HOWARD SEYMOUR WATER RECLAMATION FACILITY

REDUNDANCY AND RELIABILITY ANALYSIS

Lewes BPW
Electric, Water, and Sewer Utility

PREPARED FOR:
LEWES BPW

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PART 1 - EXECUTIVE SUMMARY

In response to recent overflows at the City of Lewes' WRF, the Board of Public Works (BPW) has requested that GMB perform an analysis of the facility and ways to improve reliability and whether redundancy improvements are necessary.

GMB recommends that the BPW initiate the planning of improvements to its flow equalization system as the two (2) options presented in this report represent a significant capital investment and will likely take some time to investigate and secure funding for the selected improvements

It is recommended that the BPW contract with the secondary screen manufacturer to have the screen inspected by a certified technician to verify that it is functioning properly before proceeding with any efforts associated with a dedicated MLSS Screen. The BPW can reinstate use of the simplistic MLSS screen which was installed by the BPW during the time when the tankage was experiencing coating system delamination.

It is feasible for the BPW to install a redundant permeate/backpulse tank; however, given the recent improvements made with turbidimeter instrumentation together with operation and reporting procedure protocols, the benefits of a redundant tank are lessened. If instrumentation is kept in proper working order and alarm issues are responded to in a timely manner, a redundant permeate/backpulse tank is unnecessary. GMB advises that further discussion on this subject should occur before a final recommendation is made, particularly because there will be challenges associated with installation and operation of the tank.

Lastly, GMB recommends that the BPW arrange for the purchase of those spare parts outlined within this analysis as being critical to the SCADA and PLC systems.

PART 2 - INTRODUCTION

2.1 Background

The City of Lewes' WRF experienced a significant failure in December 2019 which led to the discharge of untreated wastewater. In follow-up to this incident, the Lewes BPW prepared a "Root Cause Report" which included several corrective actions. One of these corrective actions was to perform an engineering analysis of the entire plant to identify ways to improve redundancy and reliability of the plant.

More recently in August 2020 during the information gathering phase of the analysis, there was another spill of wastewater at the facility related to control/alarm issues, this served as the BPW's basis for having Alarm Function/SCADA review added to this analysis effort.

2.2 Objective

GMB was retained to complete this analysis and to identify ways to improve redundancy and reliability in the facility. The BPW's Root Cause Report suggested the analysis include the following, at a minimum:

- Review current screen design to determine if there is a way to remove more of the "soft and spongy" material to reduce filter fouling.
- Potential for flow splitting the four (4) trains to have them operate in a redundant parallel configuration and as independent trains.
- Configuration of turbidity meters to provide better protection against use of dirty water during back flush cycle.

In addition to completing the analysis, GMB will prepare planning level cost estimates for the recommended redundancy improvements including cost/benefit considerations.

2.3 Assumptions

The analysis will be completed based on the full rated hydraulic capacity of the treatment facility, which is an annual average daily flow (ADF) of 1.50 million gallons per day (MGD) based on State Discharge NPDES Permit DE0021512. The analysis will not include any allowances or factors of safety based on the facility or specific unit process currently operating at a capacity which is less than that of design. For completeness of this analysis and for the reader's reference, GMB's understanding is that in the busy resort season Summer months, the facility is currently operating at approximately one-half of the rated capacity.

This analysis is for liquid and biosolids treatment stream processes and does not include the biosolids dewatering process. It should be noted that the BPW is currently underway with a construction project to construct three (3) additional biosolids drying beds. This represents a 43% increase in the surface area to the drying beds (7 are existing), which will aid in alleviating any challenges or issues currently experienced with this unit process.

PART 3 - EVALUATION OF EXISTING FACILITIES

3.1 Howard Seymour Wastewater Reclamation Facility

The existing treatment facility has been evaluated based on contract record drawings and GMB's first-hand knowledge of the facility in serving as the engineer or record for its design and construction. The hydraulic design criteria for the facility are as follows:

- Average Design Flow = 1.50 MGD
- Peak Instantaneous Flow (PS 4 & 8) = 3,055 GPM (4.4 MGD)
- Maximum Daily Flow (24 Hours) = 2.25 MGD
- Maximum Monthly Flow (24 Hours) = 1.80 MGD

3.2 Headworks Facility

The headworks facility includes screening, grit removal and flow equalization. Raw wastewater enters the plant under pressure flow via force mains.

Primary Screen & Grit Removal

All flow enters an open channel leading to a self-contained 5mm mechanical screen which is then followed by an open channel forced vortex grit removal unit. Both of these processes have a peak flow rated capacity of 4.4 MGD, matching that of the peak instantaneous flow to the facility, and they include open channel bypasses around the respective unit process. The bypass channel around the primary fine screen (5mm), includes a 1-inch coarse bar screen which is manually cleaned during bypass events. The primary fine screen is consistent with the fine screen opening size provided at most activated sludge treatment facilities, with 6mm (1/4 inch) being typical. Screening to too small of a size in this first screening step can lead to operational challenges with the screening equipment. The primary fine screen at the facility employees mesh openings in a band screen configuration, both are known for being very efficient in removing material. Use of the manual bar screen in the bypass channel should be minimized as this screen is not very effective in removing material, but is satisfactory for short term use during primary fine screen service work or if the screen is inoperable for a short period of time.

Generally speaking; fine screens and forced vortex grit removal systems are very reliable pieces of equipment and typically do not completely fail provided they are maintained as prescribed by the manufacturer. Additionally, the treatment function of these single train pieces of equipment can be supported in some ways by the downstream unit processes for short periods of time, as described further below under Flow Equalization. Associated with both the screen and grit system are ancillary equipment for handling of material removed by these unit processes. If these ancillary pieces of equipment were not functional for short periods of time, it would prove to be challenging from an operations perspective; but it would not impact the treatment of the liquid stream. During GMB's inspection of the facility, it was not possible to view the screen surface nor the screen's placement in the channel as both require extensive removal of panels and hardware to view. Therefore, GMB is unable to comment as to the screen's proper operation to remove material.

Flow Equalization

Following primary screening and grit removal, wastewater is freely discharged to a single flow equalization tank. It should be noted that there are provisions in the headworks structure to completely bypass the flow equalization tank and convey flow to the lower level of the headworks structure; however, this should only be done in critical instances and when the flow conveyed can be managed. The flow equalization tank also accepts a pumped discharge of plant recycle flows from the Plant Recycle and Emergency Storage Tank. The intent of the equalization tank is to provide a more homogenous blend of wastewater to the downstream biological treatment process, which has had the diurnal flow variations dampened and also ensures that the maximum flow conveyed downstream is no greater than 2.25 MGD. The 81-foot dia. open top bolted steel flow equalization tank has a glass fused coating and nominal capacity of 500,000 gallons based on a side water depth of 13.4-feet. The volume of the tank represents approximately 33% of the design ADF and is configured in an "on-line" arrangement whereby all flow must enter this tank before being pumping to the downstream unit process.

Based on the condition evaluation performed by Mumford-Bjorkman Associates, Inc. and report dated April 4, 2020, the tank (constructed circa 1987) is estimated to be nearing the end of its expected service life and since this style tank is not designed for rehabilitation and repair, the BPW should begin planning for its replacement in the next five (5) years. Given how critical it is that flows to the facility are equalized before being conveyed downstream, the flow equalization tank is an area of key concern to the reliable operation of the WRF. Associated with the flow equalization tank are two (2) 15-HP submersible mixers and one (1) 15-HP submersible aerator/mixer, the devices are essential and all three (3) are needed to properly mix and aerate the tank contents. However, their operation is not critical, and the tank can operate for short periods of time if one (1) of the mixers/aerators fails. The flow equalization tank can also serve as a make-shift sedimentation tank in the event that either the primary screen or grit removal system are out of operation for a short period of time. This will ensure that the downstream treatment process is not inundated with inorganic matter and debris. However, in the event the primary screening or girt removals operations are bypassed, it will be necessary to utilize a vac-truck to remove any material which settled out in the tank.

Equalized Flow Pumping

Preliminarily treated wastewater is removed from the equalization tank via three (3) dry-pit, self-priming, non-clog centrifugal pumps. The pumps operate in a lead-lag-standby configuration with two (2) duty pumps able to convey 2.25 MGD. The pumps share both common suction and discharge piping manifolds. The operation of this system is critical to the facility's treatment of wastewater. The pump system has sufficient redundancy and has proven to be very reliable as currently installed and operated.

Secondary Screening

The flow equalization pumps convey equalized flow to the lower level of the headworks structure for secondary screening. There is an open channel leading to a self-contained 2mm mechanical screen which serves as a secondary screen to remove fine matter such as hair and fibrous material, which would accumulate downstream on the hollow fiber membranes in the activated sludge treatment process. The screen has a peak flow rated capacity of 2.25 MGD and includes an open channel bypass around the unit process. The secondary fine screen employees mesh openings in a band screen configuration. As noted previously, band screens are very effective in removing material as they are oriented such that whenever the screen is in contract with the flow stream, it always has the force of flow on the screen face. However, similar to all in-channel screens, the seals between the screen and channel wall must be in full contact to prevent wastewater from passing around the screen surface. There is uncertainty whether this screen is operating efficiently as the BPW's Root Cause report identified that a significant amount of material has been found to accumulate on the membrane units. Given the critical operating nature of this screen, and no means to mitigate the accumulation of hair downstream, it is not advisable to bypass this treatment unit for any significant period of time. Despite this screen being a single unit and extremely critical, it would be atypical for a facility the size of Lewes to have two (2) units operating in parallel. Instead it would be advisable to have any necessary spare parts on hand to ensure downtime during failures is kept to an absolute minimum.

Similar to the primary screen, during GMB's inspection of the facility it was not possible to view the secondary screen surface nor the screen's placement in the channel as both require extensive removal of panels and hardware to view. Therefore, GMB is unable to comment as to the screen's proper operation to remove material and GMB recommends that the BPW contract with the screen manufacturer to have both screening systems inspected by professionally.

3.3 Membrane Bioreactor (MBR) Treatment Process

Biological Treatment Tankage

Screened and equalized wastewater flows via head pressure from the headworks structure to the splitter box at the beginning of the MBR activated sludge process. The splitter box evenly divides the wastewater between two (2) process trains. The biological treatment trains are divided into a series of anoxic and aerobic zones to accomplish the removal of soluble organics and nutrients. The treatment trains are redundant in that there are two (2), but both trains must be in service to accomplish the design effluent water quality parameters at the design flows. However, if either treatment train is out of service, the in-service train is able to hydraulically pass the design flow but the effluent water quality results would be compromised from the design parameters. This is typical for facilities the size of Lewes due to cost, it's not until much larger capacity facilities where treatment trains are configured as N+1 where "N" is the number of treatment trains necessary to achieve design level water quality treatment. The need to remove a treatment train from operation for service is very infrequent and such an operation can usually be planned since it typically done so in association with servicing of the diffused aeration system.

Other key components of the treatment train (submersible mixers and pumps) are retrievable with the train(s) still in service, these pieces of equipment are simplex in nature; therefore the facility should have one (1) shelf spare unit for each type of mixer and pump, with each shelf spare unit able to be shared by the treatment trains. There are three (3) aeration blowers associated with the treatment trains, two (2) duty blowers and common standby blower. The operation of the blowers is critical to proper treatment train operation, the blowers as currently installed have sufficient redundancy to serve the system. There are also three (3) chemical systems associated with the treatment process, these systems are for sodium hydroxide, aluminum sulfate and MicroC. These chemical systems are essential to the treatment system being able to achieve the tertiary treatment standards of the discharge permit but are not critical to basic facility operation and reliably processing all flow which enters the system.

Membrane Tankage

Downstream of the two (2) treatment trains is a common channel which receives the mixed liquor from both treatment trains to maintain one (1) common mixed liquor across the entire biological treatment system. Each treatment train can be isolated from the channel so that the channel can remain in service if either treatment train is removed from service. The common channel distributes the mixed liquor to four (4) membrane trains, with each membrane train being able to be isolated from the common channel and operated independent of the others. Each membrane train contains three (3) membrane cassettes, with room for installation of a 4^{th} cassette. Each membrane cassette contains forty (40) ZW-500d membrane modules, for a total of 120 modules in each train. Each membrane cassette is capable of holding a maximum of forty-eight (48) modules, for a total train capacity of 192 modules if the 4^{th} cassette is installed.

Each membrane train is served by dedicated primary recirculation and permeate pumps. Each pump is critical to the operation of the membrane train it serves; accordingly, the facility should have at least one (1) shelf spare of each type pumping unit. Each membrane train represents 25% of the facility's hydraulic capacity, therefore it is essential that all membrane trains remain in service at design flow conditions. Since there are three (3) membrane cassettes in each membrane train, that affords some level of redundancy for each membrane train. Accordingly, if one (1) entire membrane cassette were out of service, that membrane train's capacity would be reduced by 33% and the overall facility capacity reduced by approximately 8%. Typically, an entire cassette is not taken out of service permanently due to a faulty membrane module. Instead, the cassette is removed from service to allow the module to be manually removed from the cassette and then the remainder of the cassette can be placed back in service. Due to this possibility, just a fraction of the membrane train's capacity is impacted.

