RACEWAY – ONE HOT AND ONE NEUTRAL
⊖GFCI	GROUND FAULT RECEPTACLE	T OR T	THERMOSTAT
⊖WP	WEATHERPROOF RECEPTACLE		SELECTOR SWITCH
⊖IG	ISOLATED GROUND RECEPTACLE		MOTOR
⊖GFCIP	PROTECTED BY GFCI RECEPTACLE UPSTREAM	SWSV	SEAL WATER SOLENOID VALVE
✕✕✕✕	DELETED OR REMOVED (DEMOLISION)		

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FIGURE 16
PROPOSED ONE LINE DIAGRAM

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