Operation & Maintenance Manual
Sewage Treatment Plant

In Accordance with Water License 2AM-MEL1631

Prepared by:
Agnico Eagle Mines Limited – Meliadine Division

Version 1
December 2016

EXECUTIVE SUMMARY

The Nunavut Water Board (NWB) has issued Type A Water License 2AM-MEL1631 to Agnico Eagle Mines Limited (Agnico Eagle) for the Meliadine Gold Project site authorizing the use of water and the disposal of waste required by mining and milling and associated uses.

Agnico Eagle has prepared the following document which summarizes the operational and maintenance procedures to be followed at the sewage treatment plant (STP).

This report documents the stand alone Operation & Maintenance Manual – Sewage Treatment Plant, as specified under Water License 2AM-MEL1631 Part F, Item 9 and includes the following requirements:

- The manual was prepared in accordance with the “Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996”, and adapted for the use of a mechanical sewage treatment facility;
- The manual includes contingency measures in the event of a plant malfunction; and
- The manual includes sludge management procedures.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEL1631, Part D, Item 10, the proposed implementation schedule for this Plan is outlined below.

This Plan will be implemented upon Board approval and subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

Agnico Eagle Internal:

- Site Services Superintendent
- Site Services General Foreman
- Environmental Superintendent
- Senior Environmental Coordinator
- Environmental Compliance Counselor
- STP Operator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	16/12/2016			Operation and Maintenance manual

Version 1

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1 INTRODUCTION

1.1 PURPOSE

This Sewage Treatment Plant (STP) Operation and Maintenance (O&M) Manual for the Meliadine Gold Project (the Project) has been prepared in accordance with the Nunavut Water Board Type A Water License 2AM-MEL1631, Part F, item 9, and is based on the "*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996, prepared by the Department of Municipal and Community Affairs, NWT*". The manual has been adapted for the use of a mechanical sewage treatment facility.

This manual is a component of the Meliadine Environmental Management System. The objectives of this plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the treatment of sewage generated at the Meliadine Project; and
2. To provide monitoring requirements for the STP.

1.2 BRIEF DESCRIPTION OF THE PROJECT

Agnico Eagle is developing the Project, located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of the hamlet of Chesterfield Inlet in the Kivalliq Region of Nunavut. Situated on the western shore of Hudson Bay, the Project site is located on a peninsula between the east, south, and west basins of Meliadine Lake (63°1'23.8'' N, 92°13'6.42"W) on Inuit Owned Land.

Gold will be extracted using traditional open-pit and underground mining methods during the mine life. Access to the site is via an all-weather access road from the Hamlet of Rankin Inlet. On-site facilities will include a mill, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, and accommodation and kitchen facilities for 520 people.

1.3 CONTACT INFORMATION

The individuals responsible for the operation of the sewage treatment plant for the Meliadine Gold Project are the following:

Site services Superintendent	819-759-3555 ext 3910
Site services General Foreman	819-759-3555 ext 3980

2 DESCRIPTION

2.1 DESCRIPTION OF TREATMENT PLANT

2.1.1 Screening and Flow Equalization

Influent wastewater is pumped to the two (2) aerated equalization tanks. The equalization system is able to manage a variation in flows. It provides raw wastewater storage of up to 50% of the design flow to store feed during high flow periods and to ensure feed supplementation during low flow periods. It provides a stable and consistent raw feed for the downstream processes. Equalized water is pumped via two (2) equalization pumps into a standpipe inside the second tank and flows from that pipe by gravity to the fine screens. The fine screens are rotary drum screens with 2 mm perforated plate openings that operate continuously. The screens will ensure the removal of large debris to protect downstream equipment. Pressurized wash water is used intermittently to clean the screens and screenings.

2.1.2 Aerobic Biological Treatment

Screened raw water falls by gravity from the screens into the sump tank, where it is pumped to the aerobic tank, which is located outdoors. Aerobic biological treatment remove the organic load (measured as BOD) of the wastewater. Bacteria grown in the bioreactor remove unwanted organic pollutants to produce a treated water of high quality. Oxygen is supplied by regenerative blowers and is injected by fine bubble diffusers in the tank. The diffusers are designed for a wide range of air flows, according to the system's demand in oxygen. It keeps a dissolved oxygen concentration of at least 2 mg/L at any time to satisfy the needs of the biomass. The mixed liquor suspended solids (MLSS) overflows into a standpipe inside the tank and flows by gravity to the membrane filtration trains.

2.1.3 Membrane Filtration System

Membrane filtration is used to separate the bacteria from the water to ensure keeping them in the process at the desired concentration. Activated sludge is returned at a constant flow rate to the aerobic tank to prevent a build-up of sludge in the membrane tank. The return activated sludge (RAS) is pumped at a higher flow rate than the design flow rate of the plant, to make sure that there is good circulation in the whole system and that there is no accumulation of solids.

The membranes are totally submerged and have a pore size of 0.4 microns, which remove all suspended solids in the effluent.

Permeation pumps are provided to suction the effluent through the membrane modules and transport it to the permeate tank. Permeation pumps are supplied with variable speed drives to overcome any changes in transmembrane pressure and achieve the design at all times.

The operating cycle for the selected modules is to suction effluent water for seven (7) minutes and to relax the membrane for one (1) minute. The cycle optimizes the long-term operation of the membrane modules. The housings are constructed with an integrated diffuser at the bottom to aerate continuously the membrane and prevent clogging and accumulation of sludge. The relaxation of the membranes allows extending the interval between cleanings (CIP or Clean-In-Place). CIP cleans are done about twice a year. Washes are performed with permeate stored

in the permeate storage tank while a cleaning chemical (either sodium hypochlorite or citric acid) is added. Chemical solutions are reverse flowing through the membranes, which are soaked for a few hours after. After washing, the permeation is restarted. While a train is washing, the other train can continue to treat water and ensure a continuous production of effluent.

Once a week, a chemically enhanced backpulse (CEB) should be performed on the membrane modules with sodium hypochlorite to mitigate membrane fouling. Permeate flow is reversed to flow back into the membranes while the cleaning chemical is added inline.

2.1.4 UV Disinfection System

From the permeate pumps, each membrane bioreactor train sends permeate through an inline ultraviolet disinfection system. It is a physical process that inactivates instantaneously microorganisms. The UV system process adds no chemicals to the water, and therefore, has no impact on the chemical composition of the effluent. From here, effluent is sent to a common permeate storage tank. The permeate tank acts as a reservoir for treated water that is pumped to a discharge location. This tank can also be used for CEB and CIP process, as previously mentioned.

2.1.5 Sludge Handling System

Since bacteria continue to reproduce as the consume organics and nutrients, the concentration of biomass, measured as Mixed Liquor Suspended Solids (MLSS), increases with time. Periodic sludge wasting is required to control the MLSS concentration in the bioreactor tanks.

Sludge is sent to the sludge storage tank by redirecting the flow of the RAS pump. A blower and coarse bubble diffuser system maintains an aerobic environment within the sludge tank to minimize the proliferation of odours. Periodic settling is used to facilitate the thickening of the waste activated sludge. The supernatant (upper portion of the tank) is sent back to the sump tank by opening a valve, where it will re-enter the treatment process. This operation (called decanting) reduces the volume of sludge that needs to be handled and extends the period of time that the sludge tank can be used before thickened sludge is disposed.

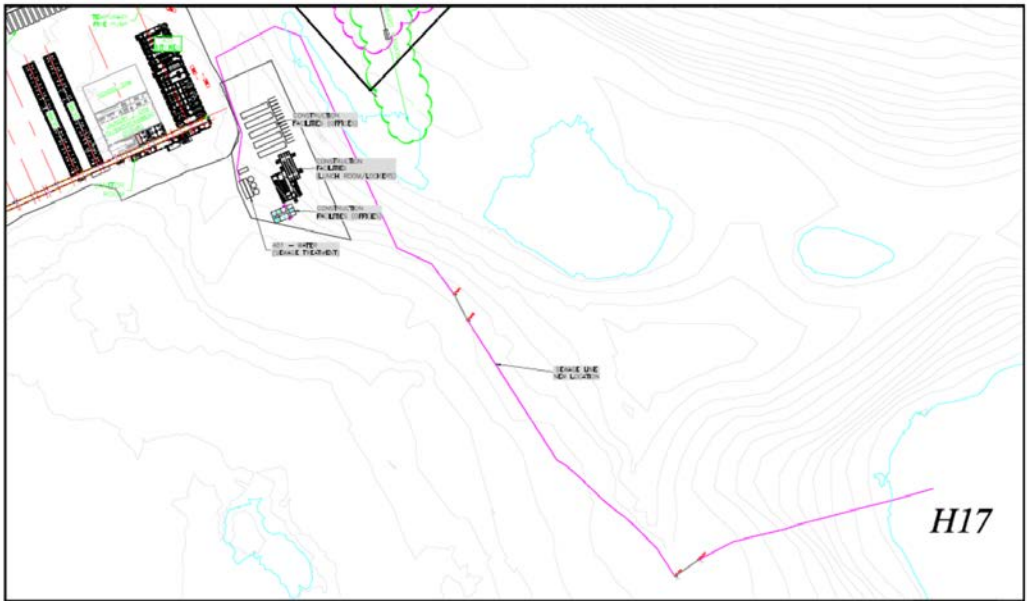

Figure 1 – Location of Meliadine STP and effluent pipeline to CP1 (former dewatered Pond H17)

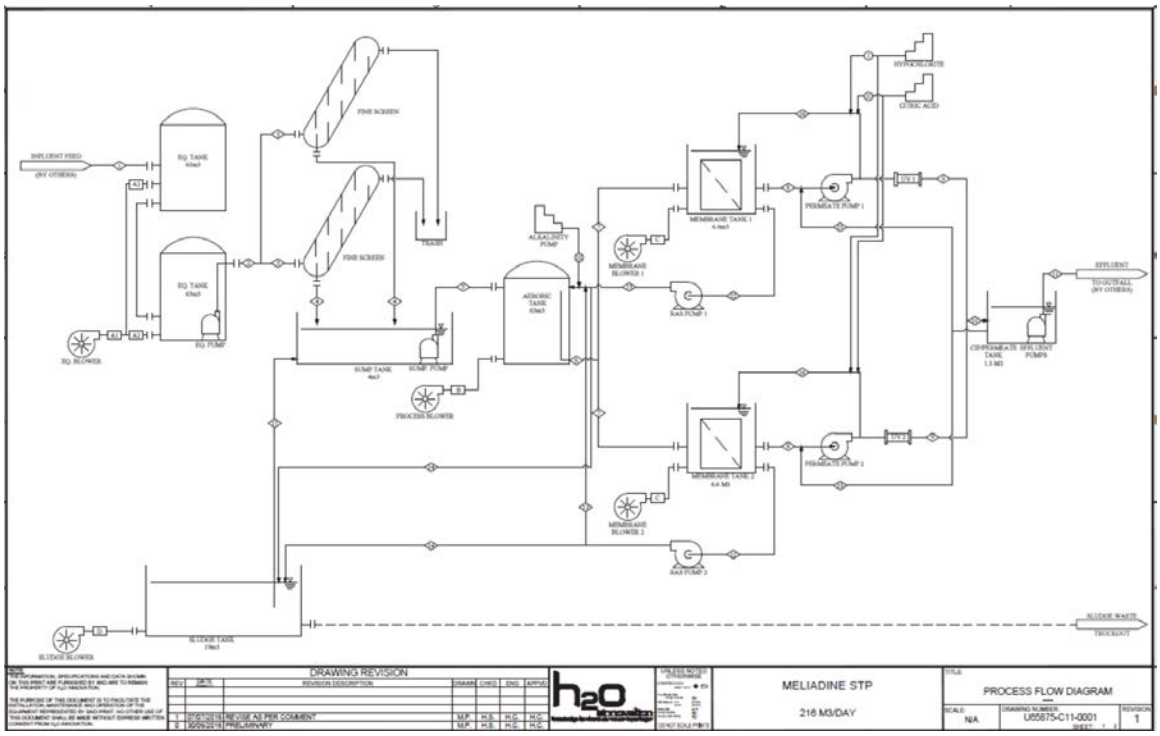

Figure 2 – Process flow diagram

2.2 SEWAGE GENERATION AND COMPOSITION

The Sewage Treatment Plant (STP) is housed in a prefabricated (modular) structure, located on the east side of the industrial pad. The sewage treatment system is designed for a maximum daily flow rate of 216 m^3 and a peak hour flow of 106 m^3, and an average Biological Oxygen Demand (BOD) in the influent of 200-360 mg/L.

The composition of the sewage and grey water entering the plant and the composition water exiting the units will be monitored on a weekly basis (to determine plant efficiencies).

3 OPERATION AND MAINTENANCE

3.1 WASTEWATER COLLECTION

Wastewater from the accommodation complex and from satellite sewage tanks will be treated in the Sewage Treatment Plant (STP) before being directed to Collection Pond 1 (CP1).

All sewage and grey water generated at Meliadine is drained by gravity pipelines to localized lift stations, then pumped to one of the two centralized collecting lift station. From those centralize lifts stations the effluent is pumped through a heat traced insulated pipeline to the STP equalization tanks. The number of lifting stations, and the building they service, is provided below.

- Lifting station 1 (local) service the dormitory wing A and connects to lifting station 11.
- Lifting station 2 (local) service the dormitory wing B and connects to the lift station 11.
- Lifting station 3 (local) service the dormitory wing C and connects to the lift station 11.
- Lifting station 4 (local) service the dormitory wing D and connects to the lift station 11.
- Lifting station 5 (local) service the dormitory wing E and connects to the lift station 11.
- Lifting station 6 (local) service the dormitory wing F and connects to the lift station 11.
- Lifting station 7 (local) service the dormitory wing G and connects to the lift station 11.
- Lifting station 8 (local) service the dormitory wing H and connects to the lift station 11.
- Lifting station 9 (local) service the dormitory wing I and connects to the lift station 11.
- Lifting station 10 (local) service the dormitory wing J and connects to the lift station 11.
- Lifting station 11 (main central) service the Main Camp complex, recover all sewage from kitchen, dormitories and recreation hall and pumped all the sewage to the STP equalization tanks. This is the primary line that feeds the STP.
- Lifting station 12 (local) service the Power plant and connect to the lift station 15.
- Lifting station 13 (local) service the Process plant and connect to the lift station 15.
- Lift station 14 (local) service the Assay laboratory and the Emergency responder building and connect to the lift station 15.
- Lifting station 15 (central) service the Power plant, the Process plant, the Assay lab, the ERT and the Multi-service truck shop building and pumped all the sewage collected to the STP equalization tanks. This is the secondary line that feeds the STP.

In addition to the sewage generated from the buildings above, a sewage vacuum truck collects sewage from storage tanks at different temporary or remote buildings such as the emulsion plant, the paste plant, the crusher building, the portal #1 and construction offices. This material is directly deposited into in the STP equalization tanks.

3.2 SLUDGE DISPOSAL

Sewage sludge removed from the STP will be added to the landfarm as nutrient amendment on an as needed basis. Excess sludge will be disposed of in the Tailings Storage Facility (TSF) or shipped south for disposal. Additional options to dispose of sludge will be further explored.

3.3 COLLECTION POND 1

The treated sewage from the STP is pumped through a heat traced insulated pipeline to CP1 pond which is designed to receive all the surface contact waters on site. This water is pumped to the final effluent treatment plant for TSS control prior to discharge into Meliadine Lake.

3.4 NORMAL OPERATIONAL AND MAINTENANCE PROCEDURES

The sections below outline the general operational and maintenance procedures at the plant; further details are available in the manufacturer' operating manuals in Appendix A (H2O Innovation).

In order to keep a properly functioning STP, certain material must be kept out of the influent raw sewage. These items are:

- Food and other kitchen grease are removed from the sewage in the kitchen via a grease trap. The grease trap is manually cleaned to keep this material out of the sewage treatment plant influent and the recovered grease is disposed in drums and shipped south for final disposal.

- Camp rules and purchasing practices prohibit anti-bacterial soap from being used on site to protect the biological activity in the STP process.

3.4.1 Chemicals Used in the Treatment Process

The dry bacteria product, BEC105, could be used in the treatment process to stimulate biological activity when needed.

3.4.2 General Operation & Maintenance and Sampling Procedures and Frequency

The STP at Meliadine will be put in service in February 2017. The following are the general Operation, Maintenance and Sampling procedures that will be employed when the plant will be in service. Further details of Operation, Maintenance procedures are provided in the equipment operating & maintenance manual (Appendix A).

Daily

A daily inspection of the sewage collection system, heat traced pipelines, and treatment plant will be conducted to ensure there are no spills or incidents to report.

Inspection and sampling sheets will be completed daily for the STP system, these forms include:

- Daily weather observations
- Temperature and pH of influent in the STP
- Influent flowrate
- Mixed Liquor Suspended Solids (MLSS) concentration range
- Discharge volumes
- Turbidity
- Dissolved Oxygen and pH measurements of the final discharge of the treatment unit
- Visual observations of the final discharge

Example daily/monthly record sheets are provided in Appendix B.

Weekly

On a weekly basis, many STP performance parameters will be monitored by the STP operator. Sampling forms will be completed on a weekly basis for the following parameters:

Treated Water sample:
- BOD (Biochemical Oxygen Demand)
- TSS (Total Suspended Solids)
- NH3 (ammonia)
- NO3 (nitrate)
- TP (Total Phosphorus)
- Alkalinity as CaCO3
- Total Coliforms
- Fecal Coliforms
- pH

Once a week, a chemically enhanced backpulse (CEB) should be performed on the membrane modules with sodium hypochlorite to mitigate membrane fouling.