Membrane Cleaning

Cleaning of the membrane units is accomplished at planned intervals and requires complete removal of a membrane train from service. The membrane system affords adequate redundancy to complete this operation provided that it is not performed during peak flow event conditions. The sodium hypochlorite chemical system associated with the cleaning of membranes is comprised of two (2) systems, one for recovery cleans and another for maintenance cleans. Each system is comprised of a single bulk storage chemical tank and two (2) chemical feed pumps dedicated and duty and standby. Both cleaning system are crucial to proper membrane operation; however, recovery cleans are planned and very infrequent whereas maintenance cleans occur very regularly. Therefore, reliable operation of the maintenance clean system is deemed critical and must always be operable. To provide this redundancy, the sodium hypochlorite tanks are plumbed in parallel. There is also a citric acid chemical system associated with recovery cleans of the membranes, the system has a single tank and duplex pumps and has adequate redundancy considering its designed use.

There are five (5) aeration blowers associated with the membrane trains, four (4) are potentially duty blowers at certain conditions and one (1) is a standby blower. The operation of the blowers is critical to proper membrane train operation, the blowers as currently installed have sufficient redundancy to serve the system.

Backpulse/Permeate Tankage

Permeate pumps discharge effluent to single backpulse/permeate storage tank. This storage tank serves as a reservoir to ensure an adequate volume of treated effluent is available to backpulse the membrane units. Based on as-built drawings of the facility, it is calculated that the tank has a gross nominal volume of 4,000 gallons, but the elevation of the permeate supply/return piping results in a lower net/usable volume for the tank, which GMB estimates to be 2,700 gallons. The tank is open to the atmosphere and its maximum operating level is maintained via a weir. It was observed at GMB's site visit that during backpulse events the tank drains to a point where effluent ceases to freely discharge as the tank level is lowered below the discharge weir elevation. Hence during backpulse events under normal flow rates, the backpulse rate (effluent being used) is greater than that of the treated effluent being permeated by the other membranes in service.

During GMB's visit, WMES noted that there is a low level alarm to ensure that the storage tank level is not lowered too much and that if two (2) membrane trains were to attempt to backpulse at the same time, there would not be adequate effluent in the storage tank. According to WMES, this situation can develop if two (2) membrane trains are in standby at the same time and if flow into the reactors increases thereby calling for both trains to activate at the same time. Based on GMB's review of the Zenon O&M manual, the PLC should allow only one (1) membrane train to backpulse at a time. The matter should be explored in more detail with Zenon if further investigation indicates WMES' suspicions are correct.

There is a 1,255-gallon non-potable (process) water (NPW) tank adjacent to the storage tank. The primary purpose of the NPW tank is to supply NPW for facility uses, which largely consists of wash water at the headworks. However, there is a 1.25" non-potable water line which is routed into the backpulse/permeate storage tank and the line includes a solenoid operated valve to control the release of process water into the storage tank. GMB's understanding is that this is a safety measure to prevent over-draining of the storage tank during backpulse events when flow thru the facility is low. This feature should be explored further to ensure that it is functional, if needed.

3.4 Ultraviolet Light Disinfection

From the permeate/backpulse tank, effluent is conveyed via head pressure flow to an open channel flow ultraviolet light (UV) disinfection system. The disinfection system is configured as a single channel with two (2) UV banks in series, with each bank having four (4) modules and each module containing four (4) lamps. Each UV bank is powered from a dedicated electric breaker in MCC 4. The system is designed to disinfect treated effluent up to a peak discharge rate of 3.0 MGD and the UV dose employed varies based on the flow rate entering the system. The system also implements automated cleaning of UV bulbs to ensure optimum transfer of UV light to the flow stream; there is a single hydraulic system powered by a single electrical breaker which accomplishes the cleaning for both UV banks . The operation of UV systems has been found to be extremely reliable and this disinfection technology is frequently utilized in the industry. It is feasible to service UV modules for lamp replacement while the bank remains in service and only one (1) module is removed at a time. If one (1) bank were completely removed from service, the system would still be able to completely disinfect the facility's design ADF rate (1.5 MGD). It should be noted that the influent design parameters for the treated effluent entering the UV channel are quiet conservative over what the actual parameters are, it is possible that a single UV bank is able to disinfect the facility's peak discharge rate (2.25 MGD) at actual field conditions as this rate is only 50% greater than the peak design capacity for each bank. Although not recommended, it has been found that many treatment systems which employ membrane technology for separation of suspended solids from the treated effluent, are able to achieve the facility's disinfection treatment limits immediately following the membrane filtration process as the membranes filter down to such a fine level.

Once disinfected, treated effluent enters the outfall sewer and is conveyed via gravity flow to the outfall point in the Lewes-Rehoboth Canal. The outfall sewer presents a single point failure opportunity; however, this is deemed to be a very low risk.

3.5 Plant Recycle and Emergency Storage Tank (PREST)

The PREST's primary purpose is to serve as an emergency storage tank for overflow from the Primary Flow Equalization Tank, thereby expanding the raw wastewater flow equalization capacity of the facility. It also serves an overflow for the influent splitter box which introduces pretreated wastewater to the biological treatment tankage. The PREST is a repurposed primary clarifier that is constructed of concrete and has an internal diameter of approximately 45-feet and maximum side water depth of 11-feet, equating to a volume of approximately 130,000 gal. As a significant portion of the PREST is situated below grade, any wastewater entering the tank needs to be pumped to the headworks to be reintroduced back into the liquid treatment flow stream. There is a duplex pumping station (duty/stand-by) which conveys flow and the pump station has a listed capacity of 375 gpm (0.54 MGD). The PREST does include provisions for mixing and aeration of its contents as well. The normal condition for the PREST is to be off-line and empty. The PREST is an important feature to the facility; however, it is not critical to the facility's operation.

3.6 Membrane Thickened Aerobic Digester (MBT)

Waste activated sludge (WAS) is discharged through a dedicated force main from the MBR process to the digester tankage (specifically anoxic tank) via a motor operated valve located on the MBR's manifolded primary recycle force main. The WAS concentration is approximately the same concentration as the MLSS, which should be around 1% (10,000 mg/l). The MBT (digester) consists of an "in-loop" system comprised of an anoxic tank, membrane tank and aerobic digester. There is also a side-line aerobic digester tank that receives digested sludge when it is discharged out of the in-loop aerobic digester. The system is designed to thickened sludge up to a concentration of 3% (30,000 mg/l) in order to achieve Class B stabilization of biosolids. However, biosolids at the facility are disposed of at a landfill, therefore the MBT system can be operated at a sludge concentration of less than 3% since landfill disposal does not require Class B stabilization standards. However, the system does need to be operated at a solids concentration which is high enough to provide the biosolids drying beds with an adequate solids loading rate (lbs/sf) to maximize the amount (lbs) of biosolids dewatered during each bed dewatering cycle. Based on GMB's experience with porous asphalt drying beds, it is expected that the capacity of the beds can be maximized with a digester solids concentration of approximately 1% (10,000 mg/l). Application of a sludge on the bed surface which is "thinner" than this would lead to inefficient solids loading (lbs/sf) as the loading would be diminished since the wall height of the bed would limit the mass of sludge applied to the bed surface.

The membrane thickening system consists a single permeate pump and two (2) membrane cassettes operating in parallel. The air scouring system associated with the membranes utilizes a small amount of air from the aerobic digester blowers. Based on the above assessment, the membrane thickening feature of the MBT is deemed to not be critical to facility operation and it is feasible for this system to be out of service for reasonable periods of time. What is critical to the digester system is reliable operation of all components needed to keep the in-loop and side-line tankage operational and flowing. The digester system includes redundant pumping and aeration equipment and the air-lift pump which initiates flow for the in-loop tankage is very simplistic and easy to keep in service continuously. The submersible mixer located in the anoxic tank should be supported by a redundant shelf spare unit.

The membranes are removable; however, the membrane tank must be taken out of service and dewatered to access and remove either membrane cassette. When the membrane tank is out of service, this prevents WAS from being conveyed to the in-loop digester tank, which in turn could hinder WAS operations. Typically, operators are able to accommodate such an interruption in service by holding/building MLSS in the biological reactor. If this is not possible, a 3-inch trash pump can be used to transfer WAS from the anoxic tank to the digester tank(s) while the membrane tank is out of service.

3.7 SCADA System

The treatment plant SCADA system consists of the Main Terminal Unit (MTU) and four (4) associated Remote Terminal Units (RTUs).

- RTU-1, located in the Headworks facility, monitors the Gorman Rupp equipment. It also monitors the EQ Tank, Mixers, Grit Removal and 5mm screen.

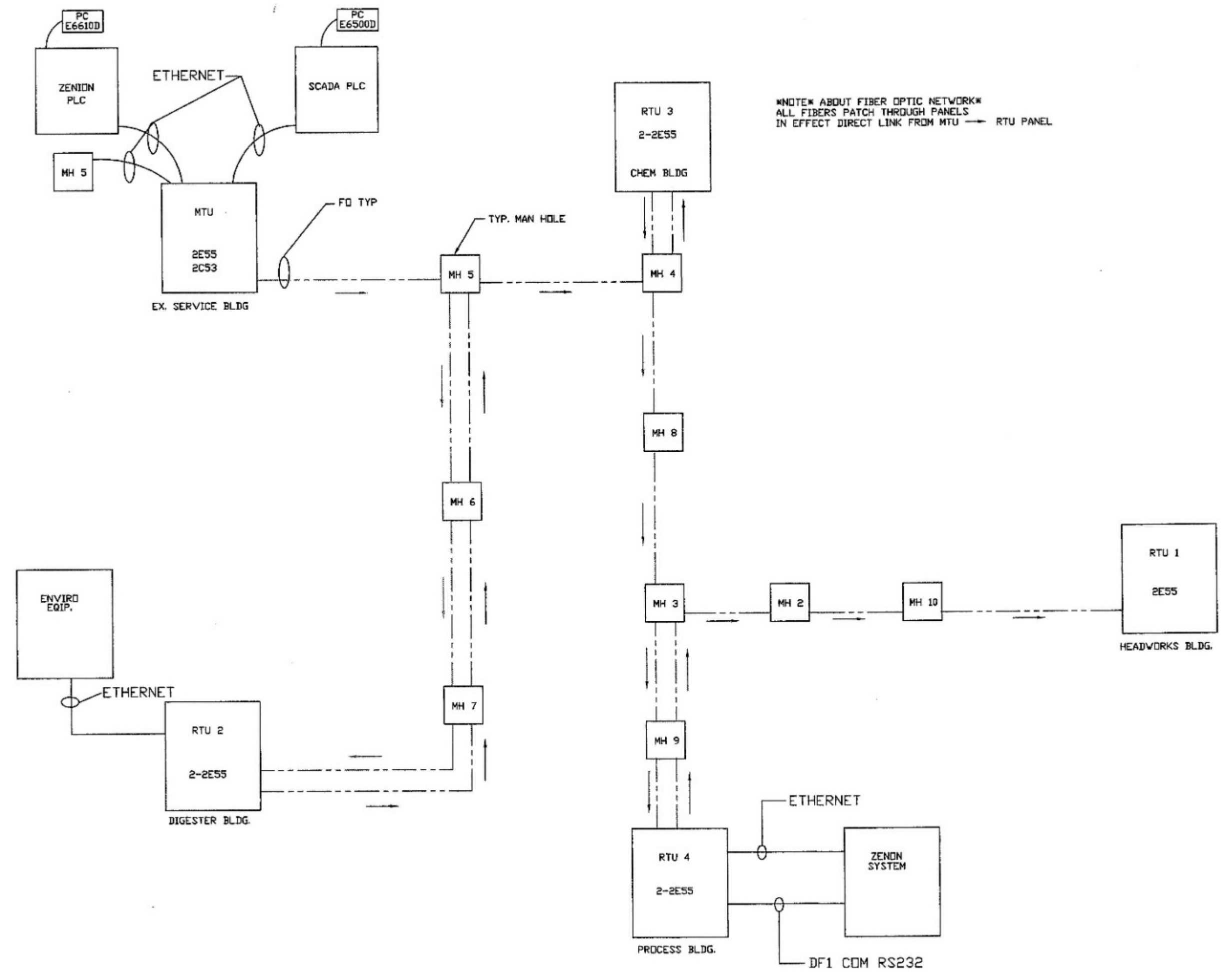
- RTU-2, located in the Digester Building, monitors the pumps in the building and blowers. A network switch is installed, which allows connection to the Enviroquip Digester. From this location an “OK to waste” signal is sent to RTU-4, which is sent to the Zenon System.