Maintenance inspections and repairs, if necessary, will be performed weekly. It is primordial to check the entire system for signs of wear, deterioration and damage. These symptoms include excessive vibration, excessive or unusual noise, corrosion, pipes or loose connections and leaks.

Bi-annual

Twice a year, a Clean In Place (CIP) of the membrane will be performed by reversing the flow with chemical cleaning solution, After the reverse flow process, the membrane will soak in the cleaning solution for a few hours before being put back to service.

Twice a year, the bearing of the electrical motors of the pumps will be greased.

Twice a year, all instrument and sensors will be calibrated. It is also important to confirm the status of the level and pressure switches at least twice a year.

3.5 RECORD KEEPING

Records of the operational and maintenance and sampling procedures will be kept daily in order to assist in the evaluation of the effectiveness of the STP.

The following will be recorded on a daily basis:

- Volume of any effluent discharged to environment;
- Sewage volume collected; and
- Details of any maintenance undertaken at site.

As per water licence 2AM-MEL1631 Part I Item 9h, the following will be recorded on a monthly basis:
- Volume of sewage sludge removed from the STP
- Locations and methods of sewage sludge disposal

The record sheets will be kept in the STP office.

3.6 SAFETY PROCEDURES FOR OPERATORS

Employees working in the STP facility must be trained prior to commencement of work so that they are aware of the health and safety risks as well as the operational procedures associated with the STP. The following are important safety rules:

- Working with sewage requires adequate protection for operators. This includes wearing steel toed boots, hard hat, rubber aprons, protective glasses with side shields, protective gloves, and ear plugs.
- All authorized personnel working in the STP must have received Hepatitis A and B vaccine.
- Operator need to keep his working area clean to minimize the risk of accidents.
- Regular personnel hygiene (like washing hands) is important to prevent illness.
- Always follows the Lock-out , tag-out procedures when servicing equipment.
- No person shall drink the water in the plant or the water that is discharged from the STP.
- MSDS for all chemical used in the STP plant will be readily available for the operator.

Safety showers and eyewash are located within proximity of chemical systems in the STP plant.

3.7 CONTROLLING ACCESS TO STP

Access to the STP at Meliadine will be restricted to authorized personnel only. All doors to the plant will be locked, with only authorized persons having keys. Signs will be posted on the STP entrance doors notifying all people that the entrance to the STP is for authorized personnel only.

No fencing is used to control access to the STP. Due to the remote nature of Meliadine, there is no concern of non-mine personnel attempting to access the site.

4 EMERGENCY RESPONSE

4.1 FIRE

In case of fire at the STP, the on-site emergency response team will be notified as per Agnico Eagle's protocol. Instructions from the on-site emergency response team will be followed by all personnel at the STP. Further details of fire response are provided in the "*Risk Management & Emergency Response Plan*".

4.2 SPILL

In the event of a spill at the STP, the on-site emergency response team will be notified as per Agnico Eagles's protocol. Instructions from the on-site emergency response team will be followed by all personnel at the STP. Further details of spill response are provided in the "*Spill Contingency Plan"*.

4.3 PLANT MALFUNCTION

If there is major problem or failure in the STP it would be most likely due to changes in the influent (raw sewage) (i.e. high strength sewage (BOD high) killing bacteria in the STP). In this case, there would be visible effluent problems (part of daily operational checks), low dissolved Oxygen (part of daily operational checks) and increased odours that the operator would note. If this occurs, a sample will be taken to try to determine the source of the problem.

In the event of a failure of the STP, there are four (4) holding tanks at the Exploration camp STP that can be temporarily used.

The following other contingent measures can be applied by Agnico Eagle in the event of a malfunction at the Meliadine STP for more than 24 hours:

- Cut back on allowable camp water until the malfunction is corrected and use the equalization tank to retard the peak flow to the functional unit;
- Shut down the malfunctioning unit until the malfunction is repaired and use only one of the two parallel units until repairs are completed;
- Shut down all water use in the camp until the repairs are completed; and
- Bypassing untreated STP influent around the malfunctioning unit and holding this untreated influent in a holding tank or lined pond on site until the repairs are complete is another contingent measure that could be applied. The untreated sewage would then be pumped back to the STP when the unit is repaired. This will require the coincidental restriction of water use to minimize the volume of untreated influent being bypassed.

Appendix A: H2O Innovation Operation and Maintenance Manual

Agnico Eagle Mines Limited
Meliadine Containerized Waste Water Treatment Plant

J04

Operation & Maintenance Manual

U65875–J04–0001

h2o innovation®

SECTION 1 - CONTACTING H_2O INNOVATION

If you need telephone or on-site service support, chemicals, membranes, filters, or spare parts for your system, please contact your H_2O Innovation SP&S Regional Manager. If they are unavailable or to place standard orders the following contact information can be used.

Service in the United States
(763) 566-8961
service.us@h2oinnovation.com

Service in Canada
(418) 688-0170 #321
service.ca@h2oinnovation.com

Should you require EMERGENCY support for anything other than a chemical spill, you can contact our 24-hour hotline at 1-855-H20-SRVC (1-855-426-7782). The number is not routed to a call center, but rather it will ring the cell phone of the service person on-call. While we cannot commit to an immediate answer, our goal is to respond to emergency calls within 2 hours. For emergencies regarding chemical spills, refer to the SDS for the specific chemical.

Please note that the following standard rates may apply (all rates are valid for 2016 calendar year – please contact H_2O Innovation for a current rate sheet if required).

Table 1: Service Rates

Role	Hourly Rate
On-site: Field service technician [1-4]	$125
On-site: Engineer or Programmer [1-4]	$125
Off-site: Field service technician [5]	$125
Off-site: Engineer or Programmer [5]	$125

Notes:
1. Hours in excess of a 10-hour work day will be invoiced at 1.5 x the applicable labor rate.
2. Automobile mileage expenses will be invoiced at $0.56 / mile.
3. Hotel, airfares, flight change fees and related travel expenses will be invoiced at 1.15 times cost.
4. Meals will be invoiced at a per diem rate of $58.50.
5. Including on site visit preparation, travel time, support by telephone or email and report writing time.

SECTION 2 - SYSTEM OVERVIEW

2.1 - INTRODUCTION

This operation and maintenance manual, submitted by H_2O Innovation, is intended for a membrane bioreactor containerized waste water treatment plant. This system consists of the following subsystems:

1. Screening and Flow Equalization
2. Aerobic Biological Treatment
3. Membrane Bioreactor (MBR) Filtration System
4. Ultra-Violet Treatment System
5. Sludge Handling System and Tank

This waste water treatment plant is designed for municipal sewage surface water discharge. The system was based on a maximum daily flow of 216 m^3/day, with a peak hourly flow of 106 m^3/hour. The equalization system is designed for a peak hourly flow lasting no longer than 1 hour over a 24 hour period.

This manual is intended to cover various equipment, instruments and valves that make up the wastewater treatment system and the specifications and design conditions. Equipment that is not part of H_2O Innovation's supply is not covered in this manual. Moreover, it is beyond the scope of this manual to describe the operating processes and control systems that are not provided by H_2O Innovation.

This manual contains drawings of the system, process and instrumentation diagrams, wiring diagrams, maintenance procedures and any other documents necessary for operation. In addition, subsequent parts of this manual contain the necessary technical documents, obtained from manufacturers, to operate specific components and ensure good maintenance procedures.

2.2 - PROCESS DESCRIPTION

2.2.1 - SCREENING AND FLOW EQUALIZATION

Influent wastewater is pumped the two aerated equalization tank. The equalization system is able to manage a variation in flows. It provides raw wastewater storage of up to 50% of the design flow to store feed during high flow periods and to ensure feed supplementation during low flow periods. It provides a stable and consistent raw feed for the downstream processes. Equalized water is pumped via two equalization pumps into a standpipe inside the second tank and flows from that pipe by gravity to the fine screens. The fine screens are rotary drum screens with 2 mm perforated plate openings that operate continuously. The screens will ensure the removal of large trash and debris to protect

downstream equipment. Pressurized wash water is used intermittently to clean the screens and screenings.

2.2.2 - AEROBIC BIOLOGICAL TREATMENT

Screened raw water falls by gravity from the screens into the sump tank, where it is pumped to the aerobic tank, which is located outdoors. Aerobic biological treatment remove the organic load (measured as BOD) of the wastewater. Bacteria grown in the bioreactor remove unwanted organic pollutants to produce a treated water of high quality. Oxygen is supplied by regenerative blowers and is injected by fine bubble diffusers in the tank. The diffusers are designed for a wide range of air flows, according to the system's demand in oxygen. It keeps a dissolved oxygen concentration of at least 2 mg/L at any time to satisfy the needs of the biomass. The mixed liquor suspended solids (MLSS) overflows into a standpipe inside the tank and flows by gravity to the membrane filtration trains.

2.2.3 - MEMBRANE FILTRATION SYSTEM

Membrane filtration is used to separate the bacteria from the water to ensure keeping them in the process at the desired concentration. Activated sludge is returned at a constant flow rate to the aerobic tank to prevent a build-up of sludge in the membrane tank. The return activated sludge (RAS) is pumped at a higher flow rate than the design flow rate of the plant, to make sure that there is good circulation in the whole system and that there is no accumulation of solids.

The membranes chosen for this plant are manufactured by Hydranautics. The HSM450-ES-HSE15 model is totally submerged and has a pore size of 0.4 microns, which remove all suspended solids in the effluent.

Permeation pump are provided to suction the effluent through the membrane modules and transport it to the permeate tank. Permeation pumps are supplied with variable speed drives to overcome any changes in transmembrane pressure and achieve the design flows at all times.

The operating cycle for the selected modules is to suction effluent water for seven minutes and to relax the membrane for one minute. The cycle optimizes the long-term operation of membrane modules. The housings are constructed with an integrated diffuser at bottom to aerate continuously the membrane and prevent clogging and accumulation of sludge. The relaxation of the membranes allows extending the interval between cleanings (CIP or Clean-In-Place). CIP cleans are done about twice a year. Washes are performed with permeate stored the permeate storage tank while a cleaning chemical (either sodium hypochlorite or citric acid) is added. Chemical solutions are reverse flowing through the membranes, which are soaked for a few hours after. After washing, the permeation is restarted. While a train is washing the other train can continue to treat water and ensure a continuous production of effluent.

Once a week, a chemically enhanced backpulse (CEB) should be performed on the membrane modules with sodium hypochlorite to mitigate membrane fouling. Permeate flow is reversed to flow back into the membranes while the cleaning chemical is added inline.

2.2.4 - UV DISINFECTION SYSTEM

From the permeate pumps, each membrane bioreactor train sends permeate through an inline ultraviolet disinfection system. It is a physical process that inactivates instantaneously microorganisms. The UV system process adds no chemicals to the water, and therefore, has no impact on the chemical composition of the effluent. From here, effluent is sent to a common permeate storage tank. The permeate tank acts as a reservoir for treated water that is then pumped to a discharge location. This tank can also be used for CEB and CIP processes, as previously mentioned.

2.2.5 - SLUDGE HANDLING SYSTEM

Since bacteria continue to reproduce as they consume organics and nutrients, the concentration of biomass, measured as MLSS, increases with time. Periodic sludge wasting is required to control the mixed liquor suspended solids (MLSS) concentration in the bioreactor tanks.

Sludge is sent to the sludge storage tank by redirecting the flow of the RAS pump. A blower and coarse bubble diffuser system maintains an aerobic environment within the sludge tank to minimize the proliferation of odours. Periodic settling is used to facilitate the thickening of the waste activated sludge. The supernatant (upper portion of the tank) is sent back to the sump tank by opening a valve, where it will re-enter the treatment process. This operation (called decanting) reduces the volume of sludge that needs to be handled and extends the period of time that the sludge tank can be used before thickened sludge must be disposed of.

2.3 - DESIGN PARAMETERS

The main design parameters and the general configuration of this wastewater treatment system are presented in the tables below. Table 2 presents the flows that were considered for the design.

Table 2: Wastewater Treatment Plant Typical Flows

Typical Flow	Value
Maximum Daily Flow (ADF)	216 m^3/day
Design Flow	216 m^3/day
Peak Hour Flow[1]	106 m^3/hour

Note 1 : The equalization system is designed for a peak hourly flow lasting no longer than 1 hour over a 24-hour period.

Table 3 presents the influent characteristics and the effluents limits.

Table 3 : Influent Characteristics and Effluent Limits

Parameter	Influent Average	Effluent Quality
BOD_5 (Five-day Biochemical Oxygen Demand)	200-360 mg/L	< 25 mg/L
TTS (Total Suspended Solids)	50-350 mg/L	< 25 mg/L
Alkalinity	250-500 mg/L	50 mg/L
TKN (Total Kjeldahl Nitrogen)	45-60 mg/L	-
Ammonia Nitrogen (NH_3-N)	40-50 mg/L	0,89 mg/L
Total Phosphorus	5-12 mg/L	-
E. Coli	-	1000 MPN / 100 mL
pH	6,5-8,5	6-9
Temperature	10-20 °C	-
Fats, Oils and Grease	20-50 mg/L	15 mg/L

Please note that benzene, toluene, ethylbenzene, lead and aluminum are not specifically targeted or removed during the wastewater treatment process and can therefore not be guaranteed.

The design parameters of this system are shown is the following table.

Table 4: Design Parameters of the Waste Water Treatment Plant

Parameter	Value
Number of process trains	1
Number of membrane trains and UV systems in the process train	2
Number of membrane modules per membrane trains	1
Total Membrane Area	900 m^2
Design Flow	206 m^3/d
F:M (Food to Microorganism) Ratio	0.1 kg_{DOB}/kg_{MLSS} per day
Targeted MLSS (Mixed Liquor Suspended Solids) Concentration	< 10 000 mg/L

The membrane filtration and UV disinfection systems operate as two separate trains. Therefore, if maintenance is required for any piece of equipment on one of the trains, the plant can continue to operate on one train treating the full flow for short periods. In the event of very low sewage production, a train can be put offline by draining and flushing the systems and filling the membrane tank with permeate. The membranes must **always** be kept wet once they are commissioned.

2.4 - CRITICAL PARAMETERS OF RAW WATER

This configuration is based on the parameters provided in your application package. If significant changes in the concentrations of raw water cause a need for additional treatment equipment, these will be the customer's expense.

Warning: The system can be damaged if water of a different composition that the one that has been submitted is used. A change in the composition of water may request additional equipment, more frequent washing or other different operating procedures. Please also note that the system performances may vary with the quality of the water influent.

Table 5 shows the critical parameters of raw water that need to be respected at all times to make sure not to affect the integrity of the membrane modules.

Table 5: Critical Parameters of Raw Water

Parameter	Value
Minimum Temperature of Raw Water	5°C
Maximum Temperature of Raw Water	40°C
Feed Water pH Range	6-8
MLSS (Mixed Liquor Suspended Solids) Concentration Range	8 000 – 12 000 mg/L

When properly operated and maintained, the process and equipment designed for this plant adequately addresses the water influent and easily meets the operations specifications. If the feed water is no longer situated in the parameters previously defined due to a change in the quality of the raw water or equipment failure of the unit, you must not operate the equipment and this until the situation is rectified. The situation is restored when the raw water is once again within the operating parameters or if the situation has been evaluated by H_2O Innovation and a discharge is given to continue operations. Continue operations with raw water that exceeds the critical parameters can cause irreversible damage.

SECTION 3 - PRE-OPERATIONAL PROCEDURES

3.1 - INSTALLATION INSTRUCTIONS

3.1.1 - INTRODUCTION

It is expected that the contractor installing this system is familiar with normal construction means and methods for water treatment equipment of this nature and that detailed instructions for installation are not required. Since the installation of the system is outside of H_2O Innovation's scope, the following is provided as general guideline only. Typical construction site safety practices must be followed as a priority. It is critical to review the safety section of this manual before any work begins: Section 7 – Safety.

For each item that is loose shipped with the system, follow the installation instructions included in Section 10 – Vendors O&M Data and Manuals of this manual. This also applies to the membranes provided with the system (if included). When membranes are included, membrane elements need to be protected from drying, freezing and systems must be fully depressurized before loading or unloading membrane elements. Membranes are typically one of the last components to be installed in the plant.

It is not expected that a representative from H_2O Innovation will be on site during the installation phase of the project. Unless special provisions are included in the scope of this project, the H_2O Innovation representative will only come to site once installation has been certified as complete by the contractor.

The following sections provide some general guidelines when it comes to installing the system. Refer to the project drawings (Section 9 – Drawings and Diagrams) for details on how the system is designed and configured. The drawings that the installation contractor will need are included with this manual and are typically piping and instrumentation diagrams (P&IDs), general arrangements (GAs), assembly drawings, and electrical drawings, etc. Drawings provided by the Owner's engineer or other outside firms should also be referred to and discrepancies noted to all affected parties for resolution. Ensure that drawings are red-lined and updated as changes are made in the field. These red-lined drawings must be forwarded to H_2O Innovation before the field service representative comes to site.

Before performing any installation work please read the section in this manual on safety: Section 7 – Safety.

3.1.2 - SHIPPING, RECEIVING AND STORAGE

Equipment will be typically packaged and shipped from one of H_2O Innovation's factories. Drop shipments are also possible for loose ship items. Please discuss timing of shipments with the H_2O project manager so that receipt can be coordinated with other site activities. All shipments must be inspected on arrival for signs of damage or discrepancies with the packing slips. Any noted damage must be photographed immediately and a report sent to H2O Innovation. Typically, ownership of the equipment transfers to the installation contractor at the reception of the equipment on site. Damage that occurs after ownership has transferred will not be the responsibility of H_2O Innovation.

Equipment should be stored on site by the installation contractor in a dark, dry location and secured to prevent theft. Temperature should be controlled to between 5°C and 30°C. Ensure control panel doors are kept closed unless the panel is being worked on. This will help to keep the interior clean. Keep strong electromagnetic radiation sources away from the sensitive electrical equipment that comes in control panels and instrumentation during storage and installation.

If rotating equipment is going to be left on site for extended periods, please inform the H_2O Innovation project manager so that advice on how often to rotate shafts can be provided. Also, electrical connection to specific equipment heaters may be needed to prevent condensation, particularly in motors.

3.1.3 - SKID AND TANK MOUNTING

Supports for skids or loose ship items typically consist of a 4" to 6" concrete housekeeping pad that has been designed by a local structural engineer and installed by the site contractor. Foundations for the pads need to be designed to support the planned, wetted equipment weight. It is also possible that other arrangements have previously been discussed and agreed with H_2O Innovation engineering and are reflected on the project drawings. The net result in either case is that a solid, level surface is required around the entire perimeter of the skid frame, equipment item or tank bottom to provide support for the equipment and dampen vibrations.

Lifting procedures are typically produced by specialized contractors on site. H_2O recommends using spreader bars such that angular loads are not applied to lifting lugs on skid frames and tanks.

Skids and tanks are typically anchored to the mounting surface. Anchors are usually specified by a licensed structural engineer for the specific plant location. Refer to the project submittals and drawings for information on anchorage requirements. Anchors should always be installed according to their installation instructions.

3.1.4 - EQUIPMENT INSTALLATION

Place all major components, such as pumps, blowers, skids and tanks as shown on drawings provided in this manual (9.3– General Arrangement Drawings). Ensure any valves or other components that were removed for shipping are placed in the correct location and fastened.

Major equipment items are often grouted in place. Please refer to specific installation instructions for each item to see if grouting is required (Section 10 – Vendors O&M Data and Manuals). After grouting has been completed and set, align all rotating equipment as described in the installation instructions.

Perform initial startup procedures (vibration checks, bumping) for all rotating equipment as per manufacturer instructions and contractual requirements.

3.1.5 - VALVE INSTALLATION

Butterfly valves should be installed in the partially open position and stroked during the installation process. Please see manufacturer's specific instructions in Section 10 – Vendors O&M Data and Manuals. Mating pipe flanges need to be aligned tangentially and also with an axial gap that agrees with the valve lay length so that no loads are applied to the valve in any direction when it is in place.

Butterfly valves that are installed in lines that could see sediment, solids or two phase flow should be installed such that the valve shaft is horizontal. This allows passage of solids and air.

Ball valves should not be used to support piping loads. Threaded metallic valves should be installed using double pipe wrenches and appropriate sealant on the joints. Orientation is not a concern for ball valves in general. Ensure packing is torqued to the requirements in the vendor information.

3.1.6 - NOZZLES AND PIPING

Interconnecting piping that is not included in H_2O Innovation scope, needs to be supplied by the installation contractor. All piping should be installed according to the drawings provided by both H_2O Innovation and the Owner's Engineer.

Mating piping must not impart a load in any direction to nozzles or other connections on a skid or tank. This means that piping must be fully supported such that if the equipment or skid flange is removed, the piping will remain in its place. Pipe support designs are typically completed and sealed by a structural engineer for the jurisdiction in which the plant is being installed. The engineer should also take dynamic loads due to moving fluids and operating pressure into account in the design of the piping system. Note that PVC piping requires support more often than metallic piping and there are known standards for how often this piping needs to be supported.

Skid and tank drain connections for block and bleed lines, instrument sample drains or general process drains must be designed with an air gap (unless specified otherwise) and sized to accommodate the full expected design flow plus a generous safety margin. Generally speaking, a sloped floor drain should be located in the vicinity of each skid to provide a destination for instrumentation drains and piping maintenance drains. Instrumentation drains should be plumbed into the drain so that slip hazards are not created by water flowing across the floor.

It is expected that the installation contractor will flush all piping before commissioning (this includes factory installed piping. H_2O Innovation recommends that potable water be used for pipe and tank

flushing. Frequent visual inspections during construction can be helpful to remove construction trash and dust that often ends up in piping systems.

Piping is often lined for corrosion protection. This is true of carbon steel pipe and also stainless steel pipe. Stainless steel has a thin chromium oxide layer that provides the inherent corrosion protection. Welding, heating or mishandling any of these piping and fittings can damage the coatings and thus compromise the corrosion protection. Metallic piping that is perpetually wet on the outside due to building ventilation issues (or other HVAC issues) is particularly prone to corrosion. Building ventilation needs to be sized to control condensation inside buildings.

Stainless steel components (not just piping) should not be handled by mild steel equipment (like mild steel forklift tines or chains) as the stainless steel surface can be marred or scratched resulting in the loss of corrosion resistance. Carbon steel can be imbedded in the stainless surface and lead to corrosion. *Keep carbon steel from contacting stainless steel during the installation process and only use tools that are dedicated for use on stainless steel when installing and working with stainless steel.*

Also, if stainless steel is stored outdoors, it should be covered and protected from the blowing dust and sand that is common on construction sites. The surface of the stainless steel can be abraded and damaged when stored outdoors. Also, when grinding or welding near stainless steel, protect the material with guards or ensure that the stainless is thoroughly cleaned, pickled and passivated afterwards (it is possible to use pickle/paste compound, but this method is not suitable for large surfaces or is not a substitute for pickling according to ASTM A380 in an acid bath).

Stainless steel can also be subject to attack by chlorides and sources are common in water treatment plants (salt water, sodium hypochlorite). Ensure that all steel surfaces are kept away from chloride sources that they are not designed to protect against.

Polyvinyl chloride (PVC) piping is brittle and care should be used when handling components made of PVC. Temperature extremes should also be avoided with PVC as well as mechanical stresses. PVC is not ultraviolet (UV) resistant and should not be stored where sunlight can contact the surface (this includes both direct and indirect sunlight). Chlorinated polyvinyl chloride (CPVC) piping does have higher UV, chemical and temperature resistance but the same general storage guidelines should be followed. PVC is not designed to convey compressed gasses (like air). Air must be completely bled from all PVC or CPVC lines before equipment is put into operation.

High density polyethylene (HDPE) is often used as an alternative to PVC. The key factor when installing HDPE piping is that it expands and contracts significantly with temperature shifts. Temperature can be changed in an HDPE pipeline by internal factors (e.g. during a high temperature CIP) or by external factors (e.g. a stagnant line exposed to sunlight). The support system and joints need to be designed to accommodate this expansion and contraction of HDPE.

Joints in chemical lines should not be located over electrical equipment or over areas where operators could reasonably be anticipated to be on a regular basis. Ideally, chemical system joints have flange

guards installed such that leakage can be detected visually. Another approach for chemical systems is to use double-walled piping with leakage detection systems.

Follow torquing recommendations provided by equipment vendors for all bolted connections; ideally by hand and not with power tools. Connections should be torqued in a star pattern to apply even force to the flanges or joints. Please ensure that the required flat washers and lock washers are included with these connections and that the bolt heads and nuts lie flat on the washers.

Note that stainless steel bolting will require an appropriate anti-seize compound applied to the threads before the connection is made. Fastening hardware specifications are listed on H_2O Innovation drawing notes and must be followed. These hardware specifications are applicable to shop manufactured equipment and field assembled components. For connections that are submerged, use NSF approved anti-seize in drinking water applications (e.g. White Knight food grade anti-seize compound).

3.1.7 - ELECTRICAL INSTALLATION

Refer to the project electrical drawings in this manual (Section 9 – Drawings and Diagrams) and the plant electrical drawings provided by the Owner's engineer. Electrical connections and interconnections to junction boxes and panels provided by H_2O Innovation must meet regulatory and local standards. Electrical work must be completed by licensed and insured electricians in the jurisdiction where the facility is being constructed. Interconnecting electrical cables need to be sized for the maximum anticipated electrical load and well supported in trays or conduit. Use separate cable trays for 24 VDC, 120 VAC and 600 VAC wire runs. Ensure that all panels, skids and cable trays (and electrical equipment in general) are properly and adequately grounded.

Generally speaking, systems will have a control panel and a power panel (these are often combined in smaller plants). Both panels need to be mounted and anchored in accordance with the project drawings. Like mechanical equipment, electrical equipment needs to be anchored according to local structural requirements if it is loose ship. Pre-mounted panels are taken into account when analyzing the support frames.

Field mounted instrumentation is normally wired to either a local junction box or back to the main control panel. This will be detailed in the electrical drawings for the plant. Ensure that the wire numbers depicted in the electrical drawings are clearly shown and permanently labeled on the field cables. Ensure that the electrical drawings are red-lined and updated as changes are made in the field. These red-lined drawings must be forwarded to H_2O Innovation before the field service representative comes to site.

Once equipment has been installed and wired the on-site electrician typically:

1. Bumps three phase motors to ensure that they have been wired for the correct rotational direction and changes the wiring if not correct.
2. Performs a continuity test for all field wiring.

3. Powers up the panels.
4. Ensures that all analog and digital signals to and from the Programmable Logic Controller (PLC) are transmitting properly.
5. Calibrates all instruments (see Section 3.3 – Calibration and Instrument Care).
6. Red lines electrical drawings with any changes that occurred in the field.
7. Shuts off power feeding the plant to ensure that the UPS is working properly.
8. Ensures that all of the remote IO is communicating with main PLC. Since a ring topology configuration is typically used, any Ethernet cable or fiber optic cable can be disconnected and the system should remain connected and communicating.

3.2 - COMMISSIONING

Before performing any commissioning work on this system please read the section in this manual on safety: Section 7 – Safety.

Commissioning services and on-site support are included in the contract and provided by H_2O Innovation. Refer to specific documentation related to commissioning for detailed information. Typically, the customer or contractor is responsible for ensuring a supply of electricity, raw water and a receiving destination for the treated water for pipe and module flushing and performance testing of the equipment. Also, the customer is responsible for the provision of necessary analytical tests for treated water quality during performance testing.

The services of a qualified electrician, pipefitter and millwright are required when H_2O Innovation staff are on site. The costs for these journeyman services are normally excluded from the commissioning contract value.

3.3 - CALIBRATION AND INSTRUMENT CARE

Before performing any calibration work on this system please read the section in this manual on safety: Section 7 -Safety.

Table 6 provides some general guidance on calibration and care for instruments in this facility and where to find the vendor information related to each type of instrument.

Table 6: Calibration and Instrument Care Guidance Summary

Manufacturer	Instrument	Frequency	Necessary Materials	Tab
ABB	Pressure Transmitter	Semi-annual	None	A1-1
ABB	Turbidimeter	Quarterly	None	A1-2
Chemline	Isolated Pressure Gauge	Semi-annual	Glycerin , replacement diaphragm (if required)	C1-5
Endress & Hauser	Level Transmitter	Annual	None	E1-4
Endress & Hauser	Electromagnetic Flowmeter	Semi-annual	Replacement seals	E1-7
Endress & Hauser	pH sensor	Semi-annual	Calibration solution	E1-2
Endress & Hauser	Dissolved Oxygen Sensor	Monthly	Replacement electrolyte, membrane body and sealing ring (if required)	E1-5
Endress & Hauser	Pressure Transmitter	Semi-annual	None	E1-6
IFM	Air Flowmeter	Monthly	Alcoholic cleaning solution	I1-1 I1-2
Wika	Pressure Gauge	Semi-annual	Glycerin	W1

SECTION 4 - SYSTEM CONFIGURATION

This membrane bioreactor system provided by H_2O Innovation is fully automated, which greatly reduces the operator's work. The system also includes monitoring functions and remote control access which allows more time for the operator to do other tasks. Refer to the literature and manufacturers manuals that are provided at the end of this manual for a detailed description of installation, operation and maintenance of any specific component.

The system designed for the Meliadine Project wastewater treatment plant is based on aerobic biological treatments. The figure below shows the process schematics for this plant.

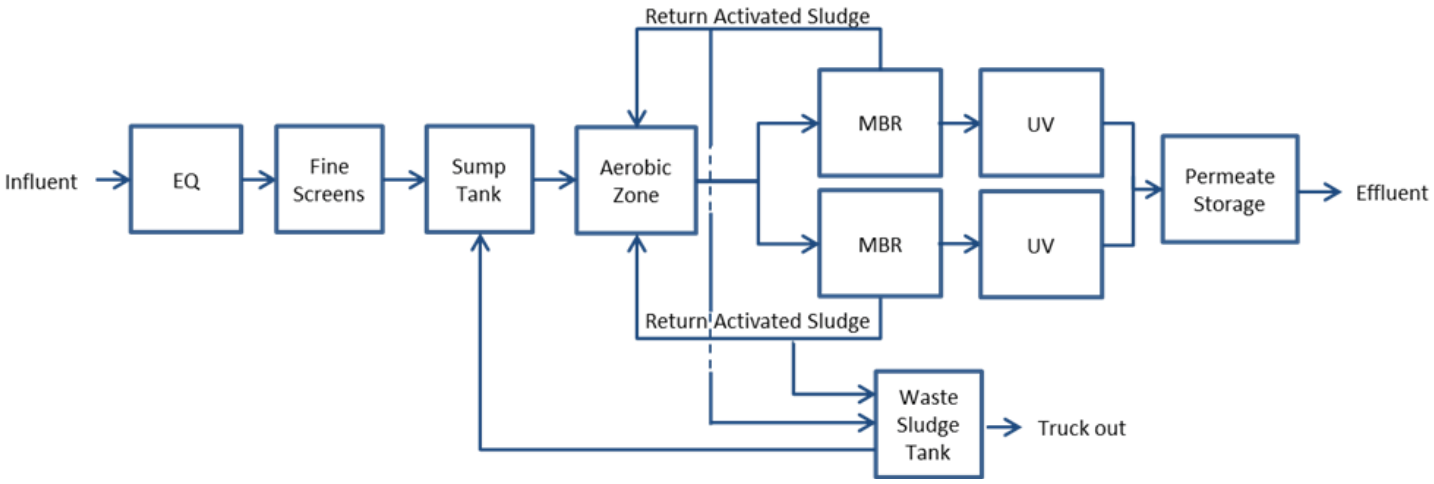

Figure 1 : Process Flow Schematics

The process illustrated above is much more detailed in the process and instrumentation diagrams (P&ID) available in Section 9.1 of this operation and maintenance manual. A basic understanding of the relationship between the different components of the system is a prerequisite to operate well and make effective maintenance of the system. The study of the drawings listed in the table below combined with the reading of Section 2.2 – Process Description provides the necessary understanding as previously mentioned.

Table 7 : Description of Process and Instrumentation Diagrams (P&ID)

Drawing Number	Drawing Name
U65875-C01-0110	Raw Water Screening
U65875-C01-0190	Feed Water Equalization
U65875-C01-0720	Aerobic Tank
U65875-C01-0740	Membrane Filtration
U65875-C01-0750 Sheet 1 and 2	Blowers for Membrane Bioreactor System
U65875-C01-0790	Permeate Tank
U65875-C01-0800 Sheet 1 and 2	Dosing Skid – Cleaning Chemicals and Alkalinity
U65875-C01-0960	Sludge Handling System

SECTION 5 - OPERATION PROCEDURES

Before operating the system, please read the section in this manual on safety: Section 7 – Safety.

This wastewater treatment system is controlled by digital input signals and a specific start sequence for the system. In this way, a transition step by step is done slowly and smoothly from a normal start up to an automatic process. The shutdown sequence is similar and closely follows the startup procedure.

Each piece of equipment forming this system appears on the touch screen that acts as the human-machine interface (HMI). When the symbol of a piece of equipment is selected, a screen appears, allowing the operator to configure and control this specific piece of equipment. From the screen, the operator can configure the device for a *control by the operator* or a *control by PLC* (automatic).

If the piece of equipment is set to *control by the operator mode*, the equipment starts to operate, regardless of the status of the plant. If the equipment is set to off, it will stop regardless of the status of the plant.

If the equipment is set in *control by PLC mode*, it will start or stop according to the selected mode and settings from the plant. For equipment whose speed can be controlled, such pumps with variable speed drives, the operator must enter a specific speed from 0-100%.

It is therefore possible to control each piece of equipment independently according to the desired results. The membrane bioreactor system is very simple to operate and requires set-up and monitoring as described in this section.

5.1 - MODES OF OPERATION OF THE SYSTEM

For more information on the modes of operation of this system as well as on the control philosophy, please refer to Section 8.1 – Process Control Narrative of this operation and maintenance manual. There are five modes of automatic operation on the provided system. They are described in table 8 below.

Table 8 : Modes of Operation of the System

Mode	Description
OFF	All process equipment is OFF.
Production	Production Mode occurs during normal operation when sewage is being sent to the plant. All process equipment operates based on the automatic control logic to provide treatment of sewage.
Standby	Standby Mode occurs when the amount sewage being sent to the system is less than the system capacity such that the system must wait for adequate feed to continue operation.
CEB	Chemically Enhanced Backpulse (CEB) is a weekly membrane maintenance process that sends a reverse flow of cleaning agents in the membrane modules to mitigate membrane fouling.
CIP	Clean-In-Place (CIP) is a process designed to return the membranes to a near-clean state using a high chemical concentration and relatively long duration (4 hours). The process is conducted semi-annually or as required.