- RTU-3, located in the Chemical Building, monitors the Emergency Generator alarms, Recycle Pumps, manholes, and old EQ Tank.

- RTU-4, located in the Process Building, monitors the Zenon system. The PC installed at this location provides as close as possible a copy of the Zenon HMI. RTU-4 only monitors the Zenon train system. It also monitors the alarms from the Zenon system. Currently, this PLC is being upgraded from an Etherlogic controller to a Schneider M340 PLC. This work is being completed by Keystone Engineering Group.

The MTU, which is located in the Service Building, monitors I/O associated with the wastewater treatment plant system. The MTU has a touchscreen display on the front of the panel to allow operators to view each screen associated with the SCADA system. The SCADA PC is located at this site. The SCADA PC allows the operator to view all I/O which has been connected to the SCADA system. Changes to selected control functions will typically be entered from this location by authorized personnel only. The access code entered by an operator when they log onto the system will determine the level of access they have to the SCADA system. Some can view only while others have the ability to change the operating parameters for a particular function. The SCADA system screen on the PC and HMI provides a view of trending and alarms which have been programmed into the system. The ScadaPhone alarm system is also installed in the Service Building. The ScadaPhone monitors alarms which have been programmed into the system. Alarms are called out over the telephone system after-hours on a pre-determined schedule to the appropriate operator as determined by the Superintendent. The operator receiving the call will acknowledge the alarm. During working hours alarms are acknowledged on screen. In addition to the MTU and SCADA PC, the Zenon PC is also located in the Service Building. The Zenon PC is currently interfaced to the SCADA system so that the SCADA system functions as monitoring system only and has no control of any of the devices associated with the Zenon system. A communication system is installed inside the new Zenon control panel that allows outside connection by operators and manufacturer representatives.

SCADA Schematic Diagram



Critical SCADA Components

All control panels contain PLCs, I/O modules, Ethernet switches, fiber optic modems, power supplies, UPS battery backup, surge protectors, circuit breakers and control relays. Many of the same components are installed in each panel. The SCADA MTU, Enviroquip and Zenon panels each contain human machine interfaces (HMIs).

Electrical surges, due to storms and/or power supplier issues, can cause component failure at any given time. For this reason, GMB recommends, at a minimum, having at least one (1) spare item of each critical component. Table 1 details known critical components and their respective budgetary costs.

Table 1

COMPONENT	BUDGETARY COST
FIBER OPTIC MODEM	$2,500
ETHERNET SWITCH	$400
GENERAL PURPOSE MIDGET RELAYS (ONE OF EACH KIND)	$200
IDEC HMI	$1,500
24VDC POWER SUPPLY	$200
MAXIO I/O MODULES (D/O, DI)	$500
ETHERLOGIC ULTIMA PLC	$3,000
ETHERLOGIC ULTIMA I/O MODULES (A/I, D/O, D/I, A/O)	$1,000
UPS BATTERY BACKUP	$750
GND SURGE PROTECTIVE DEVICE	$250
ALLEN-BRADLEY PLC	$1,800
ALLEN-BRADLEY I/O MODULES (AI, D/O, D/I, A/O)	$2,000
ALLEN BRADLEY HMI	$3,000
SCHNEIDER M340 PLC	$1,500
SCHNEIDER M340 I/O MODULES (AI, D/O, D/I, A/O)	$2,800
TOTAL	**$21,400**

Since control systems are continually evolving, many of the existing SCADA system components are likely obsolete. GMB recommends using upgraded components that will work in the existing system with as minimal reconfiguration as possible. GMB and a qualified system integrator can determine the equivalent component.

Most of the processes at the treatment plant run in automatic mode by design. Manual operation is usually not practical. It can be challenging to locate a replacement component when needed. It is important to have spare components at the treatment plant ready to replace a failed component at any time to lesson downtime and prevent overflows and NPDES permit violations. This applies to VFD’s as well.

PART 4 – IMPROVEMENT CONSIDERATIONS

Plant Recycle and Emergency Storage Tank (PREST)

To increase redundancy in the facility, one idea that has been proposed is to revert this structure back to being a primary clarification process. It is assumed that in this arrangement, the clarification process would only be utilized under an emergency situation, whereby the membrane treatment system was either inoperable or could only treat a limited amount of flow, and at all other times the tank would function as it currently does. A primary clarifier would provide some basic level of treatment (60% TSS and 33% BOD removal) and its effluent would flow via gravity to the facility's outfall. Disinfection of the effluent would not occur unless a separate chemical (chlorine) based unit process was constructed. Disinfection of the effluent by the existing UV system is not possible hydraulically, nor from a technical standpoint, as primary clarifier effluent is too "dirty" for UV light to disinfect properly.

As a primary clarifier, flow would enter the structure once the primary equalization tank was full; and then once the primary clarifier was filled with wastewater, the clarifier mechanism would be turned on and operate as a primary clarifier. As noted earlier, effluent from the primary clarifier would flow by gravity to the facility outfall via a new pipeline which would need to be constructed. Given the tank's 45-foot diameter, the corresponding surface area is 1,590 SF. The typical industry standard hydraulic loading rate for primary clarifiers under normal conditions is 1,000 gpd/sf. Accordingly, the primary clarifier could effectively treat to primary treatment levels (those noted earlier) a flow rate of approximately 1.5 MGD. During the mid-1980s improvements to the facility when this structure was converted from a primary clarifier to a flow equalization tank, the 16-inch feed piping to the center well of the structure was cut and capped at the structure's perimeter and the center well of the clarifier filled with concrete. Considering that this pipe has been abandoned under the structure for nearly 30 year and that the pipe was installed in the 1960s when the structure was built (+55 year old), a new feed pipe under the structure would need to be installed. Consider this, along with the age of the structure and limited benefit of only partially treating and not disinfecting effluent, it is GMB's opinion that benefits of such an improvement for facility redundancy are far outweighed by the cost and accordingly this option should not be explored further. We do however believe that the structure is adequate to continue to serve its current purpose (emergency EQ tank); but investing additional capital into this structure is not recommended.

For completeness of the analysis, it should be noted that use of this structure as a secondary clarifier in conjunction with the biological tankage (membranes are inoperable), is not feasible as the side water depth of the structure (11-ft) is inadequate for separation of MLSS from treated effluent and too may solids would carry over in the effluent.

Secondary Fine Screen

It has been observed that stringy material is accumulating on the membranes in the MBR, hence it is hypothesized that a finer mesh for the secondary screen would remove more material and allow less material to travel downstream. GMB has researched its contract files from when the MBR facility was constructed and also discussed the subject with Ovivo/Bracket-Green (screen manufacturer) and determined that the secondary screen was originally designed and installed as a 1mm screen. However, during start-up of the facility, it was found that the 1mm screen mesh openings were too fine, and they would not work hydraulically. Accordingly, the 1mm mesh panels were replaced with 2mm mesh panels. This change was reviewed and approved by the membrane system vendor (Zenon).

There are many MBR facilities in operation with 2mm screens that do not have an accumulation of stringy material on the membranes in a normal timeframe between mechanical cleaning of the membranes. Based on discussions with the screen manufacturer, it is suspected that the secondary screen may either have seals which are not properly seating with the concrete channel walls, or bushings on the mesh panels have stretched which creates a gap between the mesh panels. Both of these items would result in material bypassing the screen. It would be most beneficial to have a technician of the manufacturer visit the site to inspect the current condition and operation of the screen to verify that everything is proper. According to the manufacturer, the cost for such a visit would be approximately $3,500. GMB's recommendation is to first have the screen properly inspected by the manufacturer prior to exploring any improvements to either headworks screen.

It should be noted that in discussing the matter with the screen manufacturer, they inquired on use of grinder pumps in the City's sewer collection system. The manufacturer's experience is that grinder pumps yield very small material which is difficult for the screen to capture. This material can then combine and "weave" itself into a stringy type matter in the aeration basin. Review of the sewer collection system and associated pumps is beyond the scope of this analysis; however, it is recommended that this subject be explored in more detail.

MLSS Screening

To aid in removing stringy material entering the membrane tank, before it can accumulate, an option would be to screen the MLSS. A small stream of MLSS can be screened continuously; due to the high rate of recycle pumping within the Membrane and Biological Tankage, the supply point of MLSS could be just about anywhere in the process and be effective. To minimize the cost of the screening equipment, the flow rate of the MLSS stream entering the screen could be as low as 200 gpm and that rate would be able to screen the volume of the entire tankage four (4) times per week.

There are may screening options which can be evaluated, the most economical will be a tank-based screen whereby the screen is situated in a pre-engineered stainless-steel tank. It is recommended that the screen be located in the Process Building to avoid concerns with freezing. The screen would need to be elevated higher than the process tankage to allow for flow to renter the tankage under gravity flow conditions. To ensure that the MLSS across the entire tankage is screen, the supply to the screen should either come from the common channel feeding the membrane tanks or from the common manifold discharge piping of the primary recycle pumps. In exploring this option, GMB took a conservation approach and requested pricing for a robust packaged fine screen which included a spray wash system (NPW) for the screen surface and a washer/compactor unit for processing/handling of screenings removed. The technology which GMB explored was an internally fed rotary drum screen, these screens are routinely used for screening raw wastewater at small MBR facilities as they are available as package units and are very effective in removing fine matter. Screens technologies/options are available which do not require screen surface wash water and also do not require a washer and compactor unit; however, these technologies would need to be explored further to ensure that they would meet the BPW's expectation for a fully functional system. A construction cost estimate and sketch showing a possible location for the screen are included in the Appendix for review.

As noted in the preceding Secondary Screen section, GMB's recommendation is to first have the existing headworks screen properly inspected by the manufacturer prior to exploring additional screening options. In the interim, the BPW can reinstate use of the simplistic MLSS screen which was installed by the BPW during the time when the tankage was experiencing coating system delamination.

<u>Flow Equalization Tank</u>

As described above in the Evaluation of Existing Facilities section, the existing flow equalization tank is nearing the end of its expected service life and oriented in the flow path such that it must be operational at all time (at facility design capacity), but there is no way to remove it from service for maintenance and still maintain a significant level of flow equalization capability. Accordingly, GMB recommends that the BPW begin planning for the replace of the existing tank. Given the proximity of the existing tank to the headworks structure and how the ultimate height of the tank is limited by the headworks overflow point and foundation of the existing tank; GMB recommends that the BPW replace the tank in kind. Given that facility experiences seasonal flow variations together with flows being significantly less than the design capacity, it is feasible under the current conditions to have the flow equalization tank removed from service (for replacement) during the wintertime for a period of several months. Provided that peak instantaneous flows to the facility do not exceed 2.25 MGD, the facility is capable of fully screening and passing the flow through the MBR system. It is feasible to utilize the PREST for flow equalization of flow entering the process tankage; however, temporary piping modifications would be necessary. Refer to Part 5 and the Appendix of this report for estimated costs associated with replacement of the existing tank.

In addition to replacement of the existing tank, GMB also recommends that the BPW plan for the construction of a secondary flow equalization tank that can be operated off-line or in parallel with the existing tank. This will provide much needed redundancy for this unit process as the facility nears its design capacity. Unless an additional pumping step were included, the height of the secondary tank would need to match that of the existing tank to support flow hydraulics. For the purpose of this report, it has been assumed that the capacity of the proposed tank will match that of the existing and the proposed tank will be located on the site immediately west of the existing tank. Refer to Part 5 and the Appendix of this report for estimated costs associated with the proposed tank and a sketch indicating the location.

Note that in the near future (under current flows) it is feasible to construct either option and then construct the other option sometime later as one (1) of the two (2) tanks would be available to equalize the higher flows the facility will experience in the future.

<u>Redundant Backpulse/Permeate Storage Tank</u>

As described in the BPW's Root Cause Report, in the event that the storage tank becomes contaminated, it will lead to the introduction of this dirty water into the interior of the membranes during a backpulse event. The creates a disastrous scenario whereby the permeability of the membranes will fail quickly and stop the flow of treated effluent completely.

During GMB's site visit of the facility, it was discovered that the storage tank has never been dewatered and inspected for an accumulation of solids. Should there be solids accumulated in the bottom of the tank, if an event occurred which placed these solids into suspension, this could lead to the introduction of contaminated water into the membranes during a backpulse event. Accordingly, GMB recommends that the BPW arrange to have the storage tank dewatered and inspected for solids and cleaned if appropriate. The bidirectional basket strainer on the permeate supply/return piping should also be inspected.