The sequence of operation chart, presented in Section 8.1 – Process Control Narrative, determines which equipment is working according to each of the operating modes.

5.2 - MODES OF OPERATION OF THE DOSING SYSTEM

For the chemical skid to be operational, the valves must be arranged to allow the chemical to flow from the tank to the designated service point. For the chemical pump to be calibrated, the valves must be arranged to allow the chemical to flow from the tank to the calibration column. After calibration the column should be emptied before returning back to service. The valves must be arranged to allow the chemical to flow from the calibration column back to the tank. All these modes of operation are achieved by opening and closing the valves according to table 9 below.

Table 9 : Valve Positioning for the Modes of Operation of the Dosing System

Tag Number	Calibration Filling	Calibration Emptying	Operation
HV-XXX01	O	O	O
HV-XXX29	X	X	X
HV-XXX50	O	O	O
HV-XXX99	X	X	O
HV-XXX15	O	X	X
HV-XXX12	X	O	X
HV-XXX53	X	O	X
HV-XXX52	O	O	O

5.3 - EQUALIZATION PUMPS SET-UP AND AUTOMATIC OPERATION

The equalization pump should be set-up to operate at the average day flow rate (this is expected to change over time and requires regular adjustments). This flow can be monitored using the feed flow meter. Although the plant is designed for an average day flow rate of 206 m^3/day, the pump should be set to provide a flow rate that reflects the average flow that the system actually sees. This flow calibration should be done during a condition where the equalization tank level is just above the level of the pumps. The totalizer on feed flowmeter should be manually logged at the same time each day so that the cumulative volume that has passed through the system can be calculated for each 24-hour period. This will allow a reasonable estimate of the expected average day flow rate.

If the plant has very low or no flow for a period of 48 hours or more, please contact H_2O Innovation to discuss remedial measures that may be required to maintain the viability of the biomass through the addition of supplemental substrate.

5.4 - RETURN ACTIVATED SLUDGE FLOW

The flow rate of this pump should be set to approximately 400% of the design flow rate. A pump bypass and valve is included to allow this flow to be adjusted easily.

5.5 - OPERATING THE SYSTEM

Before operating the system, please read the section in this manual on safety: Section 7 - Safety.

Before starting the system, the wastewater treatment plant must be prepared for the operation. Use the following checklist as a guide to ensure that the unit is ready to operate. Here are the parameters to be monitored prior to starting the system:

- All necessary processing circuit breakers must be closed.
- Check that chemicals are at an acceptable level.
- Isolate the non-functional parts for repair and maintenance.
- Check the conditions of the previous alarms have been viewed, corrected and reset.
- Put all positioners back in automatic mode.
- Before starting, especially after long periods of stops, inspect the equipment and check that each piece of equipment is ready to operate according to the manufacturer's manual.

5.5.1 - STARTING PROCEDURE

A normal startup can be launched at any time when the plant is ready to operate. The PLC starts and operates the treatment system automatically after the initial startup sequence. It is important to position the manual valves so that the process can function properly, as described in Section 8.1 - Process Control Narrative.

Here is the standard automatic start sequence for a waste water treatment plant:

1. Open the power of the human-machine interface (HMI) and ensure that the display shows the treatment main screen (or overview screen). If the power is on, but the screen is blank, touch the screen to activate it.
2. If necessary, enter the username and password, then press the OK button. The main screen should then appear.
3. On this screen, put the train in automatic mode to make it available for production. General rule, the entire system is placed in automatic mode and the PLC will ensure that all equipment used alternatively. This provides a balanced use of the available equipment. The PLC will also ensure that equipment is started in a normal sequence, so that no damage will be done to the equipment.

5.5.2 - STOPING OR RESTARTING THE SYSTEM

The same principle applies to the shutdown sequence. The PLC will ensure that the equipment stops logically not to damage the equipment. Stopping the systenm can be requested at any time during production. Stops can also be caused by alarms. Please refer to Section 8.2 - Alarm List for more details.

To restart the system after a shutdown, you can use the following standard procedure:

1. At the HMI, navigate to the display of alarms and errors.
2. Stop the audible alarms if necessary.
3. Based on the information provided on the screen, determine what conditions may have caused the shutdown of the treatment system.
4. If the cause of the alarm is a problem that requires a physical intervention in the plant, refer to section 6.8- Trouble-Shooting for more information on recurring causes of stops.
5. Reset the alarm (or reset all the alarms) on the screen. The plant will return to its automatic mode and resume production.

5.5.3 - OPERATING GUIDELINES

Here are the major guidelines for daily operations of this water treatment system:

- The critical parameters of the feed water (Section 2) should be inspected at appropriate intervals as indicated by the operation experience and adjusted if necessary.

- It is important to keep records of the system daily and accurately. The information in these sheets is essential to solving problems related to operation and performance.
- Maintain and schedule preventive maintenance regularly. This includes visual inspection, repairing leaks, cleaning and touch-up paint.

5.6 - PERMEABILITY AND TRANSMEMBRANE PRESSURE

The transmembrane pressure (TMP) is a measure of the membrane's performance. This allows the monitoring of changes in the permeability. It will provide information on the performance of CIP cleans and effects of the changes in the water quality. TMP is the variation of pressure across the membrane, which is calculated by subtracting the hydrostatic pressure of membrane permeate side to the pressure of the feed side during permeation. The calculation is done in reverse during periods of flow reversal.

$$TMP(kPa) = Feed\ Pressure - Permeate\ Pressure$$

Permeability is a calculated parameter that normalizes the PTM for different flow rates and temperatures. The flow rate per membrane surface area is called the membrane flux and is calculated based on the equation below.

$$Flux\ \left(\frac{L}{m^2 h}\right) = {Flow\ \left(\frac{L}{h}\right)}\Big/{Membrane\ Area\ (m^2)}$$

Permeability is the flux divided by the transmembrane pressure.

$$Permeability = \frac{Flux\ (\frac{L}{m^2 h})}{TMP\ (kPa)}$$

Finally, to ensure proper reading of the permeability, it must be corrected by taking in consideration the effect of temperature using the following equation:

$$Permeability\ at\ 20°C = Permeability\ \times 1{,}024^{\,T-20}$$

In the equation above, T is the temperature in Celsius degrees.

5.7 - MANUAL CONTROLS

Some measure of manual control of equipment is possible; however these controls should only be used in exceptional circumstances or for troubleshooting assistance. It is expected that this plant operates in automatic mode most of the time.

1. **Valves**: Valves can be placed in an override condition and opened or closed manually from the HMI. Normally, automated valves are left in the automatic condition.
2. **Pumps or blowers with VFDs**: Pumps or blowers with Variable Frequency Drives (VFD) can be operated manually at specific frequencies. This allows the operator to adjust the flowrate of the pump or blower manually. Normally, the frequency that a pump or blower operates at is controlled by the PLC in automatic mode.
3. **Pumps or Blowers without VFDs**: Pumps or blowers without VFDs can be placed in ON or OFF mode. Normally, pumps or blowers without VFDs are left in automatic mode and turned ON and OFF by the PLC.
4. **Chemical Pumps**: Typically chemical pumps are operated only in AUTO mode. Refer to section Section 7 - Safety to understand some of the risks involved in chemical handling. Extreme care should be used when operating chemical pumps in manual mode. Chemical pumps typically are controlled with an ON or OFF signal.
5. **Control Panels**: Control panels can be manually disabled and de-energized with the disconnect switch on the control panels themselves.
6. **Emergency Stop Button**: System operation can be stopped by pressing the emergency stop button. This is a red button located on the main control panel. In some systems, buttons are also located on remote panels but the functionality is the same. These buttons will place the system in a neutral state (all equipment placed in the OFF state) and system operation cannot resume until the button that has been depressed is physically pulled out to its ON location. When the system restarts, it restarts according to the normal start up sequence as defined in the PLC program.

SECTION 6 - SYSTEM MAINTENANCE PROCEDURES

Before performing any maintenance, trouble-shooting or cleans on this system please read the section in this manual on safety: Section 7 - Safety.

6.1 - EQUIPMENT MAINTENANCE

This manual includes vendor catalogs providing operation and maintenance instructions for the major equipment and components. Operation and maintenance personnel should become familiar with these instructions in order to develop quick troubleshooting and proper maintenance techniques.

Refer to Section 10 – Vendors O&M Data and Manuals for details on how to maintain equipment items provided by sub-vendors. The following sections are specific to system maintenance for the MBR provided system.

6.1.1 - MAINTENANCE LOGS

Clear documentation of system and equipment maintenance is helpful in understanding equipment operating costs and in warranty claims. It is recommended that for each piece of equipment in the plant, equipment identification and maintenance log sheets are kept. An example of a log sheet is shown in the appendices of this document.

It is important to perform preventive maintenance procedures periodically and regularly. Once a month, it is primordial to check the entire system for signs of wear, deterioration and damage. These symptoms include excessive vibration, excessive or unusual noise, corrosion, pipes or loose connections and leaks.

During the inspection period, it is important to remove dust, sand, oil, moisture or other contaminants from the external surfaces of the engine. Also, remove dust, dirt or other debris from the air inlets.

6.2 - WORKING WITH ROTATING EQUIPMENT

When working with or around pumps, blowers and other rotating equipment items, in addition to the instructions listed in Section 10 – Vendors O&M Data and Manuals, take the following precautions:

1. Before performing maintenance, isolate and drain all piping connected to a pump.
2. Before performing maintenance on any rotating or powered equipment item, ensure the item is brought to a zero energy state and complete all lock-out, tag-out procedures required by government regulations, plant-specific procedures, and those recommendations in this manual's section on safety.
3. Perform service using manufacturer's manuals as a guide.

4. After completing maintenance, replace any guards or other safety components removed during the procedure. Personnel working on pumps used to transfer chemicals must be familiar with the safe-handling procedures associated with the chemicals involved.
5. When working with diaphragm pumps or other chemical transfer pumps, be aware that some media may remain within the pump's diaphragm chamber even after the pump has been drained and ensure proper PPE is worn during this work.
6. In general, motors should be inspected at regular intervals; approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. Electrical connectors should be tight. Megger readings on motor insulation should be taken and recorded to monitor for issues.

6.3 - INSTRUMENT CALIBRATION

It is important to calibrate instrumentation and sensors at least twice a year. It is also important to confirm the status of the level and pressure switches at least once every six months. To do so, refer to their operation and maintenance manuals for specific calibration procedures and to the table in section 3.3 – Calibration and Instrument Care.

6.4 - LUBRIFICATION OF ELECTRIC MOTORS

Grease the bearings on the electrical motors of the pumps every six months (if necessary). The procedure is as follows:

1. Stop the electric motor.
2. Use a grease gun containing high quality grease that has a wide temperature range.
3. Remove the upper and lower caps of the grease ports of the shaft bearings. If a lubricant fitting is not permanently installed, install a grease gun fitting in the upper port.
4. Pump new grease into the bearing by upper port until the new clean grease appears at the drain port (lower port).
5. Roll the engine briefly until grease stops flowing through the port of the drain. Replace the cap of lower port (drain) and the cap of the upper port.

Caution: Do not over-lubricate the engine, as excessive lubrication can damage the bearing seals.

6.5 - LEAKING OF MECHANICAL SEALS

It is important to check for leaks from the mechanical seals after the first twenty-four (24) hours of operation. Thereafter, check the seals weekly. A leak is considered acceptable when it is not more than a drop every three or four minutes. If the leak rate increases, the gasket should be replaced.

6.6 - ANALYTICAL MONITORING

It is important to carefully monitor the plant over time to allow early detection of process problems. The collected information should be saved in a log file. It will be requested when providing troubleshooting assistance. Table 10 provides recommendations of a monitoring strategy.

Table 10: Recommended Monitoring Strategy

Source	Analyses	Source	Frequency
Feed Flow Rate	Flow Rate	Influent flowmeter	Daily
Waste Volume	Volume	Estimate volume wasted	Daily
Feed Sample	BOD, mg/L TSS, mg/L NH_3, mg/L-N TKN, mg/L-N TP, mg/L Alkalinity, mg/L as $CaCO_3$ pH Conductivity	Raw wastewater feed to the plant	Weekly Daily for first 4 weeks
Bioreactor Sample	MLSS, mg/L MLVSS, mg/L Dissolved Oxygen, mg/L pH	From Bio-Wheel Tank	Weekly Daily for first 4 weeks.
RAS Sample	MLSS, mg/L	From RAS/WAS line.	Weekly Daily for first 4 weeks
Treated Water Sample	BOD, mg/L TSS, mg/L NH_3, mg/L-N NO_3, mg/L-N TP, mg/L Alkalinity, mg/L as $CaCO_3$ Total Coliforms MPN/100mL Fecal Coliforms MPN/100mL pH	Immediately after UV disinfection	Weekly or based on reporting requirements Daily for first 4 weeks.

6.7 - MEMBRANE MAINTENANCE

6.7.1 - MEMBRANE FOULING

Membranes foul with use and this is a normal process. The expected rate of fouling is a design parameter that is used to determine the cleaning and maintenance protocols for the facility. The cleaning frequency is a function of the production rate and water quality, since cleaning interval and flux are inter-related. The higher the flux the plant is operating at, the higher the observed fouling rate will be, and the shorter the cleaning interval.

Membrane fouling creates an increase in the trans-membrane pressure (TMP). As a result, there are increased energy costs and potentially reduced membrane life (depending on the type of fouling). When TMP increases, the permeate pump requires more energy to pull the water across the membrane to meet the flow set-point. In order to operate the system in the most efficient way and keep costs down, running with a balanced TMP range is the recommended practice.

6.7.2 - FOULANTS

Foulants, in general, are compounds that accumulate on a membrane surface or inside the membrane pores. They reduce the effective membrane surface area reducing the area available for water to pass across the membrane. Foulants are divided into four types as shown in Table 11 : Foulants and Treatment.

Table 11 : Foulants and Treatment

Foulant Type	Definition	Treatment and Prevention
Solids	High levels of solids can clog membrane modules and prevent filtration.	Ensuring that pre-screening is operating effectively and that wasting to the sludge holding tank occurs regularly.
Precipitation	Scale can form when the compounds in feed water are concentrated beyond their solubility (more common in RO and NF systems). For example, calcium carbonate and magnesium sulfate. Hard scale formation membranes, can block water flow. High pHs and hard feed water can promote scale formation.	Acid based cleaners are used to remove fouling from precipitation. Adjustments to the waste stream concentration can also help. Lime softening and downward feed water pH adjustment can minimize risk.
Biological	Living organisms such as bacteria, fungus, and algae, are biological foulants. Colonies can form on the surface of the membrane blocking water flow through the membrane surface.	Regular treatment with antimicrobial agents and biocides are effective in preventing and reversing biological fouling. Sodium hypochlorite is the most frequently used agent to kill biological organisms.
Absorptive	Oils, polymers, cationic surfactants, and hydrocarbons, are common adsorptive foulants.	This type of fouling can be irreversible and feed waters containing these compounds should be minimized or piloted beforehand.

Since feed waters can change over time, it is important to have a regular sampling and testing program for potentially fouling compounds. This information is very valuable in diagnosing membrane fouling issues in the future, even if it is simply used to rule out potential causes.

6.7.3 - CLEANING PROTOCOL

The section 8.1 – Process Control Narrative of this manual describes the cleaning procedure for the project. Table 12 describes the recommended cleaning frequency for each type of cleaning and chemical cleaners.

Table 12 : Required Cleaning Frequency for This Plant

Cleaning Type	Chemical Product	Frequency
CEB (Chemically Enhaced Backpulse)	Sodium Hypochlorite	Once a week
CIP (Clean-In-Place)	Sodium Hypochlorite	Twice ayear
CIP (Clean-In-Place)	Citric Acid	Twice ayear

If alternatives to these cleaning frequencies seem necessary, discuss with your H_2O Innovation project manager. The cleaning operations must all be listed in a table (see Table 13: Typical Cleaning Log Sheet) by operators of the plant. This information is essential for monitoring the long-term performance and is required to maintain the warranty of the membranes. H_2O Innovation is a manufacturer of specialized cleaning chemicals and also offers laboratory testing services that can help determine better cleaning protocols for fouled membranes. It is important to identify and resolve the membrane cleaning and fouling problems as quickly as possible to avoid damage to the membranes.

Table 13 : Typical Cleaning Log Sheet

Cleaning Information	Date	Date	Date	Date	Date
Cleaning Type					
Chemical Product					
Volume of Chemical Product Used					
Starting Time					
Duration					
Temperature at the beginnig(°C)					
Temperature at the end(°C)					
Permeability before cleaning (corrected at 20°C)					
Permeability before cleaning (corrected at 20°C)					

6.8 - TROUBLE-SHOOTING

Before performing any maintenance, trouble-shooting or cleans on this system please read the section in this manual on safety: Section 7 - Safety.

This trouble-shooting guide is intended to provide basic information only. Experienced operators and maintenance staff are required at any facility that has significant process equipment such as this one. Only qualified and trained personnel should engage in trouble-shooting or maintenance on the equipment covered by this manual. The information provided in Section 10 – Vendors O&M Data and Manuals must also be used for diagnosing and trouble-shooting issues with sub-vendor components.

The following table describes some common problems and potential resolutions.

Table 14 : MBR System Trouble-Shooting Tips

Problem	Possible Cause	Potential Resolution
High TMP during production	Membrane fouling has occurred. If fouling occurred rapidly and unexpectedly, has there been an upstream issue?	Execute cleans as described in this manual once flow peaks have been alleviated.
	A manual valve in the pump suction line or filtrate line is partially closed.	Check positioning of all manual valves.
	Instrumentation failure.	Check the calibration and diagnostics of the feed pressure transmitter. Are the instruments communicating with the PLC?
	PID tuning parameters have been altered.	Confirm with H_2O Innovation that the PID is as it was left at the end of commissioning. Have tuning parameters been adjusted?

Problem	Possible Cause	Potential Resolution
	Aeration issues.	Check that air is getting to the entire membrane module. Air needs to get to all of each module to scour the membrane surface appropriately.
	Accidental adjustment of set-points.	Confirm set-points in HMI reflect the commissioned values or agreed to, modified values.
Pump low flow alarms	Manual valves are closed or partially closed. Has maintenance recently occurred on the pump or system?	Confirm that manual valves are all in the correct positions. Isolation valves should be open for equipment that is intended to be online.
	Automated valves are not actuating as expected.	Check that the automated valves in the line are opening when they should for the programming sequence by looking at the position indicators on the actuators. Confirm that the valve timing is suitable (delays between valve actuation and pump actuation). Confirm that all pneumatic lines are open and connected to pneumatic valves. Confirm lines do not contain frozen moisture.
	Piping leaks.	Check that all piping connections are tight and not leaking.
	Instrumentation related issues.	Check to see if there is air trapped in the pipe where the mag meters is installed or if air is passing through a mag meter.
	Air entrainment.	Check if air is causing issues with pump priming and proper functioning.
	Issues with VFD.	Check to see if the VFD has presented any faults.
Analogue device issues	Instrumentation issues – moisture ingress.	Check that the seals in the instrument are good.

Problem	Possible Cause	Potential Resolution
	Power issues.	Confirm that the instrument is receiving power and has booted up correctly. Check that the power supply is working.
	Communication issues.	Check that the PLC is receiving a signal from the instrument and if the instrument has HART, check the instrument's on-board diagnostics.
Digital device issues	Power issues.	Check that the fuse has not blown to the switch and that the switch is receiving power as expected.
	Communication issues.	Check that the PLC is receiving a signal from the switch (continuity).
Filtrate water quality	Leaking modules or plates.	A module inspection may be required – please contact H_2O Innovation.
	Instrumentation issues (typically turbidity; if installed).	The most common cause of high turbidity are issues with the instrument itself. Confirm that the instrument is functioning correctly and that calibration is accurate. Confirm that the flow through analytical instruments is within specification.
	Air entrainment.	The second most common cause of direct quality measurement issues is air entrainment in the process stream. Confirm that the flow rate to the instrument is within specification and that degassers are functioning appropriately.
Unexpected alarms on HMI	Devices in manual.	Required equipment is disabled or not in automatic mode. Place all available equipment in AUTO mode.

SECTION 7 - SAFETY

7.1 - OUR FIRST PRIORITY – SAFETY

For your own protection and that of your co-workers, please pay particular attention to this section. These safety precautions are intended to protect operators and equipment from risk of physical harm and damage that may arise from the operation and maintenance of this water treatment system. The following table summarizes the symbols used in this manual to highlight areas of risk. These warnings are not intended to be exhaustive and the operator and maintenance staff are expected to execute due diligence in carrying out their work on this system. When in doubt please ask for assistance or advice.

Symbol	Description
	Alerts operators to items that if not followed will result in severe injury or death.
	Alerts operators to items that if not followed can result in severe injury or death.
	Alerts operators to items that if not followed may result in a minor or major injury.
	Alerts operators to items that if not followed may result in damage to equipment or property.

7.2 - PREAMBLE AND GENERAL PRECAUTIONS

Please ensure to read and understand the entire operational and maintenance manual thoroughly. Ensure all assembly, operation, maintenance or inspection instructions described in this manual are followed before using any devices included with this plant. A device can be a valve, instrument, equipment item or any other physical or software component required in the operation of this water plant. Misuse of devices or failure to follow the instructions described in this manual may result in death, serious personal injury and/or damage to property. Failure to read the entire manual before using any device included in the scope of this project constitutes a misuse.

The plant operator is responsible to inspect each device before using it. Only use the device if it passes inspection. Always use the device as described by the original manufacturer of the device. Do not use any malfunctioning device. Keep by-standers away from device during use.

It is up to the operator to use common sense when operating any device. A moment of inattention while operating a device can cause personal injury or death to the operator or to any by-standers and/or damage to property. Keep hands, clothes, loose jewelry from being caught in moving parts. Do not exceed stated weight limits for any device used for lifting.

Do not modify any device in any way other than that described in vendor instruction manuals unless prior written approval of H_2O Innovation Inc. is obtained. Unauthorized modifications to a device may void the warranty and might make the device unsafe to use.

In no event shall H_2O Innovation Inc. be liable for any indirect, incidental or consequential damages resulting from the use of devices in this plant. This disclaimer applies before, during and after use of the device, which include, without limitation, assembly, inspection, use and/or storage. No warranties (express, implied, or statutory) are made in connection with this operational and maintenance manual.

BY REFERRING TO, OR OTHERWISE EMPLOYING, THIS OPERATIONAL AND MAINTENANCE MANUAL, THE OPERATOR, USER OR OWNER OF THE PLANT AGREES TO DEFEND, PROTECT, INDEMNIFY, AND HOLD H_2O INNOVATION INC., ITS AFFILIATES, SUBSIDIARIES, SUCCESSORS, ASSIGNS, DIRECTORS, OFFICERS, AGENTS, AND EMPLOYEES HARMLESS FROM AND AGAINST ALL CLAIMS, LOSSES, EXPENSES, DAMAGES AND LIABILITIES, DIRECT, INCIDENTAL, OR CONSEQUENTIAL, ARISING FROM ACCEPTANCE OR USE OF THIS MANUAL, INCLUDING LOSS OF PROFITS AND REASONABLE ATTORNEY'S FEES, WHICH MAY ARISE OUT OF THE ACCEPTANCE OR USE OR ALLEGED USE OF THIS MANUAL, IT BEING THE INTENT OF THIS PROVISION AND OF THE OPERATOR, USER OR OWNER TO ABSOLVE AND PROTECT H_2O INNOVATION INC., ITS AFFILIATES, SUBSIDIARIES, SUCCESSORS, ASSIGNS, DIRECTORS, OFFICERS, AGENTS, AND EMPLOYEES FROM ANY AND ALL LOSS RELATING IN ANY WAY TO THIS OPERATIONAL AND MAINTENANCE MANUAL INCLUDING THOSE RESULTING FROM ITS OWN NEGLIGENCE.

7.3 - SAFETY STANDARDS

Local safety regulations and standards take precedence over the recommendations discussed here only when they are stricter or more onerous than this manual. The operators and plant owners are expected to follow their local standards and augment those with the information provided in this manual. Also, standards evolve over time and the onus is on the plant operations staff to maintain current certifications and be familiar with the most recent requirements, particularly those related to safety.

7.4 - PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is required to operate this system safely. The following items should be readily available and properly fitted for operators of this system:

1. Hardhat
2. Safety boots
3. Safety glasses with side shields
4. Face shields
5. Rubber aprons
6. Ear plugs
7. Fall protection equipment (lanyard, harness)
8. Housekeeping equipment (brooms, mops, spill kits, rags)

7.5 - KEY SAFETY WARNINGS

Please pay particular attention to this section. These safety precautions are intended to protect operators from risk of physical harm and damage that may arise from the operation and maintenance of this water treatment system.

Do not mix sodium hypochlorite solution with any acidic solution. This mixture will generate toxic chlorine gas which is lethal. Common acidic solutions include citric acid, sulfuric acid, hydrochloric acid, sodium bisulfite (but are not limited to these).

Membrane modules and piping is under pressure (or vacuum). Ensure that equipment and piping networks are fully de-pressurized to atmospheric pressure before servicing. Energy release, particularly for compressible fluids, can cause serious personal injury or death.

Working on or servicing electrical equipment or mechanical equipment powered by electricity can cause severe injury or death if the electrical source is not completely disconnected and locked out by the service person. Following a documented lock-out, tag-out program is highly recommended for working on equipment in this system.

Air (or other gasses) trapped in PVC piping or conveyed by PVC piping can cause severe injury or death. PVC material shatters if the piping is subject to abnormal stresses when compressed air is present inside. Pieces of piping become projectiles in this case. Ensure air is completely bled with non-compressible fluids from all systems that use PVC piping.

The cleaning of membranes involves the use of strong chemicals. When handling chemicals wear appropriate PPE (face shields, full length rubber gloves, rubber apron, safety glasses with side shields) as recommended in the MSDS for each respective chemical. The MSDS will also provide treatment recommendation in the case of exposure to the chemicals. Failure to follow MSDS recommendations can result in serious injury or death.

The cleaning chemical sodium hypochlorite generates chlorine gas over time that presents a health and safety concern and is highly corrosive to humans and equipment surfaces. Appropriate ventilation is required in areas where sodium hypochlorite solutions are exposed to the operator's air space or equipment that can be damaged by corrosion.

Membranes are typically shipped in a preservative solution. Ensure appropriate PPE (face shields, full length rubber gloves, rubber apron, safety glasses with side shields) as recommended by the membrane manufacturer are worn. The MSDS for the preservative solution will also provide treatment recommendation in the case of exposure to the chemicals. Failure to follow MSDS recommendations can result in serious injury or death.

Membrane modules are heavy and should not be manipulated by hand. Use properly designed lifting equipment for installing and removing modules into membrane racks. A falling module can result in serious injury or death.

Do not lift skids from equipment or piping mounted on the skid. Doing so may result in injury or death for workers involved in the operation or damage to the components mounted on the skid.

Exposure to moderate noise levels can lead to long term hearing damage. Exposure to high noise levels, even for short durations, can cause immediate hearing damage. When the possibility of exposure to such noise levels is present {particularly around air blowers, compressors, air release devices} use appropriate hearing protection.

This plant includes rotating equipment. Blowers, compressors, pumps and valves all have components that turn with high energy. Before operating equipment with rotating components or pinch points, ensure that all shields, guards, and emergency kill switches are in place and operational. Rotating parts can catch clothing, fingers, or tools and cause serious injury, death or equipment damage.

Ultraviolet light is often used for disinfection in water treatment systems. Do not look directly at light sources or expose skin to the light as it can burn both eyes and skin.

Maintaining strict cross-connection controls are required to protect public health and maintain water quality. This system may be outfitted with automated cross-connection prevention systems, however, the proper operation of these needs to be routinely verified by operations staff. Failure of cross-connection prevention systems can result in release of chemical or untreated water into the public water system.

When alternating between cleaning chemicals (particularly between an acid and sodium hypochlorite), ensure that the lines and tanks are fully rinsed before using the next chemical. The use of higher quality product water for rinsing is recommended (rather than feed water). Failure to rinse systems adequately can result in adverse chemical reactions. Refer to other warnings in this section.

Operating equipment can get hot. Also, heated chemical solutions are used for cleaning membranes and equipment or piping may not be protected with insulation. To avoid burns, please use caution when touching operating equipment and piping in the plant. Permanent operator protection insulation or guarding is typically required for components that can be warmer than 45°C.

When cleaning membranes, strictly follow the procedures described in the membrane manual and document cleans appropriately on log sheets. Otherwise damage may occur to the modules which can negatively affect the membrane performance and the membrane warranty.

Membrane modules can be stored in water and not used for short periods of time. If they are to be left for longer than 4 days, follow procedures listed in the membrane module manufacturer's manual. Failure to follow recommendations from the manufacture can result in membrane damage.

During membrane integrity tests (MIT) on ultra-filtration membrane systems, the compressed air used must be clean, dry, and free of oil. Do not exceed the maximum recommended testing pressures.

During construction, maintenance, or any other work performed directly above open tanks that feed membrane systems (particularly upstream of the membranes and downstream of the strainers), ensure that foreign debris (for example; pipe turnings, paint chips) do not fall into the tank.

Operating the system using manual controls introduces a risk of equipment damage. It is highly recommended that the system is monitored carefully and with an operator present if manual controls or partial manual controls are used. Refer to the section on manual controls for more information.

7.6 - SAFETY GUIDELINES

There are a number of general guidelines that can greatly improve the safety of operators and visitors to a water treatment plant:

1. **Personal Protective Equipment (PPE)**: Wear the appropriate PPE for the job or task being conducted which applies to bystanders as well. Generally speaking, when in the plant environment, safety boots and safety glasses are highly recommended as a minimum.
2. **Housekeeping**: Maintaining a clean plant is key for minimizing the risk of accidents. Ensure that all tools and loose items are placed in the correct location and that spills are quickly cleaned up.
3. **Routine maintenance**: Maintaining equipment in good running order and conducting preventative maintenance regularly can help prevent situations where safety risks are elevated.
4. **Personal hygiene**: With any water treatment system pathogens can be concentrated in the waste stream. Regular personal hygiene (like washing hands) is important to prevent illness and spread of contamination. If operators are exposed to feed water, concentrate or other water not suitable for human consumption, eyes should be immediately rinsed at an eye wash station and exposed skin should be cleaned thoroughly with soap and warm water, particularly before eating, drinking or smoking.
5. **Vaccinations**: Due to pathogenic risk at water treatment facilities, it is recommended that operators and maintenance staff be vaccinated against tetanus and Hepatitis A and Hepatitis B. Seek medical advice from a licensed physician before exposure to water at the plant and also if you may have been exposed to potential sources of biological hazards. This is particularly important in wastewater systems.
6. **Fall protection**: Although pressurized membrane systems do not require significant tankage, the risk of falling into a tank or off an elevated platform can be present. A fall of any height can hurt operators and maintenance staff. Follow the local work environment regulations with respect to

falls and fall prevention. Safety harnesses, lanyards and engineered anchor points may be required. Note that fall arrest and fall restraint are distinct and in general fall restraint is preferred due to the lower risk of injury.

7. **Equipment specific safety recommendations**: Refer to the provided equipment safety manuals. These instructions manuals must be followed for safe operation and maintenance of the system as a whole.
8. **Chemical showers and eyewash stations**: Safety showers and eyewash systems are typically installed within proximity of chemical systems. Operators need to be trained in their effective use and monitoring systems installed such that assistance can be provided in the case that somebody uses one of these systems.
9. **Chemical spills**: Spill clean-up kits and neutralization chemicals should be readily available and operators trained in how to use these systems.
10. **High pressure equipment**: Some pumps, compressors and blowers are capable of generating very high pressures which creates the risk of rupture or major damage if safety devices are bypassed or not maintained. Pressure relief valves should be checked regularly, and tubing or piping used to convey pressurized fluids, such as actuated valve air lines, should be regularly inspected for cracks and damage.
11. **Material Safety Data Sheets (MSDS)**: MSDS' need to be present and available for quick reference for each chemical in use in the plant and operators should read these before doing any work involving these chemicals. The supplier of the chemical is responsible for providing the end user with MSDS sheets. Each chemical in use in the plant must have an MSDS present. All chemical containers must be labeled accurately with the chemical name such that the chemical can be readily cross-referenced with the MSDS.
12. **Lighting**: Ensuring that work areas (internal and external) are well lit is important for minimizing risks to operators and also for ease of operations and maintenance.
13. **Confined spaces**: Many workplaces contain areas that are confined spaces. While they are not necessarily designed for people, they are large enough for workers to enter and perform certain jobs. A confined space also has limited or restricted means for entry or exit and is not designed for continuous occupancy. Confined spaces include, but are not limited to, tanks, vessels, silos, storage bins, hoppers, vaults, pits, manholes, tunnels, equipment housings, ductwork, pipelines, etc. OSHA uses the term "permit-required confined space" to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress. Ensure workers are trained to recognize confined spaces and that only trained personnel are permitted to enter confined spaces when the appropriate safeguards are in place. A means of worker extraction and atmosphere control are normally used when workers are exposed to confined spaces.
14. **Lock-out, tag-out (LOTO)**: There are guidelines that address the practices and procedures necessary to disable machinery or equipment, thereby preventing the release of hazardous

energy while employees are performing service and maintenance activities. Their standards outline measures for controlling hazardous energies — electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and other energy sources. Employees servicing or maintaining machines or equipment may be exposed to serious physical harm or death if hazardous energy is not properly controlled. A documented LOTO system is highly recommended for all operating water treatment facilities.

15. **Safety culture**: An environment where safety discussions happen before all maintenance operations, where operators are free to raise safety concerns without retribution and one where safety reports are openly shared is highly recommended for this water treatment plant. Safety should be built into all routine work and standard operating procedures at the plant and all maintenance work should be prefaced with a discussion on safety for the work at hand. This builds a culture where safety is a top priority and helps ensure all workers go home healthy at the end of their day.

7.7 - HARMFUL GAS SAFETY PROCEDURE

Power Outage or System Shutdown

In the event of a power outage or any situation resulting in a system shutdown lasting more than 24 hours :

1. Put the wastewater treatment plant main power switch into the OFF position.

2. Make sure equipment items that are running in the wastewater treatment plant or in the direct vicinity are at a minimum Class 1 Division 2 rated.