The BPW has requested that GMB explore the option of a redundant backpulse/permeate storage tank. The idea is proposed to allow for a secondary option to store permeate for backpulse events should the primary tank become contaminated. It would be essential for the secondary tank to remain out of service (not operated in parallel) unless needed; otherwise, it too could become contaminated during the upset event. For the secondary storage tank alternative to work, it too would need to connect to the permeate supply/return pipe at the exterior of the existing tank and also have its discharge connect to the permeate overflow well upstream of the effluent flow meter and UV disinfection system. Furthermore, the overflow elevation of the tank would need to be elevation 18.00 or greater and the tank would need to have a nominal capacity of at least 4,000 gallons. To accomplish this, a large vertical tank can be situated at ground level, inside the Process Building, at the south end of the UV disinfection structure. To maintain accessibility to the building through the existing 10’-0” wide coiling door, the tank could have a relatively small 7’-6” outside diameter and overall height of 16’-6”, with a gross capacity of 4,900 gallons. Refer to the attached sketches at the end of this report for an overview of how the tank can be incorporated into the facility. It should be noted that the connection of the secondary tank to the existing permeate supply/return piping will prove to be very challenging and it may be necessary to rework the installation of the non-potable water pump. Part 5 and the Appendix include installation cost information associated with this option.

<u>Tubidity Meters</u>

As noted earlier, the BPW recently replaced the online turbidity meters at each permeate pump and installed Hach Tu5300 sc units, which is Hach’s most advanced Turbidimeter. The units have an approved reading range by EPA of 0 – 700 NTU and have an accuracy level of +/- 0.01 NTU and are therefore appropriate to monitor the low turbidity (NTU) levels associated with the proposed application. WMES has experienced issues with the units in that they provide false high readings following maintenance cleans of the membranes. The false high readings generate nuisance alarms which need to be resolved; the reason for the false readings is air bubbles that accumulate in the sample tubing. WMES has been working with Zenon to resolve the issue.

In addition to the turbidity meters associated with each permeate discharge pipe, the BPW has also installed a turbidimeter within the backpulse/permeate tank. The sensor is placed in-situ and is used to ensure that the water stored in the tank doesn't become inadvertently contaminated and then utilized to backpulse a membrane tank and thereby contaminate the interior of the membranes. The tubidimeter installed is a Hach Solitaxs sc, the unit has a capable reading range of 0.001 – 4000 NTU and an accuracy level of +/- 0.01 NTU and is therefore appropriate to monitor the low turbidity (NTU) levels associated with the proposed application. This unit is not currently connected to the facility SCADA system. To allow this device to provide the advanced notice to operators that it was intended to, connectively of the device with the SCADA system should be completed. It is not recommended that an alarm condition associated with this instrument result in a direct action by the membrane control system (as is the case with the other turbidimeters); but instead, the alarm will alert plant operators to a possible issue that will provide them advance notice and allow adequate time to assess and respond as appropriate.

<u>SCADA System</u>

GMB understands there is one SCADA alarm system in service. The alarm system being used communicates via the telephone system, which is fine. However, there are options for alarming over the internet. GMB recommends installing the Win911 alarm system (or equivalent) on the SCADA PC. This system can be programmed to pick-up all alarm tags and send alarms either VoIP phone call, text message or email to provide backup to the ScadaPhone system. A budgetary cost for the Win911 system is $4,000.

GMB understands the SCADA PC has internet access and that BPW and manufacturer representatives have access to the system through a VPN. For the plant operations team use, GMB recommends utilizing a remote-control software to allow the operations team access to the system while away from the site. Having continuous access to the SCADA PC can lessen the chance of issues going un-noticed. Microsoft Remote Desktop Connection (RDC) through VPN or the Teamviewer software (or equivalent) can be used for this purpose. Most Windows PCs have the RDC installed. A budgetary cost for Teamviewer is $1,200 per year.

PART 5 – ESTIMATED COSTS

Construction cost estimates were generated for those reliability and redundancy improvements which GMB deemed to be beneficial to the BPW and its facility. The construction costs are summarized below, with additional detailed cost information in the Appendix at the end of this letter report.

Flow Equalization Tank Replacement	**$600,000**
Redundant Flow Equalization Tank	**$1,100,000**
MLSS Screen	**$300,000**
Redundant Permeate/Backpulse Tank	**$90,000**
Critical SCADA Components	**$21,400**

***** END OF STUDY *****

APPENDIX A-1

PRELIMINARY COST ESTIMATES

Existing FEQ Tank Replacement Lewes BPW WRF - Redundancy & Reliability Analysis Engineer's Estimate of Probable Construction Cost			
Items		Estimated Cost	
Construction Cost			
Tank Subcontractor		$	430,800
Miscellaneous Associated Work		$	102,900
Subtotal - Construction Items		$	533,700
General Conditions	8%	$	42,700
Permits, Bonds, & Insurance	3.5%	$	18,700
Total Construction Cost		**$**	**595,100**

Existing FEQ Tank Replacement

Item/Structure	Quantity Number	Unit	Bid Costs Unit Cost	Total	Total Derived Cost
Tank Subcontractor					
Existing Tank Demoltion and Replacement	1	LS	$ 430,755	$ 430,800	
Miscellaneous Associated Work					
Piping Modifications	1	LS	$ 10,000	$ 10,000	
Existing Equipment Removal & Reinstallation	1	LS	$ 20,000	$ 20,000	
Concrete Floor Coating	5150	SF	$ 8	$ 41,200	
Site Work	1	LS	$ 5,000	$ 5,000	
Subtotal 1 - Tank Subcontractor				$430,800	
Contingency - N/A					
Subtotal 2 - Misc. Assoc. Work				$76,200	
Contingency - 35%					$26,700
TOTAL					$533,700

Redundant FEQ Tank Lewes BPW WRF - Redundancy & Reliability Analysis Engineer's Estimate of Probable Construction Cost			
Items		Estimated Cost	
Construction Cost			
Tank Subcontractor		$	539,000
Pile Foundation		$	165,600
Miscellaneous Associated Work		$	266,300
Subtotal - Construction Items		$	970,900
General Conditions	8%	$	77,700
Permits, Bonds, & Insurance	3.5%	$	34,000
Total Construction Cost		**$**	**1,082,600**

Redundant FEQ Tank

Item/Structure	Quantity Number	Unit	Bid Costs Unit Cost	Total	Total Derived Cost
Tank Subcontractor					
New Tank Construction w/Concrete Floor	1	LS	$ 538,935	$ 539,000	
Miscellaneous Associated Work					
Erosion & Sediment Control	1	LS	$ 4,500	$ 4,500	
Site Survey & Stakeout	1	LS	$ 2,500	$ 2,500	
Excavation and Disposal	380	CY	$50	$ 19,000	
Final Grading Seed & Mulch	1	LS	$ 2,500	$ 2,500	
Proposed Piping & Valves	1	LS	$ 75,000	$ 75,000	
15 HP Submersible Mixing/Aeration Equipment	3	EA	$ 17,500	$ 52,500	
Concrete Floor Coating	5150	SF	$ 8	$ 41,200	
Pile Foundation					
Concrete Piles (40T) - 80 @ 45' dp + mob	3600	VLF	$ 40	$ 144,000	
Subtotal 1 - Tank Subcontractor				$539,000	
Contingency - N/A					
Subtotal 2 - Misc. Assoc. Work				$197,200	
Contingency - 35%					$69,100
Subtotal 3 - Pile Foundation				$144,000	
Contingency - 15%					$21,600
TOTAL					$970,900

MLSS Screen
Lewes BPW WRF - Redundancy & Reliability Analysis
Engineer's Estimate of Probable Construction Cost

Items		Estimated Cost	
Construction Cost			
Screen Vendor		$	153,200
Miscellaneous Associated Work		$	114,800
Subtotal - Construction Items		$	268,000
General Conditions	8%	$	21,500
Permits, Bonds, & Insurance	3.5%	$	9,400
Total Construction Cost		**$**	**298,900**

MLSS Screen

	Quantity		Bid Costs		Total Derived
Item/Structure	Number	Unit	Unit Cost	Total	**Cost**
Screen Vendor					
MLSS Screen	1	LS	$ 139,200	$ 139,200	
Miscellaneous Associated Work					
Screen Installation	1	LS	$ 12,500	$ 12,500	
Electrical Installation	1	LS	$ 15,000	$ 15,000	
Elevated Platform & Staircase for Screen	1	LS	$ 30,000	$ 30,000	
Piping/Valve Installation (WW & NPW)	1	LS	$ 27,500	$ 27,500	
Subtotal 1 - Screen Vendor				$139,200	
Contingency - 10%					$14,000
Subtotal 2 - Misc. Assoc. Work				$85,000	
Contingency - 35%					$29,800
TOTAL					$268,000

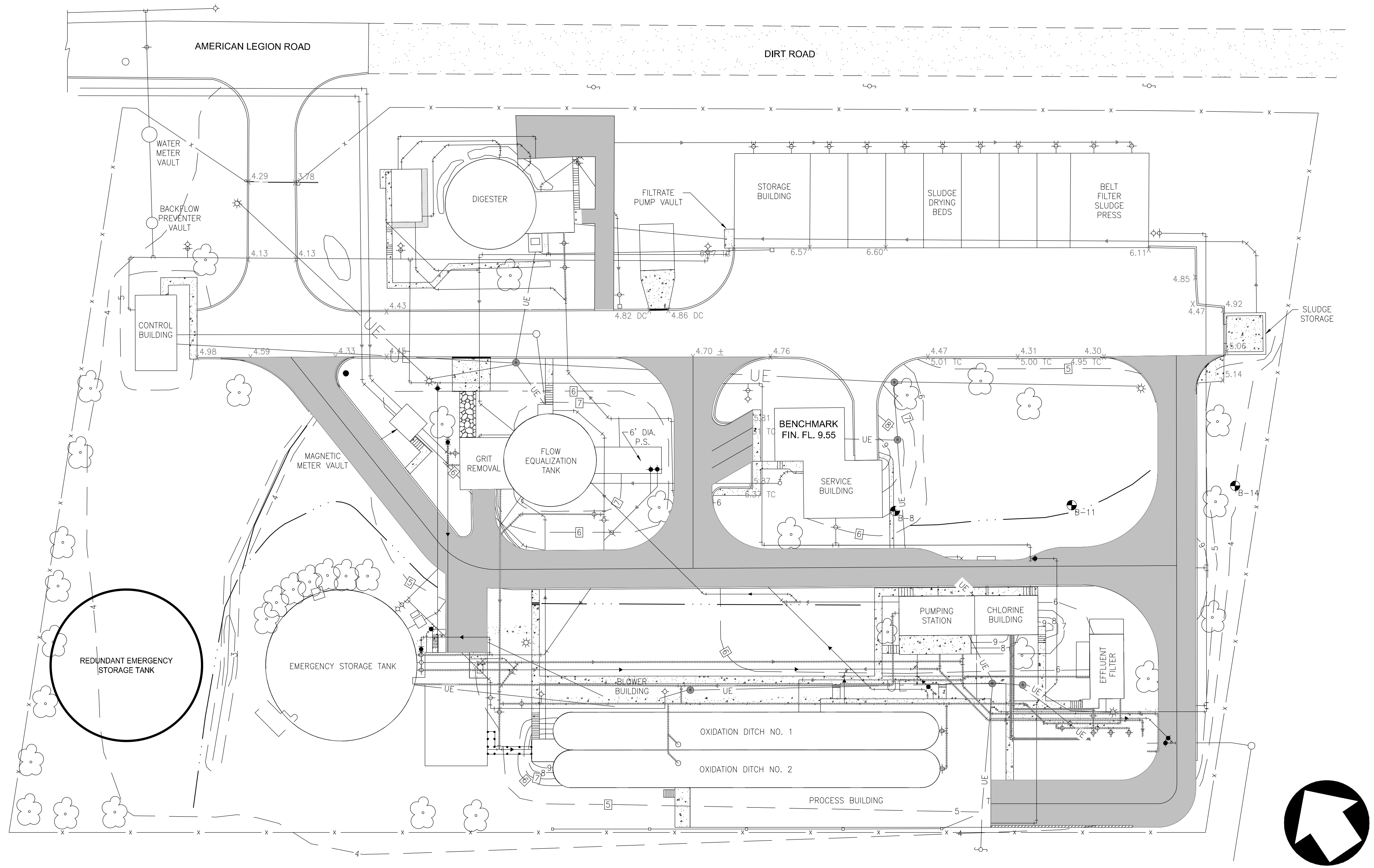
Redundant Permeate Tank Lewes BPW WRF - Redundancy & Reliability Analysis Engineer's Estimate of Probable Construction Cost			
Items		Estimated Cost	
Construction Cost			
Permeate Tank		$	80,400
Subtotal - Construction Items		$	80,400
General Conditions	8%	$	6,500
Permits, Bonds, & Insurance	3.5%	$	2,900
Total Construction Cost		**$**	**89,800**

Redundant Permeate Tank

	Quantity		Bid Costs		Total Derived
Item/Structure	Number	Unit	Unit Cost	Total	**Cost**
Permeate Tank					
4,900 Poly Tank	1	LS	$ 7,500	$ 7,500	
Tank Shipping & Installation	1	LS	$ 5,000	$ 5,000	
Piping/Valve Installation	1	LS	$ 35,000	$ 35,000	
Adjustment of Existing Components	1	LS	$ 7,500	$ 7,500	
Electrical Work	1	LS	$ 4,500	$ 4,500	
Subtotal 1 - Permeate Tank				$59,500	
Contingency - 35%					$20,900
TOTAL					$80,400

APPENDIX A-2

SKETCHES



PRINTS ISSUED FOR: REVIEW

DATE	REVISIONS	NO.