3. Make sure equipment items which will automatically start to run once the power comes back on in the wastewater treatment plant direct vicinity are Class 1 Division 2 rated.

4. Personnel required to go into the wastewater treatment plant during the power outage or system shutdown must be equipped with explosion proof portable gas detectors and breathing apparatus to ensure that levels of methane, hydrogen sulfide and oxygen are at acceptable levels as determined by the site safety officer.

5. Prior to entering, open at least two (2) or more wastewater treatment plant openings (doors, windows) to encourage air exchanges. Methane, hydrogen sulfide and oxygen levels must be monitored at all time. Nobody is to be allowed in the wastewater treatment plant if methane, hydrogen sulfide and oxygen levels are unsafe as determined by the site safety officer.

6. When the power outage or system shutdown is over, go through steps 4 & 5. Once it is confirmed the air in the whole wastewater treatment plant is safe, put the wastewater treatment plant main power switch into the ON position. Confirm that the ventilation system and aeration system (blower) are running properly.

Blower Failure

In case of a blower failure or low blower air flow, ensure the ventilation system functions properly and as expected to prevent the buildup of noxious gases or reduction in oxygen. Refer to the “Power Outage or System Shutdown” procedure.

Ventilation System Failure

In case of a ventilation system malfunction, it is necessary to monitor the methane, hydrogen sulfide and oxygen levels at all time using an explosion proof portable gas detectors in order to ensure the air quality is at safe levels as determined by the site safety officer. If any of the gas levels are at an undesirable level, open all openings (doors, windows) possible in order to encourage air exchanges. If methane level reaches a dangerous level, put the wastewater treatment plant main power switch into the OFF position to prevent risk of explosion. Refer to the “Power Outage or System Shutdown” procedure until the ventilation system is repaired.

7.8 - MATERIAL SAFETY DATA SHEETS

7.8.1 - SODIUM HYPOCHLORITE

Material Safety Data Sheet

LA5839
Sodium Hypochlorite 12% Water Treatment

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Id: LA5839
Product Name: Sodium Hypochlorite 12% Water Treatment
Synonyms: Sodium oxychloride; Soda bleach liquor; Javel water; Clorox; Javex.
Chemical Family: Hydrochlorous acid, sodium salt.
Application: Chemical intermediate. Laboratory reagent. Water treatment. Pulp and paper. Bleaching agent. Disinfectant.

Distributed By:
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC
V6X 1W5

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.
Preparation date of MSDS: 03/Apr/2014
Telephone number of preparer: 1-866-686-4827

24-Hour Emergency Telephone Number (CANUTEC): (613) 996-6666

2. HAZARDS IDENTIFICATION

Potential Acute Health Effects:
Eye Contact: Corrosive to eye tissue and may cause severe damage and blindness.
Skin Contact: Corrosive. May cause severe skin irritation. Prolonged contact may lead to burns and blisters and may aggravate dermatitis. May cause whitening or bleaching of the skin.
Inhalation: Corrosive to the respiratory passage. Causes irritation of the mouth, nose and throat. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage.
Ingestion: Corrosive. Causes burns to the mouth, throat and stomach. Causes vomiting, nausea, and diarrhea. Coma, shock and death may occur.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	Percentage (W/W)	LD50s and LC50s Route & Species:
Water 7732-18-5	60-100	Oral LD50 (Rat) >90 mL/kg
Sodium Hypochlorite, Solution 7681-52-9	10-30	Oral LD50 Rat = 8200 mg/kg Dermal LD50 Rabbit > 10000 mg/kg

Note: Drug Identification Number (DIN) - 02265729

4. FIRST AID MEASURES

Eye Contact: Wash eyes with water for a minimum of 30 minutes or until no evidence of the chemical remains. Hold eyelids open during flushing. Seek immediate medical attention.
Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 30 minutes. Get medical attention.
Inhalation: Remove person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, get immediate medical attention.
Ingestion: Rinse mouth with water. Do not induce vomiting. Do not give anything by mouth to an unconscious person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Seek immediate medical attention.
Notes to Physician: Due to the severely irritating or corrosive nature of the material, swallowing may lead to ulceration and inflammation of the upper alimentary tract with hemorrhage and fluid loss. Also, perforation of the esophagus or stomach may occur, leading to mediastinitis or peritonitis and the resultant complications.

5. FIRE FIGHTING MEASURES

Flash Point: None.
Flash Point Method: Not applicable.
Autoignition Temperature: Not available.
Flammable Limits in Air (%): Not Available.
Extinguishing Media: Use extinguishing media appropriate for surrounding fire.
Special Exposure Hazards: Keep containers cool to prevent rupture and release of material. Closed containers may explode in fire. Spilled material may cause floors and contact surfaces to become slippery.
Hazardous Decomposition/Combustion Materials (under fire conditions): Chlorine. Oxygen. Oxides of sodium.
Special Protective Equipment: Fire fighters should wear full protective clothing, including self-contained breathing equipment.
NFPA RATINGS FOR THIS PRODUCT ARE: Not Available.
HMIS RATINGS FOR THIS PRODUCT ARE: HEALTH 3, FLAMMABILITY 0, REACTIVITY 1

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures: Wear appropriate protective equipment.
Environmental Precautionary Measures: Prevent entry into sewers or streams, dike if needed. Consult local authorities.
Procedure for Clean Up: Ventilate area. Small spills: soak up with absorbent material and scoop into containers. Large spills : prevent contamination of waterways. Dike and pump into suitable containers. Clean up residual with absorbent material, place in appropriate container and flush with water. Spilled material may cause floors and contact surfaces to become slippery.

7. HANDLING AND STORAGE

Handling: For industrial use only. Handle and open containers with care. Avoid contact with eyes, skin and clothing. Do not ingest. Avoid inhalation of chemical. Empty containers may contain hazardous product residues. Keep the containers closed when not in use. Protect against physical damage. Use appropriate personnel protective equipment. When diluting, add this product to water in small amounts to avoid spattering. Never add water to this material.
Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Store below 29 °C. Do not freeze. Keep away from direct sunlight. Store away from organic chemicals, strong bases, metal powders, carbides, sulfides, and any readily oxidizable material. Storage area should be equipped with corrosion-resistant floors, sumps and should have controlled drainage to a recovery tank. Store in a sealed polyethylene lined container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:

Local exhaust ventilation as necessary to maintain exposures to within applicable limits. Make up air should always be supplied to balance air exhausted (either generally or locally). Ventilation required when spraying or applying in a confined area. Ventilation should be explosion proof. Eliminate ignition sources.

Respiratory Protection: Wear a NIOAH approved full facepiece respirator for acid gases or a self-contained breathing apparatus for air concentration levels up to 5 ppm. NIOSH approved supplied air respirator when airborne concentrations exceed exposure limits.

Gloves:

Impervious gloves. Neoprene gloves. Nitrile gloves. Rubber gloves.

Skin Protection: Neoprene coated apron or chemical resistant clothing. Impervious boots.

Eyes: Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes.

Other Personal Protection Data: Ensure that eyewash stations and safety showers are proximal to the work-station location.

Ingredients	Exposure Limit - ACGIH	Exposure Limit - OSHA	Immediately Dangerous to Life or Health - IDLH
Water	Not available.	Not available.	Not Available.
Sodium Hypochlorite, Solution	0.5 ppm As For Chlorine.	Not available.	Not Available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Color: Clear Green to yellow.
Odor: Chlorine.
pH 11.5 - 13
Specific Gravity: 1.175
Boiling Point: Decomposition at 40°C / 104°F
Freezing/Melting Point: -25°C / -12°F
Vapor Pressure: 17.5 mmHg
Vapor Density: Not Available.
% Volatile by Volume: Not Available.
Evaporation Rate: Not Available.
Solubility: Soluble in water.
VOCs: Not Available.
Viscosity: Not Available.
Molecular Weight: Not Available.
Other: Not Available.

10. STABILITY AND REACTIVITY

Chemical Stability: Unstable above 40°C / 104 °F.
Hazardous Polymerization: Will not occur.
Conditions to Avoid: High temperatures. Exposure to light.
Materials to Avoid: Acids. Ammonia. Strong oxidizers. Reducing agents. Metals.
Hazardous Decomposition Products: When heated to decomposition, it emits acrid smoke and irritating fumes. Chlorine. Oxides of sodium. Oxygen.

Additional Information:

Hypochlorites may react with primary amines to form nitrogen trichloride which explodes spontaneously in air. Hypochlorite bleach reacts with urea to form nitrogen trichloride which explodes spontaneously in air. Some metals accelerate the decomposition of Sodium Hypochlorite. Nickel. Copper. Tin. Iron and its alloys. Manganese.

11. TOXICOLOGICAL INFORMATION

Principle Routes of Exposure

Ingestion: Corrosive. Causes burns to the mouth, throat and stomach. Causes vomiting, nausea, and diarrhea. Coma, shock and death may occur.

11. TOXICOLOGICAL INFORMATION

Skin Contact: Corrosive. May cause severe skin irritation. Prolonged contact may lead to burns and blisters and may aggravate dermatitis. May cause whitening or bleaching of the skin.
Inhalation: Corrosive to the respiratory passage. Causes irritation of the mouth, nose and throat. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage.
Eye Contact: Corrosive to eye tissue and may cause severe damage and blindness.

Additional Information: Aspiration may cause lung damage. Corrosive effects on the skin and eyes may be delayed, and damage may occur without the sensation or onset of pain.
Acute Test of Product:
Acute Oral LD50: Not Available.
Acute Dermal LD50: Not Available.
Acute Inhalation LC50: Not Available.

Carcinogenicity:

Ingredients	IARC - Carcinogens	ACGIH - Carcinogens
Water	Not listed.	Not listed.
Sodium Hypochlorite, Solution	Group 3	Not listed.

Carcinogenicity Comment: No additional information available.

Reproductive Toxicity/ Teratogenicity/ Embryotoxicity/ Mutagenicity: Not Available.

12. ECOLOGICAL INFORMATION

Ecotoxicological Information:

Ingredients	Ecotoxicity - Fish Species Data	Acute Crustaceans Toxicity:	Ecotoxicity - Freshwater Algae Data
Water	Not Available.	Not Available.	Not Available.
Sodium Hypochlorite, Solution	0.03 - 0.19 mg/L LC50 (Oncorhynchus mykiss) 96 h semi-static 0.05 - 0.771 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through 0.06 - 0.11 mg/L LC50 (Pimephales promelas) 96 h flow-through 0.18 - 0.22 mg/L LC50 (Oncorhynchus mykiss) 96 h static 0.28 - 1 mg/L LC50 (Lepomis macrochirus) 96 h flow-through 0.4 - 0.8 mg/L LC50 (Lepomis macrochirus) 96 h static 4.5 - 7.6 mg/L LC50 (Pimephales promelas) 96 h static	Not Available.	0.095 mg/L EC50 Skeletonema costatum 24 h

Other Information:
Harmful to aquatic life at low concentrations. Toxicity is primarily associated with pH.

13. DISPOSAL CONSIDERATIONS

Disposal of Waste Method: Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations.
Contaminated Packaging: Empty containers should be recycled or disposed of through an approved waste management facility.

14. TRANSPORT INFORMATION

DOT (U.S.):
DOT Shipping Name: HYPOCHLORITE SOLUTION
DOT Hazardous Class 8
DOT UN Number: UN1791
DOT Packing Group: III
DOT Reportable Quantity (lbs): Not Available.
Note: No additional remark.
Marine Pollutant: No.

TDG (Canada):
TDG Shipping Name: HYPOCHLORITE SOLUTION
Hazard Class: 8
UN Number: UN1791
Packing Group: III
Note: No additional remark.
Marine Pollutant: No.

15. REGULATORY INFORMATION

U.S. TSCA Inventory Status: All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt.

Canadian DSL Inventory Status: All components of this product are either on the Domestic Substances List (DSL), the Non-Domestic Substances List (NDSL) or exempt.

Note: Not available.

U.S. Regulatory Rules

Ingredients	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Water	Not Listed.	Not Listed.	Not Listed.
Sodium Hypochlorite, Solution	Not Listed.	Listed	Not Listed.

California Proposition 65: Not Listed.
MA Right to Know List: Listed.
New Jersey Right-to-Know List: Listed.
Pennsylvania Right to Know List: Listed.

WHMIS Hazardous Class:
E CORROSIVE MATERIAL

16. OTHER INFORMATION

Additional Information: This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

Disclaimer: NOTICE TO READER:
Univar, expressly disclaims all express or implied warranties of merchantability and fitness for a particular purpose, with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this MSDS as a product specification. For product specification information refer to a Product Specification Sheet and/or a Certificate of Analysis. These can be obtained from your local Univar Sales Office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein. This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process.

*****END OF MSDS*****

7.8.2 - CITRIC ACID

Material Safety Data Sheet

LA3183
Citric Acid 50% Solution

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Id: LA3183
Product Name: Citric Acid 50% Solution
Synonyms: None
Chemical Family: None Known
Application: Not Available.

Distributed By:
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC
V6X 1W5

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.
Preparation date of MSDS: 04/Feb/2014
Telephone number of preparer: 1-866-686-4827

24-Hour Emergency Telephone Number (CANUTEC): (613) 996-6666

2. HAZARDS IDENTIFICATION

Potential Acute Health Effects:
Eye Contact: Causes eye irritation. Resulting in stinging, reddening, tearing and swelling.
Skin Contact: Causes skin irritation. Resulting in stinging, reddening and swelling.
Inhalation: May cause irritation of the respiratory tract.
Ingestion: If large amounts of the product are ingested, symptoms may include gastrointestinal irritation, nausea, vomiting and diarrhea.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	Percentage (W/W)	LD50s and LC50s Route & Species:
Water 7732-18-5	Balance	Oral LD50 (Rat) >90 mL/kg
Citric acid 77-92-9	30-60	Not available.

Note: No additional remark.

4. FIRST AID MEASURES

Eye Contact: In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Inhalation: Remove person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, get immediate medical attention.
Ingestion: Do NOT induce vomiting. Never give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.
Notes to Physician: Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point: None.
Flash Point Method: Not applicable.
Autoignition Temperature: Not available.
Flammable Limits in Air (%): Not Available.
Extinguishing Media: Use extinguishing media appropriate for surrounding fire.
Special Exposure Hazards: Not flammable.
Hazardous Decomposition/Combustion Materials (under fire conditions): Not available.
Special Protective Equipment: Not applicable.
NFPA RATINGS FOR THIS PRODUCT ARE: HEALTH 1, FLAMMABILITY 0, INSTABILITY 0
HMIS RATINGS FOR THIS PRODUCT ARE: HEALTH 1, FLAMMABILITY 0, REACTIVITY 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures: Wear appropriate protective equipment.
Environmental Precautionary Measures: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. Consult local authorities.
Procedure for Clean Up: Isolate hazard area and restrict access. Absorb with an inert dry material and place in an appropriate waste disposal container. Flush area with water to remove trace residue. Collect washings for disposal.

7. HANDLING AND STORAGE

Handling: Avoid breathing mist or vapor. Avoid contact with eyes, skin and clothing. Protect from freezing. Wash thoroughly after handling.
Storage: Store in a dry place away from excessive heat, in original or similar waterproof containers. Keep containers tightly closed. Store between 10°C (50°F) - 60°C (140°F).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:

Local exhaust ventilation as necessary to maintain exposures to within applicable limits.
Respiratory Protection: Not normally required if good ventilation is maintained. Avoid breathing mists or vapors.
Gloves:

Rubber gloves. Vinyl gloves.
Skin Protection: Skin contact should be prevented through the use of suitable protective clothing, gloves and footwear, selected for conditions of use and exposure potential. Consideration must be given both to durability as well as permeation resistance. Wear chemical resistant pants and jackets, preferably butyl or nitrile rubber.
Eyes: Safety glasses with side shields or chemical goggles.
Other Personal Protection Data: Ensure that eyewash stations and safety showers are proximal to the work-station location. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities.

Ingredients	Exposure Limit - ACGIH	Exposure Limit - OSHA	Immediately Dangerous to Life or Health - IDLH
Water	Not available.	Not available.	Not Available.
Citric acid	Not available.	Not available.	Not Available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Color: Clear Colorless
Odor: Essentially odorless to very slight sugar odor.
pH Not Available.
Specific Gravity: 1.24
Boiling Point: 104°C /219°F
Freezing/Melting Point: Not Available.
Vapor Pressure: 16 mmHg
Vapor Density: 0.62
% Volatile by Volume: 50%
Evaporation Rate: <1
Solubility: Completely miscible.
VOCs: Not Available.
Viscosity: Not Available.
Molecular Weight: 192.13
Other: Not Available.

10. STABILITY AND REACTIVITY

Chemical Stability: Stable.
Hazardous Polymerization: Will not occur.
Conditions to Avoid: None known.
Materials to Avoid: Carbon. Caustics.
Hazardous Decomposition Products: None known
Additional Information:

Solutions are mildly corrosive to carbon steel.

11. TOXICOLOGICAL INFORMATION

Principle Routes of Exposure

Ingestion: If large amounts of the product are ingested, symptoms may include gastrointestinal irritation, nausea, vomiting and diarrhea.
Skin Contact: Causes skin irritation. Resulting in stinging, reddening and swelling.
Inhalation: May cause irritation of the respiratory tract.
Eye Contact: Causes eye irritation. Resulting in stinging, reddening, tearing and swelling.

Additional Information: Pre-existing eye and skin disorders may be aggravated by exposure to this product.