GMB
GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
SALISBURY • BALTIMORE • SEAFORD
206 WEST MAIN STREET
SALISBURY, MARYLAND 21801
410-742-3115, FAX 410-548-5790
www.gmbnet.com

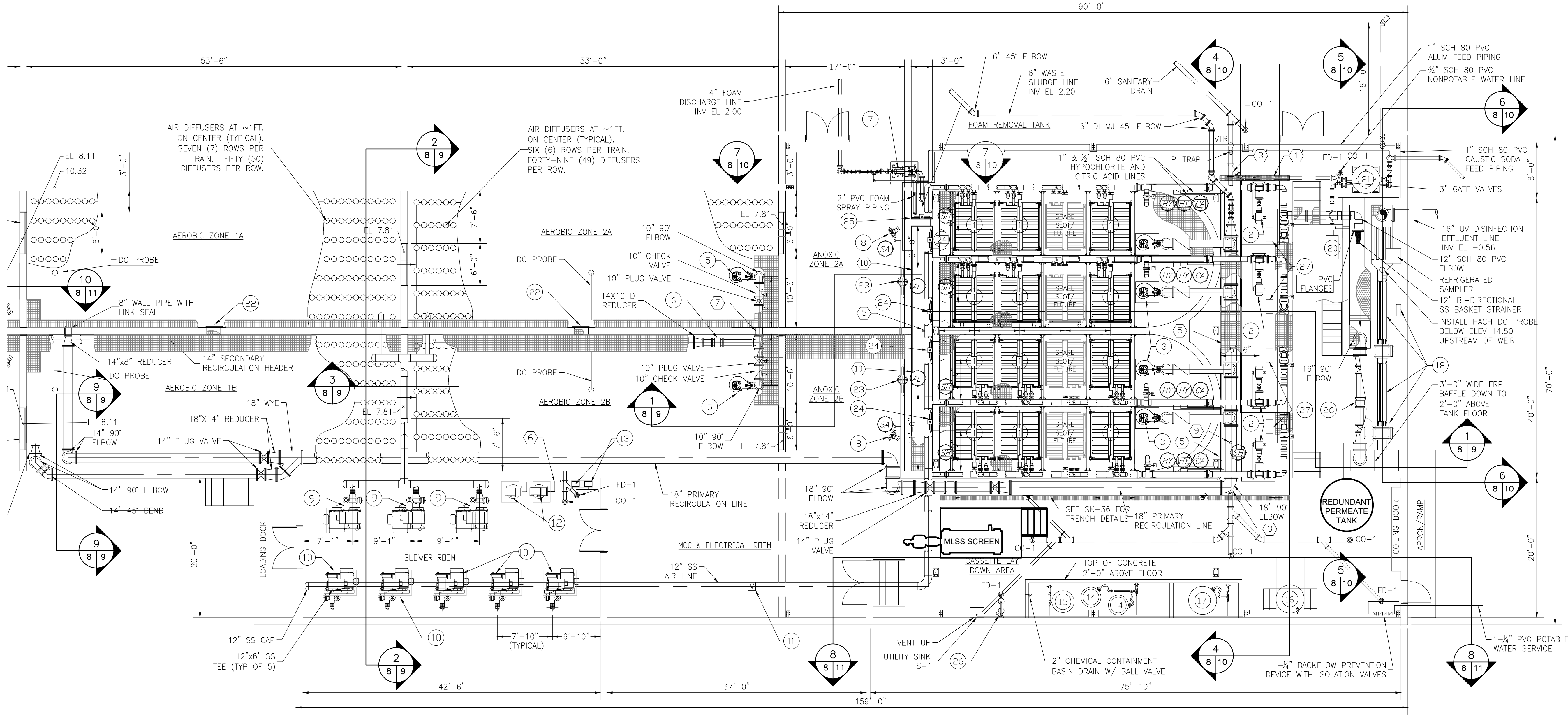
BPW WRF REDUNDANCY AND RELIABILITY ANALYSIS

LEWES, DELAWARE

SITE PLAN

SCALE	: AS NOTED
DESIGN BY	: CBD
DRAWN BY	: MMD
CHECKED BY	: CBD
GMB FILE	: 200113
DATE	: SEPT. 2020

SHEET NO. SK-1



PLAN - PROCESS BUILDING AND MBR TANKS

NORTH

PLAN NORTH

PRINTS ISSUED FOR: REVIEW

DATE	REVISIONS	NO.

GMB
GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
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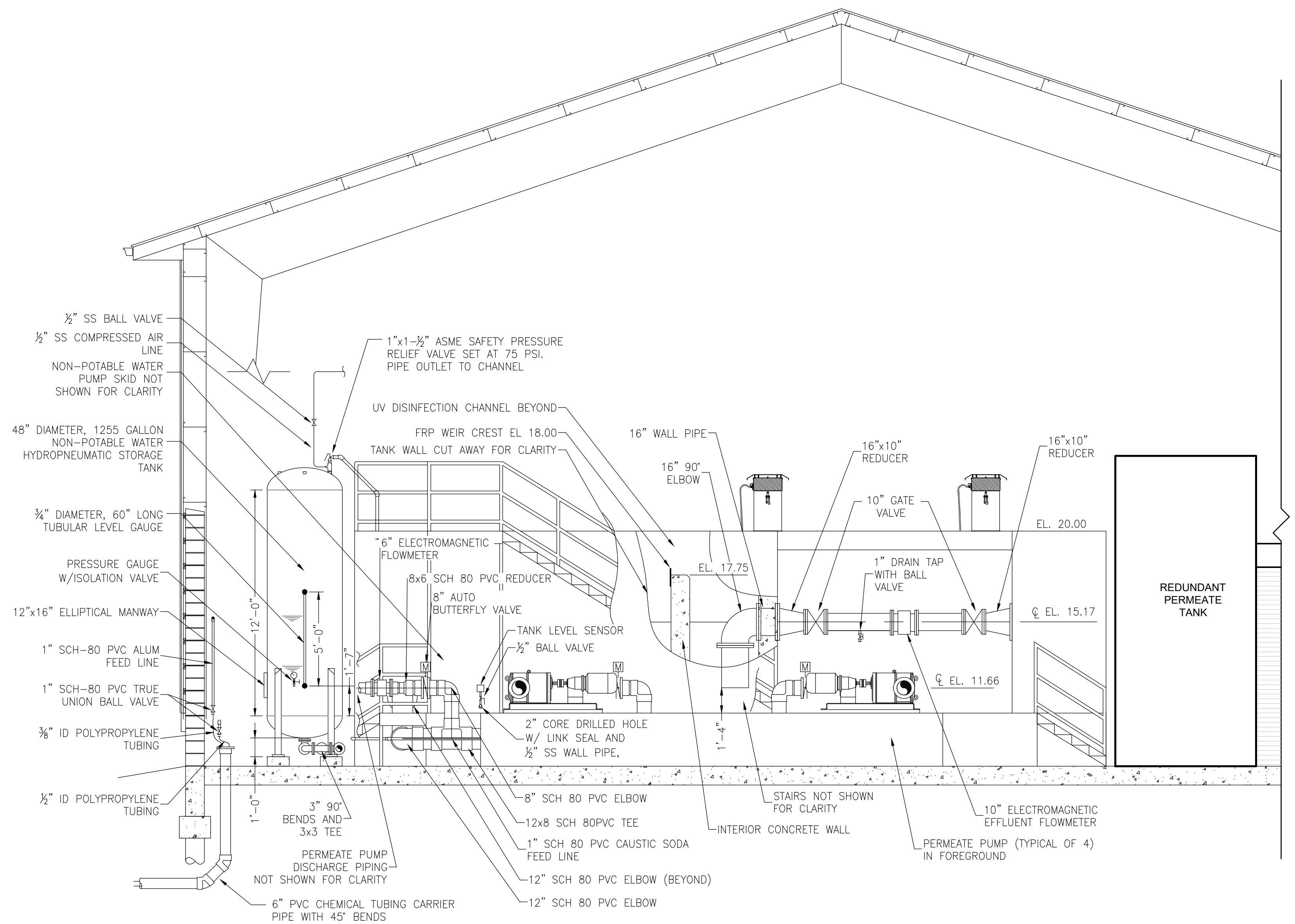
BPW WRF REDUNDANCY AND RELIABILITY ANALYSIS

LEWES, DELAWARE

MBR AND PROCESS TANKS

SCALE	: AS NOTED
DESIGN BY	: CBD
DRAWN BY	: MMD
CHECKED BY	: ----
GMB FILE	: 200113
DATE	: SEPT. 2020

SHEET NO.
SK-2



NOTES:

1. SUPPORT ALL PIPING AS REQUIRED. THIS INCLUDES ALL VALVES AND FLOWMETERS TO FACILITATE MAINTENANCE AND REMOVAL.
2. FOR CLARITY, HANDRAILING IS NOT SHOWN IN ALL LOCATIONS REQUIRED. REFER TO OTHER SHEETS FOR EXTENT OF HANDRAILING TO BE INSTALLED.

SECTION 5 / 8 10

PRINTS ISSUED FOR: REVIEW

NO.	REVISIONS	DATE

GMB
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BPW WRF REDUNDANCY AND RELIABILITY ANALYSIS

LEWES, DELAWARE

MBR AND PROCESS TANKS SECTION

SCALE	: AS NOTED
DESIGN BY	: CBD
DRAWN BY	: MMD
CHECKED BY	: ----
GMB FILE	: 200113
DATE	: SEPT. 2020

SHEET NO. SK-3

G:\Projects\2020\200113 BPW WRF Redundancy Evaluation\Drawings\Working Sets\SK-2 MBR AND PROCESS TANKS.dwg, 9/22/2020 11:21:34 AM, mmd, _DWG To PDF.pc3

PLOT CODE
PEN1=RED .006 INCHES (.15mm)
PEN2=YELLOW .007 INCHES (.18mm)
PEN3=GREEN .010 INCHES (.25mm)
PEN4=CYAN .014 INCHES (.35mm)
PEN5=BLUE .020 INCHES (.50mm)
PEN6=MAGENTA .027 INCHES (.70mm)
PEN7=WHITE .039 INCHES (1.00mm)

APPENDIX A-3

VENDOR / MANUFACTURER QUOTATIONS & CUT SHEETS

September 17, 2020

GMB Architects / Engineers
206 West Main Street
Salisbury, MD 21801
Attn: Chris Derbyshire, P.E.