Acute Test of Product:
Acute Oral LD50: Not Available.
Acute Dermal LD50: Not Available.
Acute Inhalation LC50: Not Available.

Carcinogenicity:

Ingredients	IARC - Carcinogens	ACGIH - Carcinogens
Water	Not listed.	Not listed.
Citric acid	Not listed.	Not listed.

Carcinogenicity Comment: No additional information available.

Reproductive Toxicity/ Teratogenicity/ Embryotoxicity/ Mutagenicity: Not Available.

12. ECOLOGICAL INFORMATION

Ecotoxicological Information:

Ingredients	Ecotoxicity - Fish Species Data	Acute Crustaceans Toxicity:	Ecotoxicity - Freshwater Algae Data
Water	Not Available.	Not Available.	Not Available.
Citric acid	LC50/96h/goldfish : 440-706 mg/l	Not Available.	Not Available.

Other Information:
No additional remark.

13. DISPOSAL CONSIDERATIONS

Disposal of Waste Method: Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations.
Contaminated Packaging: Empty containers should be recycled or disposed of through an approved waste management facility.

14. TRANSPORT INFORMATION

DOT (U.S.):
DOT Shipping Name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (CITRIC ACID)
DOT Hazardous Class 8
DOT UN Number: UN3265
DOT Packing Group: III
DOT Reportable Quantity (lbs): Not Available.
Note: No additional remark.
Marine Pollutant: No.

TDG (Canada):
TDG Shipping Name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (CITRIC ACID)
Hazard Class: 8
UN Number: UN3265
Packing Group: III
Note: No additional remark.
Marine Pollutant: No.

15. REGULATORY INFORMATION

U.S. TSCA Inventory Status: All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt.

Canadian DSL Inventory Status: All components of this product are either on the Domestic Substances List (DSL), the Non-Domestic Substances List (NDSL) or exempt.

Note: Not available.

U.S. Regulatory Rules

Ingredients	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Water	Not Listed.	Not Listed.	Not Listed.
Citric acid	Not Listed.	Not Listed.	Not Listed.

California Proposition 65: Not Listed.
MA Right to Know List: Not Listed.
New Jersey Right-to-Know List: Not Listed.
Pennsylvania Right to Know List: Not Listed.

WHMIS Hazardous Class:
E CORROSIVE MATERIAL

16. OTHER INFORMATION

Additional Information: This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

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*****END OF MSDS*****

SECTION 8 - CONTROLS DOCUMENTATION

8.1 - PROCESS CONTROL NARRATIVE

I13

PROCESS AND CONTROL NARRATIVE

Meliadine STP

U65875-I13-0001,02

Katherine Scott
08/01/2016

TABLE OF CONTENTS

SECTION 1 - DOCUMENT INTRODUCTION

1.1 - OBJECTIVES OF THIS DOCUMENT

This process control narrative document presents sewage treatment system functions. It describes the specific system requirements in terms of functionality and control. The information in this document is necessary for proper and efficient operation of the system. It explains how the system runs through the different operating modes. This document should be read in tandem with the process and instrumentation diagrams (P&IDs), process flow diagram (PFD), general arrangement (GA) drawing and HMI operator interface. It should be noted that only the scope of work of H2O Innovation is explained in this document.

1.2 - REFERENCE DOCUMENTS

1.2.1 - DRAWINGS

DRAWING NUMBER	DRAWING NAME	NUMBER OF PAGES
U65875-C01-0001	LEGEND	1
U65875-C01-0190	FEED WATER EQUALIZATION	1
U65875-C01-0110	RAW WATER SCREENING	1
U65875-C01-0720	AEROBIC TANK	1
U65875-C01-0740	MEMBRANE FILTRATION	1
U65875-C01-0750	BLOWERS FOR MBR SYSTEM	2
U65875-C01-0790	PERMEATE TANK	1
U65875-C01-0800	DOSING SKIDS – CLEANING CHEMICALS	1
U65875-C01-0800	DOSING SKIDS – ALKALINITY	1
U65875-C01-0960	SLUDGE HANDLING SYSTEM	1

1.3 - ABBREVIATIONS

ABBREVIATIONS	DEFINITION
AUTO	Automatic Operation
BOD	Biological Oxygen Demand
CEB	Chemically Enhanced Backwash
CIP	Clean in Place
EQ	Equalization
GA	General Arrangement Drawing
HMI	Human Machine Interface
MBR	Membrane Bioreactor
MLSS	Mixed Liquor Suspended Solids
NaOCl	Sodium Hypochlorite
NH3	Ammonia
PFD	Process Flow Diagram
P&ID	Process & Instrumentation Diagram
PLC	Programmable Logic Controller
RAS	Return Activated Sludge
STP	Sewage Treatment Plant
TMP	Trans-Membrane Pressure
UV	Ultraviolet
VFD	Variable Frequency Drive
WAS	Waste Activated Sludge

SECTION 2 - PROCESS DESCRIPTION

The Sewage Treatment Plant (STP) is a membrane bioreactor (MBR) design, and will treat domestic sewage from the Agnico Meliadine Lake Mine in Nunavut. It will include equalization, fine screening, biological reactors with membrane filtration, and a sludge handling system. A process schematic, shown in Figure 1 below, illustrates the process flow of this system.

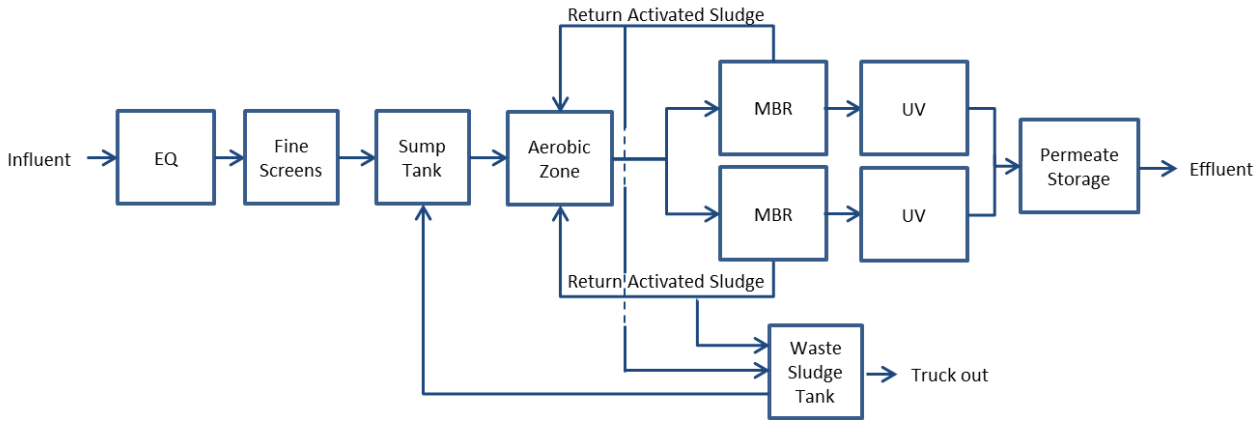


Figure 1 – Process Flow Schematic

The biological treatment system is designed to handle an average day flow rate of 216 m3/d. The system is comprised of a common equalization system with screening and biological treatment followed by two trains of membrane filtration. Trains are numbered 1 and 2. Waste sludge is sent to a single sludge holding tank before it is removed for disposal. The system is installed in above ground insulated tanks and ISO containers with associated mechanical and electrical equipment provided inside the containers.

2.1 - EQUALIZATION (EQ) SYSTEM

Feed is pumped (by others) to the equalization system, which is comprised of two aerated cylindrical tanks sized to handle the peak hour design volume of 106,200 L. The equalization tank provides a residence time sufficient to maintain steady flows to the biological treatment system during low and high flow periods. Equalized water is pumped via two equalization (EQ) pumps on variable frequency drives (VFDs) into a standpipe inside the second cylindrical tank and flows from that pipe by gravity to the fine screens inside Container 1.

2.2 - FINE SCREEN SYSTEM

Equalized wastewater flow to the fine screens by gravity. The fine screens are rotary drum screens with 2 mm perforated plate openings that automatically remove debris and trash. This protects the downstream processes and equipment. The fine screen operates continuously. Pressurized wash water

is used intermittently to clean the screens and screenings. Screened raw water falls by gravity from the screens into a sump, where the screened water is collected and pumped to the aerobic tank.

2.3 - AEROBIC BIOLOGICAL TREATMENT

The aerobic tank is a third cylindrical tank located outdoors. Aerobic biological treatment is the work-horse of any biological wastewater system. In this process, heterotrophic bacteria consume organic pollutants (BOD), oxygen and ammonia, and produce carbon dioxide, water and nitrate as well as reproducing to grow the bacteriological population. Fine bubble diffusers are installed in the bottom of the aerobic tank and process blowers continuously provide air to the diffusers. The air bubbling from the bottom of the tank imparts oxygen into the liquid phase to maintain a dissolved oxygen concentration of approximately 2 mg/L to satisfy the needs of the biomass. The bubbling is also used to keep the bacteria in suspension. The oxygenated mixed liquor suspended solids (MLSS) overflows into a standpipe inside the cylindrical tank and flows by gravity to the membrane filtration trains in Container 2.

2.4 - MEMBRANE FILTRATION

The activated sludge is split between the two membrane tanks that are located in Container 2. Membrane filtration is used to separate the bacteria from the water to keep them in the process at the desired concentration. Activated sludge is returned at a constant flow rate to the Aerobic Tank to prevent a build-up of sludge in the membrane tank. The Return Activated Sludge (RAS) is pumped by the RAS pumps at a flow rate 4 times greater than the design flow rate of the plant. In this manner the activated sludge is recirculated from the aerobic tank, to the membrane tank and back to the aerobic tank constantly at approximately 4 times the average feed flow rate.

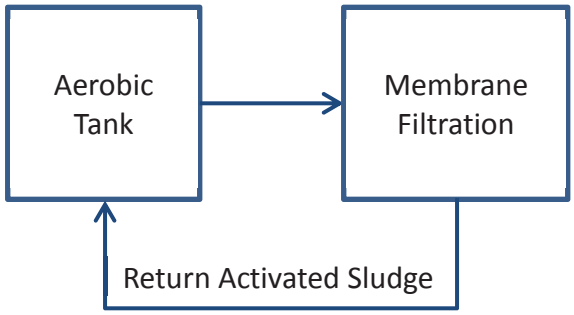


Figure 2 – Bioreactor Sludge Recirculation Set-up

The filtered liquid (called permeate) is pulled through the hollow-fiber membrane filters by the permeate pumps at a flow rate that matches the feed flow rate entering the aerobic tank to maintain a constant liquid level in the membrane tanks. From the permeate pumps, each membrane bioreactor train sends permeate through an inline ultraviolet (UV) disinfection system. The UV system operates continuously to kill any residual organisms remaining before it is sent to a common permeate storage

tank. The permeate tank acts as a reservoir for treated water that can be used for CEB and CIP processes.

2.5 - MEMBRANE CLEANING

To mitigate membrane fouling, several maintenance processes are performed:

1. Membrane Relax – membrane permeation is stopped for 1 minute after every 7 minutes of permeation.
2. Chemically Enhanced Backpulse (CEB) – membrane permeate flow is reversed to flow back into the membranes while cleaning chemical is added inline. This is done once per week.
3. Clean in Place (CIP) – a semi-annual process where a high concentration of chemical is used to restore permeability to the membranes. This is a combination of a reverse flow with chemical and a soak period.

2.6 - TREATED WATER SYSTEM

Permeate is transferred into the permeate tank, where it is then pumped by effluent pumps to a discharge location.

2.7 - SLUDGE HANDLING

Since bacteria within the STP continue to reproduce as they consume organics and nutrients, the concentration of biomass, measured as Mixed Liquor Suspended Solids (MLSS), increases with time. To maintain a steady MLSS in the bioreactors, some sludge must be removed (wasted) on a daily basis. Sludge is wasted by re-directing the RAS flow to the sludge storage tank, referred to as waste activated sludge (WAS). The sludge storage tank is aerated to maintain an aerobic biomass. The aeration can be turned off for a period of time to allow sludge to settle within the sludge tank and thicken by gravity. The supernatant that is left in the upper portion of the tank can be removed by opening a valve from the sludge tank, and allowing it to flow to the sump tank where it re-enters the treatment process. This operation (called decanting) reduces the volume of sludge that needs to be handled and extends the period of time that the sludge tank can be used before thickened sludge must be disposed of.

2.8 - OPERATIONAL FLEXIBILITY

The membrane portion of the sewage treatment system operates as two (2) separate trains. Therefore, if maintenance is required for any piece of equipment in the membrane system, the plant will continue to operate one train treating the full flow for short durations.

In the event of very low sewage production periods, a train can be taken completely offline by draining and flushing the system and filling the membrane tank with permeate since the membranes must be kept wet once they are commissioned.

SECTION 3 - CONTROLS PHILOSOPHY

3.1 - INTRODUCTION

The controls for the Meliadine STP are automated by a programmable logic controller (PLC) that functions based on a series of operating "modes". The PLC automatically moves the system between the different modes using triggers that are executed based on a variety of parameters such as tank level, pressure, dissolved oxygen and flow rate that are measured continuously by the instrumentation that is installed throughout the plant. Automated valves are actuated and equipment is turned on and off based on the modes and conditions at any given time.

3.1.1 - EQUIPMENT CONTROL – HOA CONTROL

All equipment can either be manually controlled or controlled by the PLC program. Each piece of equipment appears on the touch screen that acts as the Human Machine Interface (HMI). When the symbol for a piece of equipment such as a pump is touched, a pop-up screen appears allowing the operator to choose to override the AUTO setting to ON or OFF. If it is set to ON, the equipment will RUN and start operating irrespective of plant conditions. If it is set to OFF, the equipment will STOP, regardless of the current status of the plant. If it is set to AUTO, it will automatically operate in RUN and STOP based on the mode and conditional programming that has been established and is described in detail within this document.

The HOA screen for equipment with variable speed, such as a pump with a VFD, allows the operator to input a specific speed (0-100%) at which the equipment will operate when it is manually turned ON.

3.1.2 - TRAIN OPERATION

The two (2) membrane trains operate independently depending on their status at a given time. Each train operates based on the tank levels, flow rates and pressures of the particular train. When one train encounters a situation where it needs to stop operation, such as a cleaning or alarms that require it to stop, the feed from the aerobic tank continues to flow into a pipe that hydraulically connects both membrane tanks. As a result, even if one membrane train stops, the hydraulic connection causes all of the feed to flow to the other train to balance the membrane tank levels.

3.2 - MODES OF OPERATION

The controls system operates based on a number of modes as shown below:

MODE	DESCRIPTION
OFF	All process equipment is OFF with the exception of blowers to ensure the system remains aerobic.
PRODUCTION	Production mode occurs during normal operation when sewage is being sent to the EQ tanks. All process equipment operates based on the automatic control logic to provide treatment of sewage, as described below.
STANDBY	Standby mode occurs when the amount sewage being sent to the system is less than the system capacity such that the system must "wait" for adequate feed to continue operation.
CEB	CEB or "Chemically Enhanced Backpulse" is a weekly membrane maintenance process that sends cleaning agents to the membranes to mitigate membrane fouling
CIP	CIP or "Clean in Place" is a process designed to return the membranes to a near-clean state using a high chemical concentration and relatively long duration (4 hours). The process is conducted semi-annually as required.

3.3 - OPERATING SEQUENCE CHART (OSC)

The OSC shown below provides an overview of the status of the major equipment and valve positions for different operating modes and steps within each mode. It indicates for each operating mode whether equipment is in STOP, as indicated by an "X" or RUN/AUTO, as indicated by an "O".

Where a piece of equipment is assigned an "X" for a particular mode, it indicates that this equipment will always be in STOP during the associated mode. Where a piece of equipment is assigned an "O" for a particular mode, it indicates that this equipment will operate either continuously or based on a set of conditions. Since some equipment operates conditionally based on triggers, the "O" status indicates that this equipment will be subject to its conditional programming. For example, the Fine Screen is indicated as "O" during "Production" mode; however, it is programmed to only operate when the Feed Flow Rate is >0. Therefore, even though the system is in "Production" mode, if the Feed Flow Rate is zero, the Fine Screen will stop operating until the Feed Flow Rate >0.