RE: Lewes, DE WWTP
Wastewater EQ Tank

Per your request for budget pricing we offer the following:

Aquastore New Tank Option:

One (1) AQUASTORE® Glass Fused to Steel Wastewater EQ Tank Model – 8115 SSTT
81.12' diameter x 14.68' sidewall height with **Open top Tank, concrete floor w/ pile cap**
528,822 gallons maximum capacity with **12" freeboard, liquid level 13.68**
Installed Price Estimate*: $538,935.00*

DESIGN CONDITIONS	(AISC / AWWA D103-19 design standard)
Stored Contents:	Wastewater
Specific Gravity:	1.0
pH Range:	6.0 to 8.0
Storage Temperature:	Ambient
Wind Speed:	130 MPH / IBC 2018
Seismic:	AWWA D103-19
Snow Load:	N/A
Soil Bearing:	2,000 PSF minimum
Frost Depth:	36"

Included:

- Design of the Tank and Pile Cap stamped with a P.E. in the state of Delaware
- Tank and Pile Cap design code per AISC / AWWA D103-19 seismic zone
- Standard Color Cobalt Blue
- Excavation of the site (Assuming min 2,000 PSF soil bearing strength)
- 24" Reinforced concrete pile cap and floor, with compacted stone under slab (Pile Design by others)
- Concrete encased 12" DIP inlet-outlet piping stubbed out 5' from ringwall foundation
- Glass-coated, bolted steel sidewall with One (1) 24" manway
- One (1) Aluminum spiral staircase w/ top landing to include inside ladder to the floor
- One standard exterior ladder w/ top platform
- 8" PVC internal overflow, transition to DIP under tank slab stubbed out 5' from foundation
- 16" HDG double flanged sidewall nozzle

- 12” HDG double flanged sidewall nozzle
- One (1) lot of SS brackets for mixer rails (rails & mixer by others)
- Cathodic Protection
- Freight to job site
- **Sussex County DE prevailing wage rates, open-shop non-union installation labor**

<u>Aquastore Replacement Tank Option:</u>

One (1) AQUASTORE® Glass Fused to Steel Wastewater EQ Tank Model – 8115 GFTT
81.13’ diameter x 15.36’ sidewall height with **Open Top Tank, glass floor**
555,093 gallons maximum capacity with **12” freeboard, liquid level 14.36**
Installed Price Estimate*<u>: $430,755.00</u>*

<u>DESIGN CONDITIONS</u>	(AISC / AWWA D103-19 design standard)
Stored Contents:	Wastewater
Specific Gravity:	1.0
pH Range:	6.0 to 8.0
Storage Temperature:	Ambient
Wind Speed:	130 MPH / IBC 2018
Seismic:	AWWA D103-19
Snow Load:	N/A
Soil Bearing:	2,000 PSF minimum
Frost Depth:	36”

Included:

- Design of the Tank with a P.E. in the state of Delaware
- Tank design code per AISC / AWWA D103-19 seismic zone
- Standard Color Cobalt Blue
- Re-use of the existing 12” center outlet pipe
- Glass-coated, bolted steel sidewall with One (1) 24” manway
- Glass-coated bolted steel floor over existing concrete floor and foundation
- ½” Fiber expansion board under steel floor
- One (1) Aluminum spiral staircase w/ top landing to include inside ladder to the floor
- One standard exterior ladder w/ top platform
- 16” HDG double flanged sidewall nozzle
- 12” HDG double flanged sidewall nozzle
- Reuse of existing 8” internal overflow line, new 8” PVC riser to be installed
- One (1) lot of SS brackets for mixer rails (rails & mixer by others)
- Cathodic Protection
- Freight to job site
- Demo and removal of the existing Tank
- **Sussex County DE prevailing wage rates, open-shop non-union installation labor**

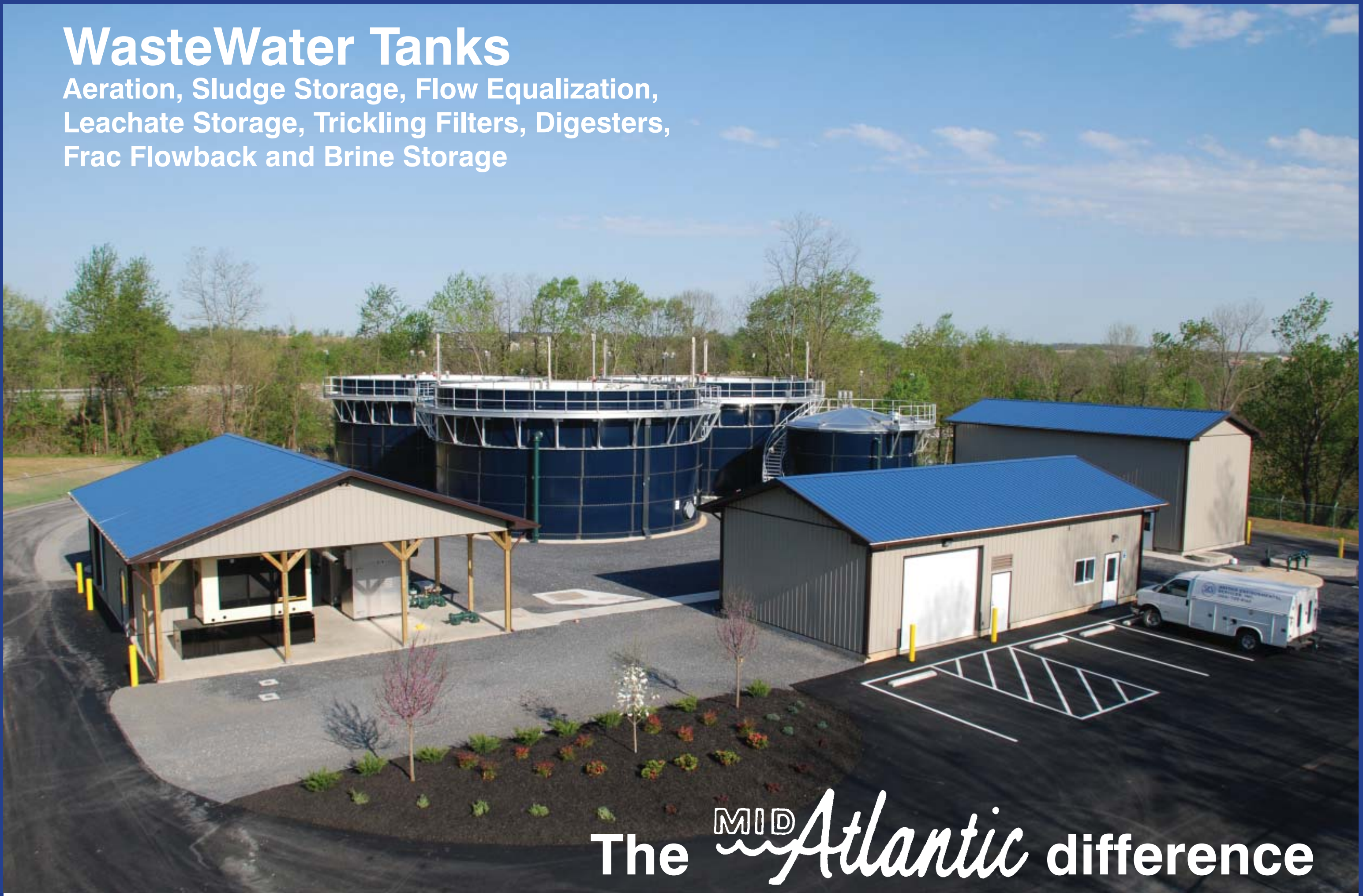
Not included:

- ➢ Access road and site preparation
- ➢ Yard piping and vault
- ➢ Bonds/permits
- ➢ Off loading of material by others
- ➢ Level sensing-measuring equipment
- ➢ Rock excavation of foundation *(if encountered)*
- ➢ Sales tax
- ➢ Geo Technical Report
- ➢ Pile foundation for new tank
- ➢ *Removal of excavated materials for the new tank

Please advise of any questions or further needs on this project. Thank you!

Brian Hyde
Regional Sales Manager
(267) 614-2237 Brian@midatlanticstorage.com

Cc: Dave Kachman / Kappe Associates, Inc.



You deserve the best service and top quality products for your wastewater treatment, sludge storage or landfill leachate tank needs. Consider these Mid Atlantic advantages...

Total Service

We define service as a comprehensive series of customer focused activities that include:

- Trained sales reps ask the right questions about your wastewater treatment needs.
- Detailed proposals with CAD drawings and technical specifications
- Complete submittal packages that simplify the approval process
- Warranty and periodic inspection programs

Complete Tank Construction

Our employee crews are factory trained and annually certified by the tank manufacturer.

- Turnkey supply and installation: sitework, piping, tank foundation, tank construction, staircases, internal equipment
- System start-up assistance and operator training
- Construction Management Responsibility
- Hydrostatic testing

Top Quality Product Lines

- Aquastore® Tanks with state-of-the-art glass fused to steel coatings
- TecStore™ Tanks of epoxy-coated-steel, galvanized-steel or stainless steel
- Clear-span, aluminum dome roofs

MID Atlantic
Storage Systems, Inc.
www.midatlanticstorage.com

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brian@midatlanticstorage.com 267/614-2237

Landfill Leachate

SBR Tank

Flow Equalization

Brine Treatment

Municipal Wastewater

Dan Widdel
630/837-5640, ext. 225
dw@lakeside-equipment.com

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

Budgetary Proposal

July 30, 2020

TO	PROJECT
Chris Derbyshire, P.E. GMB 206 West Main Street Salisbury, MD 21801	Lewes, Delaware

EQUIPMENT	UNIT	QTY	TOTAL
Lakeside Tank-Mounted Raptor® Rotating Drum Screen **Model 30RDS - 0.04**	**$139,200**	**1**	**$139,200**

Due to the current volatility of stainless steel prices, budgetary cost of equipment may be subject to change.

SPECIFICATION

Unit Capacity:	230	gpm (at 1% solids)	Maximum Headloss:	16	inches
Inclination:	35	degrees	Maximum Upstream Level:	21	inches
Wedge Wire Spacing:	0.04	inches (1 mm)	Nominal Basket Diameter:	29	inches
Water Requirements:	35	gpm at 80 psi	Transport Screw Diameter:	10	inches

SCREEN	CONTROL PANEL
AISI 304 stainless steel construction	NEMA 4X - 304 stainless steel main control panel
Stainless steel tank assembly with anchorage	No local control station
Wedge wire screenings basket	Fusible disconnect switch with door handle
Screw conveyor with helical flights	Control power transformer
2 hp drive unit	Allen-Bradley MicroLogix 1100 PLC
3-Zone wash system with solenoid valves	Variable frequency drive with line reactor
Two (2) float switches	Selector switches
Spare parts	Indicator lights

EXCLUSIONS

Piping, valves or fittings, unless noted otherwise
Manual bar screen
Screenings collection containers
Interconnecting conduit or wiring

OPTIONAL ITEMS	UNIT PRICE
Extra screen transport tube length (per foot of extra vertical height)	$900
Explosion proof design package	$5,400
Booster pump and related controls	$6,400
Weather protection system package (for screen and tank)	$37,000
Screenings bagger - individual or continuous type	$1,100

NOTES

FOB:	Chariton, Iowa	Approvals:	6 to 8	weeks
Freight:	Freight allowed to jobsite	Shipment after Approval:	18 to 20	weeks
Start-Up Service:	2 days in 1 trip	Weight per Screen:	4,000	lbs
Warranty:	One (1) year	Installation Time per Screen:	32	hours

Budgetary Proposal

July 30, 2020

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

Dan Widdel
630/837-5640, ext. 225
dw@lakeside-equipment.com

TO	PROJECT
Chris Derbyshire, P.E. GMB 206 West Main Street Salisbury, MD 21801	Lewes, Delaware

EQUIPMENT	UNIT	QTY	TOTAL
Lakeside Tank-Mounted Raptor® Rotating Drum Screen	**$148,800**	**1**	**$148,800**
Model 36RDS - 0.08			

Due to the current volatility of stainless steel prices, budgetary cost of equipment may be subject to change.

SPECIFICATION

Unit Capacity:	220	gpm (at 1% solids)	Maximum Headloss:	20	inches
Inclination:	35	degrees	Maximum Upstream Level:	26	inches
Hole Diameter:	0.08	inches (2 mm)	Nominal Basket Diameter:	35	inches
Water Requirements:	40	gpm at 80 psi	Transport Screw Diameter:	10	inches

SCREEN	CONTROL PANEL
AISI 304 stainless steel construction	NEMA 4X - 304 stainless steel main control panel
Stainless steel tank assembly with anchorage	No local control station
Perforated plate screenings basket	Fusible disconnect switch with door handle
Screw conveyor with helical flights	Control power transformer
2 hp drive unit	Allen-Bradley MicroLogix 1100 PLC
3-Zone wash system with solenoid valves	Variable frequency drive with line reactor
Two (2) float switches	Selector switches
Spare parts	Indicator lights

EXCLUSIONS

Piping, valves or fittings, unless noted otherwise
Manual bar screen
Screenings collection containers
Interconnecting conduit or wiring

OPTIONAL ITEMS	UNIT PRICE
Extra screen transport tube length (per foot of extra vertical height)	$900
Explosion proof design package	$5,400
Booster pump and related controls	$6,400
Weather protection system package (for screen and tank)	$39,000
Screenings bagger - individual or continuous type	$1,100

NOTES

FOB:	Chariton, Iowa	Approvals:	6 to 8	weeks
Freight:	Freight allowed to jobsite	Shipment after Approval:	18 to 20	weeks
Start-Up Service:	2 days in 1 trip	Weight per Screen:	4,500	lbs
Warranty:	One (1) year	Installation Time per Screen:	32	hours

LAKESIDE EQUIPMENT CORPORATION
Water and Wastewater Treatment Equipment
P.O. Box 8448
Bartlett, IL 60103

REPRESENTATIVES PRINCIPAL CITIES

TELEPHONE: 630/837-5640
FAX: 630/837-5647

LAKESIDE SCREEN GENERAL DESIGN NOTES

Follow these guidelines when incorporating a Lakeside screen in your project:

Hydraulics

1. Based upon the desired channel velocity, which is typically in the range of 1 to 3 ft/sec, you will need to determine the channel width upstream and downstream of the Lakeside Screen. The channel width may be less than that required to accommodate the Lakeside Screen basket.

2. If there is a transition from an influent feed pipe to an open channel, the maximum water level upstream of the screen should not flood the influent feed pipe. Lower the channel floor to ensure the water level does not exceed 75-percent of the inlet pipe diameter.

3. The Lakeside screen operates on a set water level upstream of the screen. Regardless of the flow rate, once the upstream water level reaches 2.0-inches below the screen's maximum upstream water level, the level sensor will activate the screen for operation. The screen's maximum upstream water level is shown on the screen layout drawing.

Installation Requirements

4. Include provisions to lift and/or rotate the screen out of the channel for service. Considerations might include: mobile lifting equipment, permanently installed hoists, overhead lifting beams or eye hooks. Accessibility, work space and convenience of use must also be considered.

5. Keep the area under the screenings transport screw free from fixed obstructions such as slide gates, electrical conduit, piping and other process equipment to allow pivoting the screen for service.

6. Installations that are subject to **freezing conditions** should be enclosed or have weather protective walls or covers over the basket area. **This protection is necessary to prevent the buildup of ice from storms and wash water overspray.**

7. **Flexible electrical conduit runs** with a drip leg between the screen and hard conduit are **required to allow free rotation of the screen**. The hard conduit should be terminated near the pivot point on the transport screw to minimize the length of flexible conduit.

8. **Flexible hose runs or quick disconnect fittings** in the wash water piping are **required** to permit rotation of the screen out of the channel.

9. Rapid closure of the wash water solenoid valves furnished on the Lakeside screen will generate a water hammer in the wash water piping. Installation of a **water hammer eliminator** is suggested to protect piping, backflow preventers or other connected equipment from the potentially damaging effects.

10. Provision for a screenings discharge container should be considered at design time. If standard size containers are available at an existing plant and will be used for the screen, check to insure the space between the operating floor and discharge hopper will accommodate the container. While containers come in many different sizes and shapes, generally a 1 cu yd container will have an overall height of approximately 42 in. If your project requires additional space, contact Lakeside for assistance in providing the correct screen for your application.

11. For tank-mounted screens:

    a. If the screen is used for septage hauling applications, the tank inlet must be sufficiently below the truck outlet to insure proper flow.

    b. Adequate supports should be furnished for any tank mounted inlet and outlet piping.

    c. Lakeside furnished tanks are not designed as pressure vessels. Adequate pressure and vacuum relief, by others, is required.

Electrical Controls

12. Surges in the plant power supply may damage electronic equipment in the control panel. **Surge suppression** is suggested where there is a history of utility upsets or when there is a regular test program of switching between utility power and emergency power systems.

13. The control panel must be located to **avoid direct exposure to the sun**. High solar heating can prevent proper operation of internal electronic equipment.

14. **Separate conduit runs** are required for high voltage power, control power and signal wiring.

15. Conduit runs must enter the bottom of the control panel and should be provided with moisture drains. Moisture from conduits entering at other locations can cause problems with sensitive electronic equipment. Water damage is not covered by Lakeside's warranty.

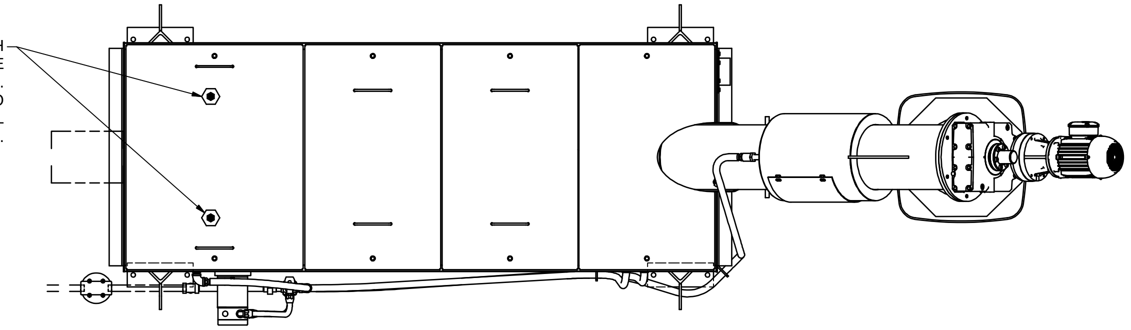
    Conduit entering the top of the panel will void the warranty.

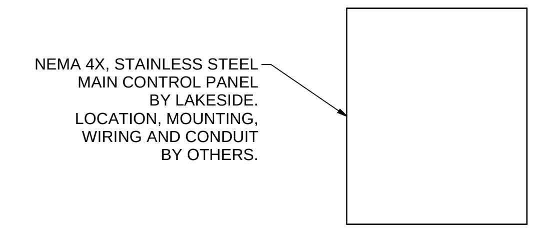
Stainless Steel and Rust

16. The main body of the Lakeside Screen is constructed of stainless steel. Contact with ferrous materials will cause iron oxide (rust) to form on the surfaces. We suggest protecting all stainless surfaces during storage, handling, and installation to prevent the unsightly formation of rust. Some of the common causes are summarized below:

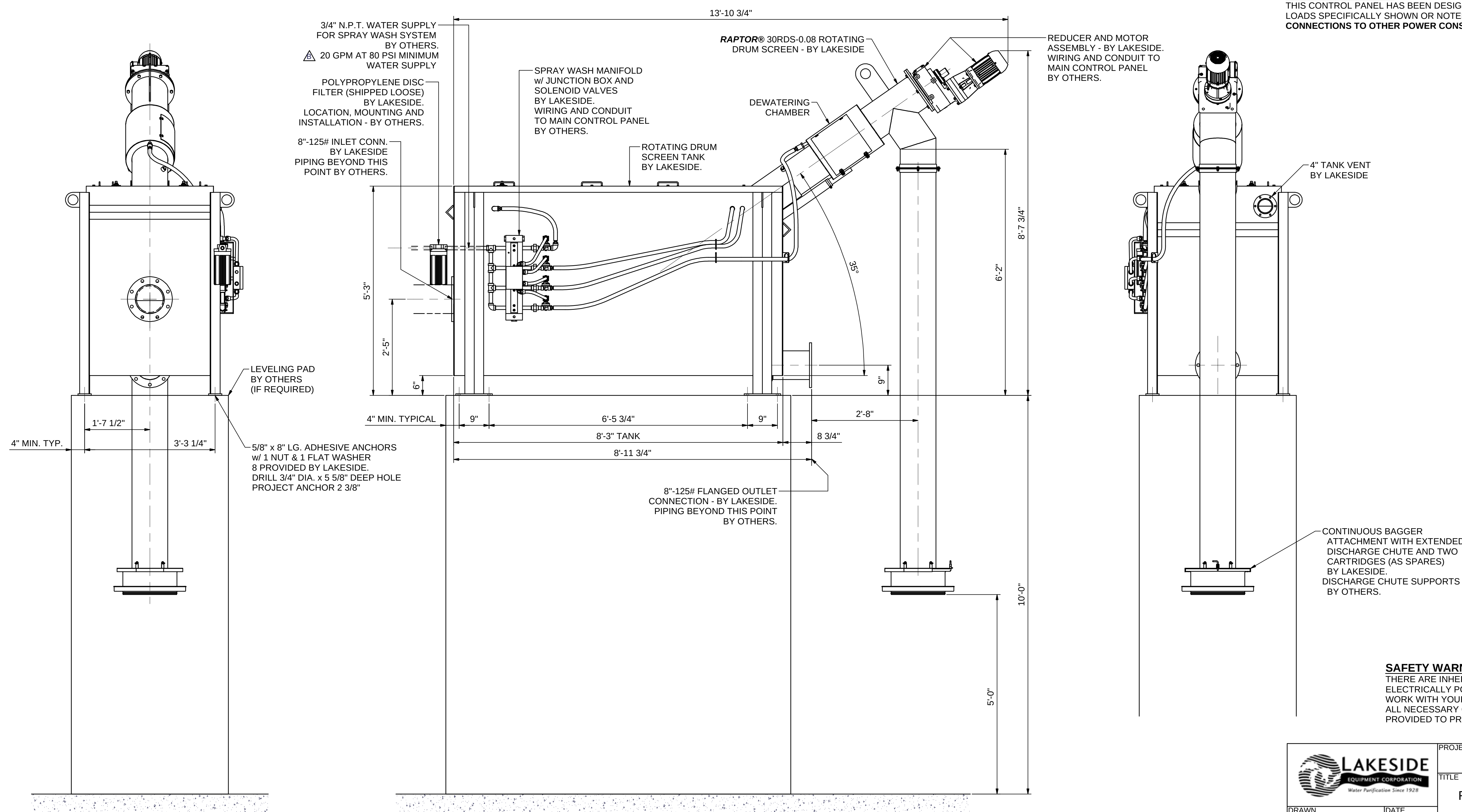
    a. Contact with carbon steel chain or cable.
    b. Wire brushes contaminated with iron.
    c. Grindings from nearby fabrication.
    d. Weld splatter from nearby fabrication.
    e. High iron content wash or process water.

DW
11/15/05





ELECTRICAL NOTE:
THIS CONTROL PANEL HAS BEEN DESIGNED TO POWER ONLY THOSE ELECTRICAL LOADS SPECIFICALLY SHOWN OR NOTED ON LAKESIDE'S ELECTRICAL DRAWINGS. **CONNECTIONS TO OTHER POWER CONSUMING DEVICES WILL VOID THE WARRANTY.**



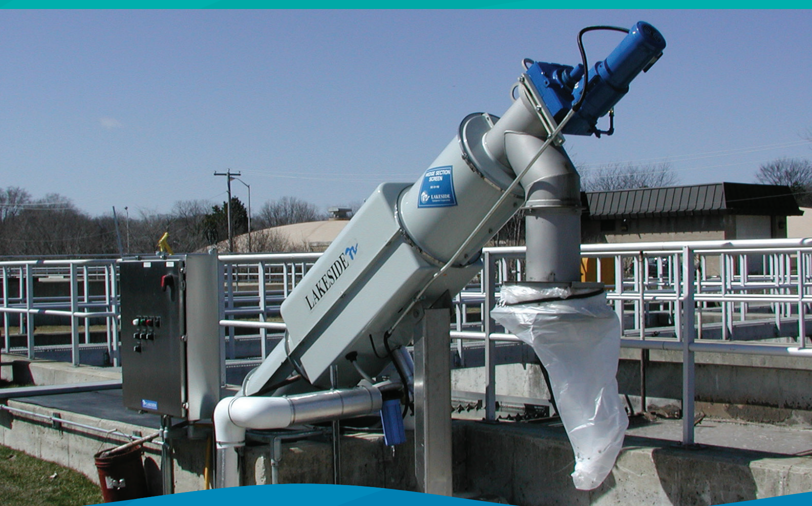
SAFETY WARNING:
THERE ARE INHERENT DANGERS WHILE INSTALLING OR OPERATING ELECTRICALLY POWERED MECHANICAL EQUIPMENT. CONSULT AND WORK WITH YOUR PROJECT SAFETY COORDINATOR TO DETERMINE ALL NECESSARY CAUTION IS EXERCISED AND GUARDING IS BEING PROVIDED TO PREVENT ACCIDENTS.

REV	REVISION	DATE	DR.	CHKD
B		8-31-18	TH	JS

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

PROJECT	WHEATLAND, CA HARD ROCK FIRE MOUNTAIN CASINO & HOTEL
TITLE	RAPTOR® ROTATING DRUM SCREEN MODEL 30RDS-0.08 INSTALLATION
DRAWN	JS
DATE	8/7/2018
CHECKED	SNYDER
DATE	8/7/2018
SIZE	D
S.O. #	18-155
DWG NO	D104855
REV	B
SCALE	
FILE NO.	172

Raptor® Rotating Drum Screen



Effectively Removes
Fine Solids

LAKESIDE
EQUIPMENT CORPORATION
Water Purification Since 1928

Cleaner Water for a Brighter Future®

One Integrated Process
Screens, Washes, Compacts and Dewaters Solids

The Lakeside *Raptor*® Rotating Drum Screen is an excellent screenings solution for removal of small particles in municipal and industrial wastewater applications. The versatility of the screenings basket being either wedge wire or perforated plate allows our team of engineers to select the right screen for your treatment facility. With its high removal efficiency, the *Raptor*® Rotating Drum Screen meets the needs of Membrane Biological Reactor (MBR) plants using a perforated plate screenings basket with openings as small as 0.08 inch (2 mm). The *Raptor*® Rotating Drum Screen is also ideal for sludge and scum applications by removing plastics and other floatable material which can have detrimental effects on various areas of the treatment process. Captured screenings are compacted, dewatered and washed free of most organics to approximately 40 percent solids. Volume is reduced by 50 percent and weight by 67 percent, thereby reducing disposal cost.

- All stainless steel construction resists corrosion
- Versatile screenings basket provides high screenings removal efficiency
- Ideal for MBR and scum removal applications
- Combines 4 processes in one unit (screens, washes, compacts and dewaters)
- Dual spray wash system provides cleaner discharge screenings
- Integrated compaction zone reduces volume and weight for reduced disposal cost
- Enclosed transport tube and optional bagger attachment reduce odors

Made in the USA to our quality standards for performance you can trust.

Raptor® Rotating Drum Screen

Weather Protection with Bagging Device for Outdoor Applications

Stainless steel covers over the basket are available as an option

Designed to Withstand the Rigors of Industrial/Municipal Operations

Screen Operation

The Lakeside *Raptor*® Rotating Drum Screen is installed in either a concrete channel or a stainless steel tank. The screen's seal assembly at the front of the basket conforms to the channel or tank profile to prevent unscreened wastewater from bypassing the basket. The flow is directed into the screenings basket where fine solids are captured by either wedge-shaped screen bars or perforated plate.

When the upstream water level rises to a high level set point, the screenings basket begins to rotate for removal of the captured material. With the aid of the lower spray wash system, the debris is removed from the rotating basket and falls into a collection trough. The debris is then removed from the trough by a central screw conveyor. The conveyed material travels up the inclined transport tube where the material is washed, compacted, and dewatered prior to being discharged into a debris container.

- Hinged structural support allows unit to pivot out of channel for maintenance at floor level
- PLC-equipped control panels for versatile and efficient operation
- Simple drive assembly makes service easy and reduces maintenance costs
- All mating parts are machined to ensure proper fit and operation
- Unit is shipped fully assembled to minimize installation expenses
- Entire unit can be enclosed in a pre-engineered tank for additional protection
- Explosion-proof designs are available
- Optional weather protection system protects to 13° F below zero (minus 25° C)

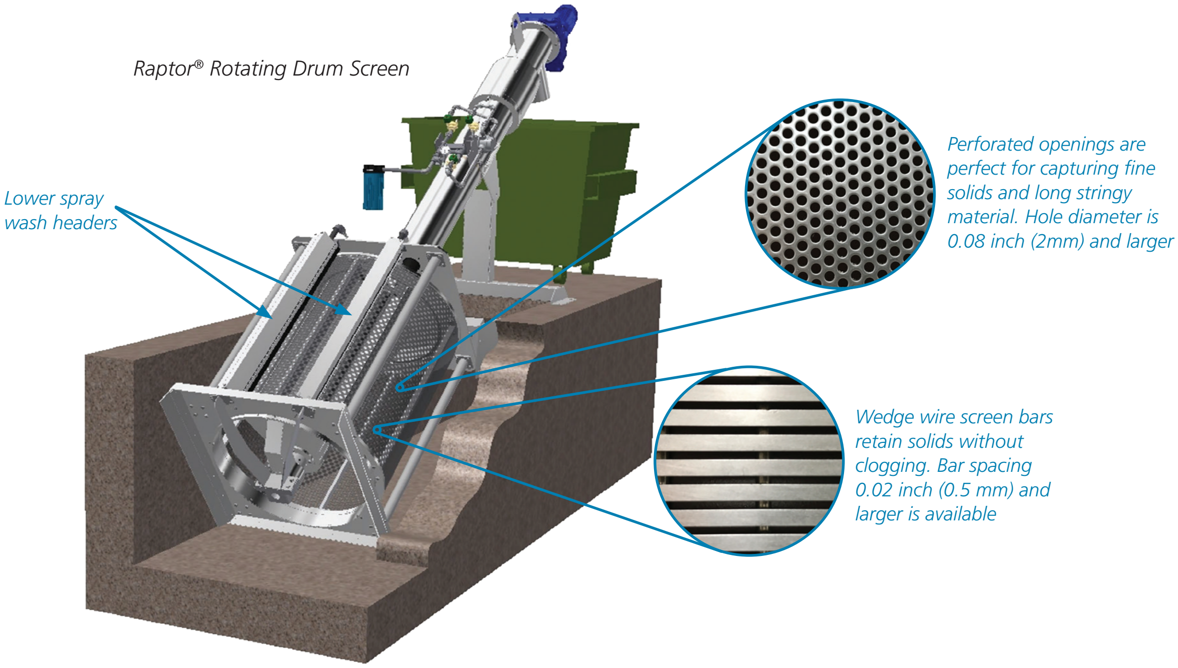
Stainless steel construction for superior corrosion resistance.

Raptor® Rotating Drum Screens with Continuous Baggers

Screenings Basket with 2mm Perforated Openings

Tank-Mounted Raptor® Rotating Drum Screen with Weather Protection

Raptor® Rotating Drum Screen



Treatment equipment and process solutions from Lakeside Equipment Corporation

Lakeside offers a wide range of equipment and systems for virtually all stages of wastewater treatment from influent through final discharge. Each process and equipment item that we supply is manufactured with one goal: to reliably improve the quality of our water resources in the most cost-effective way. We have been doing just that since 1928.

Screw Pumps
- Open Screw Pumps
- Enclosed Screw Pumps

***Raptor*® Screening**
- Fine Screen
- Micro Strainer
- Rotating Drum Screen
- Septage Acceptance Plant
- Septage Complete Plant
- Complete Plant
- Multi-Rake Bar Screen
- Wash Press

Screen and Trash Rakes
- Hydronic T Series
- Hydronic K Series
- Hydronic Multifunctional Series
- Hydronic H Series
- Catronic Series
- Monorail Series
- HY-TEC Screen
- CO-TEC Screen
- RO-TEC Screen

Grit Collection
- SpiraGrit
- Aeroductor
- In-Line Grit Collector
- *Raptor*® Grit Washer
- Grit Classifier
- H-PAC®

Clarification and Filtration
- Spiraflo Clarifier
- Spiravac Clarifier
- Full Surface Skimming
- MicroStar® Filter

Biological Treatment
- CLR Process
- Magna Rotor Aerators & Accessories
- Sequencing Batch Reactors
- Package Treatment Plants
- Submersible Mixers & Recirculation Pumps

Hauled Waste Receiving Systems
- *Raptor*® Septage Acceptance Plant
- *Raptor*® Septage Complete Plant

Package Headworks Systems
- *Raptor*® Complete Plant
- H-PAC®

Biological Treatment Systems
- CLR Process
- Package Treatment Plants
- Sequencing Batch Reactors

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

1022 E. Devon, P.O. Box 8448
Bartlett, IL 60103
630.837.5640 FAX: 630.837.5647
E-mail: sales@lakeside-equipment.com

Plastic Tank Manufacturers => Snyder Tanks => Snyder Vertical ASTM Tanks

4900 Gallon Vertical ASTM Tank 1.5 S.G.

Wrap Option: Select a Wrap Option

Original Price: $8,323.99 *(Save 13%)*
Sale Price: $7,209.99

Add to Cart

Part Number:	SII-5480000N43
Mfr. Part Number:	5480000N43
Capacity:	4900 Gallons
Dimensions:	90" dia. x 202"H
Ships From:	NE
USD Shipping:	Call For Shipping Rate 866 440 1996 or Email
PDF Drawing:	View Technical Drawing
Manufacturer:	Snyder Industries
Material:	HDLPE

Contact Us

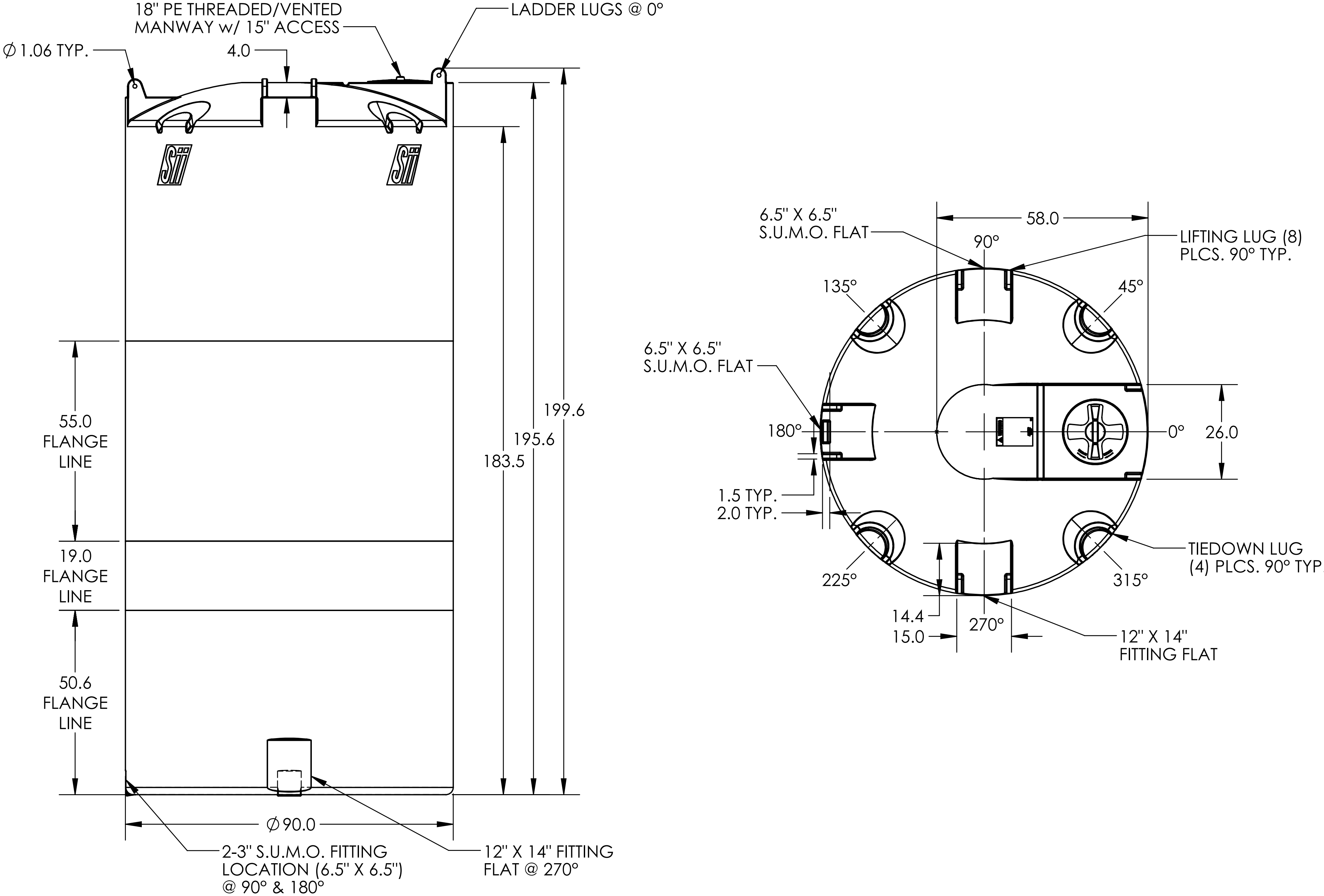
Snyder Industries 4900 Gallon Industrial ASTM Vertical Liquid Storage Tank

4900 Gallon Snyder Industries Vertical Liquid Storage Tank Includes:

- 18” Manway
- Outlet Fitting : Tank does not come standard with an outlet fitting, any fittings must be requested (additional charges will apply).
- Buyer, and user, if different, are solely responsible for making product selection and assuring chemical to be stored is suitable for the use of the product in the application.
- **Temperature**: Prevent excessive heat near or inside the tank. Standard polyethylene tnaks are designed for a maximum continuous temperature of 100 deg F / 37.7 deg C.
- **Pressure**: Tanks are not pressure vessels and are designed for atmospheric pressure only.
- **Venting**: Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" water (0.018 psi). Additional precautions may be required if the tank will be filled pneumatically (using air pressure). Failure to provide proper venting w void your warranty
- **Installation**: Do not ridigly pipe tanks. Flexible connectors are required at fitting connections to maintain warranty.

- Translucent white allows for level visibility
- Gallon Indicators

1.5 Specific Gravity Tank (Holds 12.50 lbs. Per Gallon)



***ALL EXTERNAL PIPING MUST BE INDEPENDENTLY SUPPORTED.**
***ONLY BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE.**
***Consult Snyder's Guidelines for Use and Installation prior to delivery.**
Available on-line at http://www.snyderindustriestanks.com/Technical

ALL DIMENSIONS ARE IN INCHES, NOMINAL, & SUBJECT TO CHANGE WITHOUT NOTICE.
ALL DIMENSIONS ON ROTATIONAL MOLDED PARTS ARE SUBJECT TO A ± 3% TOLERANCE.

DO NOT SCALE	DRAWN BY	DATE	SII SNYDER INDUSTRIES, INC.	TITLE: ASM TK 4900VDT X 90	REVISION A
STATUS: Released	ET3	02/11/2014	4700 Fremont Street, Lincoln, NE 68504, (402) 467-5221, www.snydernet.com	PART NO. 5480000N	SHEET 1 OF 1
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