		Common Equipment										Train Equipment				Valves									
	X - STOP O - AUTO (RUN/STOP)	EQ Pumps[1]	EQ Blower	Fine Screens[2]	Sump Pumps	Process Blowers	Alkalinity Dosing Pumps[3]	Hypochlorite Dosing Pump[4]	Citric Acid Dosing Pump[4]	Effluent Pumps	Sludge Blower	Permeate Pumps	RAS Pumps	Membrane Blowers	UV System	Wash Water Solenoid Valve (FV-11221)	TMP Control Valve (FV-31026)	Hypochlorite Dosing Valve[4] (FV-83798)	Citric Acid Dosing Valve[4] (FV-83598)	Permeate Inlet Valve (FV-79001)	CIP Inlet Valve (FV-79002)	Permeate Outlet Valve (FV-79098)	CIP Outlet Valve (FV-79099)	Membrane Tank Feed Valve (FV-74050)	Wasting Valve (FV-96001)
SYSTEM MODE	**OFF**	X	O	X	X	O	X	X	X	X	O	X	X	O	X	X	X	X	X	X	X	X	X	X	X
	Standby	O	O	O	O	O	O	X	X	X	O	X	O	O	X	O	X	X	X	O	X	X	X	O	X
	Production - Permeation	O	O	O	O	O	O	X	X	O	O	O	O	O	O	O	X	X	X	O	X	O	X	O	O
	Production - Relax	O	O	O	O	O	O	X	X	O	O	X	O	O	O	O	X	X	X	O	X	O	X	X	O
TRAIN MODE	**CEB - Initiate**	O	O	O	O	O	O	X	X	O	O	X	X	X	X	O	X	X	X	X	X	X	X	X	X
	CEB - Injection	O	O	O	O	O	O	O	O	O	O	O	X	X	X	O	O	O	O	X	O	X	O	X	X
	CEB - Soak	O	O	O	O	O	O	X	X	O	O	X	X	X	X	O	X	X	X	X	O	X	X	X	X
	CEB - Flush	O	O	O	O	O	O	X	X	O	O	O	O	O	X	O	O	X	X	X	O	X	O	X	X
	CEB - Finish	O	O	O	O	O	O	X	X	O	O	X	O	O	X	O	X	X	X	O	X	O	X	X	X
	CIP - Initiate	O	O	O	O	O	O	X	X	O	O	X	X	X	X	O	X	X	X	X	X	X	X	X	X
	CIP - Injection	O	O	O	O	O	O	O	O	O	O	O	X	X	X	O	O	O	O	X	O	X	O	X	X
	CIP - Soak	O	O	O	O	O	O	X	X	O	O	X	X	X	X	O	X	X	X	X	O	X	X	X	X
	CIP - Flush	O	O	O	O	O	O	X	X	O	O	O	O	O	X	O	O	X	X	X	O	X	O	X	X
	CIP - Finish	O	O	O	O	O	O	X	X	O	O	X	O	O	X	O	X	X	X	O	X	O	X	X	X

[1] EQ Pumps operate based on EQ Tank Level

[2] Fine Screens operate only when the EQ Pump Feed Flow Rate is >0

[3] Alkalinity Pumps operate based on a feedback loop from the pH Probe on the Aerobic Tank effluent

[4] During a CEB or CIP, *EITHER* the hypochlorite *OR* the citric acid will be initiated, depending on the type of clean selected. The two chemicals must never be mixed together to avoid the formation of poison gas.

3.4 - CONTROL SYSTEM AND COMMUNICATION

3.4.1 - PROGRAMMABLE LOGIC CONTROLLER

The system will be controlled by a Schneider Electric Modicon m340 or m580 Processor, and the HMI will operate on a Wonderware interface.

3.4.2 - DISTRIBUTED I/O

Schneider IO will be used for the I/O in each container. The local instruments and valves will be wired to the corresponding local I/O junction box.

3.4.3 - OTHER COMMUNICATIONS

Ethernet/IP will be used for the communication between the PLC and the local IO blocks. Ethernet/IP will also be used for the communication between the PLC and the local HMI screen and also the VFDs.

SECTION 4 - CONTROL NARRATIVE

4.1 - EQUALIZATION (EQ) SYSTEM

Domestic sewage is sent by lift pumps through a Raw Feed Flowmeter (FIT-11274) to the STP. The equalization system suppresses variability in feed flow to the treatment plant. The two (2) EQ Tanks (T-19000A/B) are hydraulically connected in series and combined have sufficient volume to handle the expected variability in feed flow. The equalization tanks fill and empty as sewage production varies, but send a relatively consistent flow forward to the downstream processes.

An Equalization Blower (B-75000) provides air to both EQ Tanks to maintain an aerobic environment and provide mixing. Air is distributed through Coarse Bubble Diffusers (CBD-19086) installed in the EQ Tanks.

The EQ Pumps (P-19200A/B) are submersible pumps installed on the bottom of the second cylindrical EQ tank that are used to transport equalized sewage from the EQ Tank, through the equalized feed flowmeter (FIT-19274) and into the Fine Screens (SCR-11200A/B). Each EQ pump can handle the full flow to the plant so that when one EQ pump is offline the other can continue to supply the STP with equalized flow.

4.1.1 - EQUALIZATION SYSTEM EQUIPMENT

ÉQUIPMENT	TAGS	QTY	DESIGN VALUE	NOTES
Raw Feed Flowmeter	FIT-11274	1	0-110 m3/hr	Loose shipped, measures the instantaneous flow to the plant and totalizes the daily flow [1]
EQ Tanks	T-19000A/B	2	Volume = 63 m3 each	Cylindrical tank
Equalization Blower	B-75000	1	680 m^3/h @ 6.5 m H_2O	One for both tanks
Coarse Bubble Diffusers	CBD-19086A1/A4 CBD-19086B1/B4	8	n/a	
EQ Level Sensors	LT-19060A/B	2	0-7 m H_2O	One per tank

EQ Pumps	P-19200A/B	2	9 m^3/hr each	VFD controlled
Equalized Feed Flowmeter	FIT-19274	1	0 - 25 m3/hr	Measures the equalized flow to the plant

[1]HMI should display the previous day's total flow as measured through the raw feed flowmeter as well as the cumulative flow from the current day (since midnight).

4.1.1.1 - EQUALIZATION PUMPS

When the STP system is in PRODUCTION mode or STANDBY mode, the EQ Pumps will operate based on the commands given from the PLC. The EQ Pumps operate on VFDs to allow their speeds to be adjusted to meet different Flow Rate Set-Points. These Flow Rate Set-Points are met using a PID loop to adjust the pump speed based on the measured flow of the Equalized Feed Flow Meter (FIT-19274). The EQ Pump status and Flow Rate Set-Points are determined in response to the EQ Level Sensors (LT-19060A/B) as follows:

EQ TANK LEVEL	DESCRIPTION	NOTES
Below LoLo Level Set-Point in Tank 2	STOP EQ Pumps	This protects the EQ Pumps from running dry. LoLo Alert is shown on PLC.
Between Lo Level and HiHi Level Set-Points in Tank 2	RUN EQ Pump; system enters PRODUCTION mode. Equalized Feed Flowrate = "Flow Set-Point"	The "Flow Set-Point" is 9 m3/hr; however, the operator can change this value to prevent intermittent operation during times with low sewage production
Above HiHi Level Set-Point in Tank 2	RUN EQ Pump. Equalized Feed Flowrate = "Flow Set-Point"	When the EQ Tank level increases to the HiHi Level Set-Point, a critical alarm occurs, but the pump continues to run at the same set-point.

Note: EQ Pump operation should alternate between EQ Pump A and EQ Pump B every 24 hours unless a Pump Fault indicates otherwise.

In the event of a level transmitter failure in EQ Tank 2, the level transmitter in EQ Tank 1 will be used. This mode is for emergency purposes only; it is imperative that the EQ Tank 2 level transmitter be repaired as soon as possible to resume normal plant control and operation. This is important because in the event of a line freeze or blockage between EQ Tank 1 and 2, both transmitters need to be functioning in order to identify the differing tank levels and correct the problem quickly.

4.1.1.2 - EQUALIZATION BLOWER

The Equalization Blower is used to supply oxygen to both Equalization Tanks to maintain an aerobic environment and provide mixing. One blower is supplied for both tanks. Under normal conditions, the blower will always be in RUN.

4.1.2 - EQUALIZATION SYSTEM HMI INPUTS

The following values are input on the HMI and can be adjusted to optimize system operation.

HMI INPUT	INITIAL VALUE
Raw Feed Flow Rate - Lo Set-Point	1 m3/hr
Raw Feed Flow Rate - Hi Set-Point	106 m3/hr
EQ Tank 1/2 Level – LoLo Set-Point	0.8 m
EQ Tank 1/2 Level - Lo Set-Point	1.0 m
EQ Tank 1/2 Level - Hi Set-Point	4.0 m
EQ Tank 1/2 Level - HiHi Set-Point	6.0 m
Equalized Feed Flow Set-Point	9 m3/hr
Equalized Feed Flow Rate - LoLo Set-Point	1 m3/hr

4.1.3 - EQUALIZATION SYSTEM ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Raw Feed Flow Rate - Lo	Occurs if the raw feed flow rate is lower than the Lo setpoint	No Action
Raw Feed Flow Rate - Hi	Occurs if the raw feed flow rate is higher than the Hi setpoint	Alert: “Raw Feed Flow Rate – Hi”
Raw Feed Flowmeter Fault	Occurs if the raw feed flowmeter returns non 4-20 mA signal	Alert: “Raw Feed Flowmeter Fault”
EQ Blower Fault	Occurs if EQ blower returns a non 4-20 mA signal	Alert: “EQ Blower Fault” Alert operator to repair or replace blower as soon as possible
EQ Tank 1 Level – LoLo	Occurs when EQ Tank 1 level drops below the LoLo Level Set-Point	Alert: “EQ Tank 1 - Level LoLo”
EQ Tank 1 Level – Lo	Occurs when EQ Tank 1 level drops below the Lo Level Set-Point	No Action

EQ Tank 1 Level - Hi	Occurs when EQ Tank 1 level rises above Hi Level Set-Point	Alert: "EQ Tank 1 - Level Hi" (No Action)
EQ Tank 1 Level - HiHi	Occurs when EQ Tank 1 level rises above HiHi Level Set-Point	Critical Alarm: "EQ Tank 1 – Level HiHi" (No Action) Note that an emergency overflow is installed on both EQ tanks that will allow a controlled overflow in case of emergencies.
EQ Tank 1 Level Sensor Fault	Occurs if the transmitter returns non 4-20 mA signal	Critical Alarm: "EQ Tank 1 – Level Sensor Fault" Use levels from EQ Tank 2 Level Sensor until EQ Tank 1 Level Sensor Fault cleared
EQ Tank 2 Level – LoLo	Occurs when EQ Tank 2 level drops below the LoLo Level Set-Point	Alert: "EQ Tank 2 - Level LoLo" STOP EQ pumps
EQ Tank 2 Level – Lo	Occurs when EQ Tank 2 level reaches the Lo Level Set-Point	No Alert/Alarm Put EQ Pumps in RUN if they are in STOP; system enters PRODUCTION mode
EQ Tank 2 Level - Hi	Occurs when EQ Tank 2 level rises above Hi Level Set-Point	Alert: "EQ Tank 2 - Level Hi" (No Action)
EQ Tank 2 Level - HiHi	Occurs when EQ Tank 2 level rises above HiHi Level Set-Point	Critical Alarm: "EQ Tank 2 – Level HiHi" (No Action) Note that an emergency overflow is installed on both EQ tanks that will allow a controlled overflow in case of emergencies.
EQ Tank 2 Level Sensor Fault	Occurs if the transmitter returns non 4-20 mA signal	Critical Alarm: "EQ Tank 2 – Level Sensor Fault" Use levels from EQ Tank 1 Level Sensor until EQ Tank2 Level Sensor Fault cleared
EQ Pump A Fault	Indicates mechanical failure of EQ Pump A	Alert: "EQ Pump A Fault" Turn EQ Pump A to OFF and switch operation to EQ Pump B
EQ Pump B Fault	Indicates mechanical failure of EQ Pump B	Alert: "EQ Pump B Fault" Turn EQ Pump B to OFF and switch operation to EQ Pump A
Equalized Feed Flow Rate - LoLo	Occurs when EQ Pump is ON and FIT-19274 reads less than the	Alarm: "Equalized Feed Flow Rate LoLo"

	Equalized Feed LoLo Set-Point	Turn OFF EQ Pumps – this indicates a possible broken pipe or clogged pipe/pump. Operator must repair immediately.
Equalized Feed Flowmeter Fault	Occurs if the flowmeter returns non 4-20 mA signal	Alarm: "Equalized Feed Flowmeter Fault" Continue EQ Pump operation at last setpoint for VFD and continue Fine Screen operation until Fault is cleared

4.2 - FINE SCREEN SYSTEM

The equalized sewage flows through the Fine Screens (SCR-11200A/B) to remove hair, trash and debris that can have a detrimental effect on downstream processes. The fine screens are automatic and flushing water is intermittently used to clean the screens to prevent excessive accumulation of debris on the screen holes. The frequency and duration of cleans are controlled by timers on solenoid valves that send wash water to the screens, and can be adjusted by the operator at the HMI. Once the sewage passes through the screen it falls into the Sump Tank for Screened Water (T-12000) by gravity. Screenings that are removed by the screen are washed, compacted and automatically sent to a trash receptacle (T-11800), which must be emptied and the trash disposed of on a daily basis. Screened water is pumped by the Sump Pumps (P-12200A/B) to the Aerobic Tank.

4.2.1 - FINE SCREEN SYSTEM EQUIPMENT

ÉQUIPMENT	TAGS	QTY	DESIGN VALUE	NOTES
Fine Screens	SCR-11200	2	N/A	Duty/standby configuration, both operate when the Feed Flow to the Screens > 0, and continue to operate for a set time after the signal ends
Fine Screen Wash Water Solenoid Valve	FV-11221	1	N/A	Only operates on cycle when the Fine Screens are running
Fine Screen Trash Basket	T-11800	1	N/A	Must be emptied daily by the operator

Sump for Screened Water	T-12000	1	4 m3	
Sump Pumps	P-12200A/B	2	9 m3/hr each	Duty/standby configuration
Sump Level Sensor	LT-12060	1	0 – 20 kPa (0 – 1.2 m)	
Screened Water pH Sensor	AIT-11094	1	pH: 0 - 14	
Screened Water Flowmeter	FIT-12274	1	0 - 25 m3/hr	Measures the screened flow to the plant

4.2.1.1 - FINE SCREENS

When the system is in PRODUCTION or STANDBY mode, the screens will be in AUTO. The screens only RUN when there is feed to them as measured by the equalized feed flow meter (FIT-19274). The screen auger will continue to run for the set time (T1) after the signal ends.

The screen/press shower will run on cycle whenever the auger is operating. The wash water shower will cycle on and off and can be adjusted by timer for cycle length and duration of shower. The shower will operate a minimum of once per day to keep the plug moist. A typical cycle is on for 5-20 seconds and then off for 30-200 seconds (i.e., cycle length of 35-220 seconds, and duration of wash for 5-20 seconds).

4.2.1.2 - SUMP PUMPS

When the STP system is in PRODUCTION or STANDBY mode, the Sump Pumps will operate based on the level in the Sump Tank. The Sump Pumps are each set up to operate at the design flow rate of the plant. This flow can be monitored using the screened water flowmeter (FIT-12274).

Under normal operation, one pump will operate. In the event of an upset where the Sump Tank level increases, an emergency backup is available to prevent overflowing inside the container. If the Sump Tank level reaches the “HiHi” level, the second Sump Pump will RUN to increase the flow through the system. Once the Sump Tank level falls below the “LoLo” level, both Sump Pumps will turn OFF. When the level increases again the system will return to operation as normal with one pump running.

The Sump Pump status and Flow Rates are determined in response to the Sump Tank Level Sensor (LT-12060) as follows:

SUMP LEVEL	DESCRIPTION	NOTES
Below LoLo Level Set-Point	STOP Sump Pumps	This protects the Sump Pumps from running dry.
Between LoLo Level and HiHi Level Set-Points	RUN Sump Pump.	During normal operation a single Sump Pump is in RUN and the flow rate should be adjusted to 9 m3/hr to match the Equalized Feed Flow Set-Point. The operator can manually adjust the flow if desired to meet specific plant needs.
Above HiHi Level Set-Point	RUN both Sump Pumps.	When the Sump Tank level increases to the HiHi Level Set-Point, a critical alarm occurs and the second Sump Pump will RUN. The EQ pumps will also be turned to STOP to prevent additional water from entering the Sump Tank. Both pumps will continue to RUN until the Sump Tank level drops to the Hi Level Set-Point. With both pumps running, the total flow rate will be approximately 18 m3/hr. Note that an emergency overflow is installed on the Sump tank that will allow a controlled overflow out of the container in case of emergencies.

Note: Sump Pump operation should alternate between Sump Pump A and Sump Pump B every 24 hours unless a Pump Fault indicates otherwise.

4.2.2 - FINE SCREEN SYSTEM HMI INPUTS

The following values are input on the HMI and can be adjusted to optimize system operation.

HMI INPUT	INITIAL VALUE
Fine Screen Auger Timer (T1)	2 minutes
Fine Screen Washwater Timer	200 seconds
Fine Screen Washwater Duration	10 seconds
Sump Tank Level – LoLo Set-Point	0.3 m
Sump Tank Level – HiHi Set-Point	3.6 m

Screened Water pH - Lo Set-Point	6.0
Screened Water pH - Hi Set-Point	8.0
Screened Water Flow Rate - LoLo Set-Point	1 m3/hr

4.2.3 - FINE SCREEN SYSTEM ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Fine Screen A Fault	Indicates that fine screen may not be operating properly	Alert: "Fine Screen A Fault – divert flow to Fine Screen B"
Fine Screen B Fault	Indicates that fine screen may not be operating properly	Alert: "Fine Screen B Fault – divert flow to Fine Screen A"
Sump Pump A Fault	Indicates mechanical failure of Sump Pump A	Alert: "Sump Pump A Fault" Turn Sump Pump A to OFF and switch operation to Sump Pump B
Sump Pump B Fault	Indicates mechanical failure of Sump Pump B	Alert: "Sump Pump B Fault" Turn Sump Pump B to OFF and switch operation to Sump Pump A
Screened Water Flow Rate - LoLo	Occurs when Sump Pumps are ON and FIT-12274 reads less than the Screened Water Flow Rate LoLo Set-Point	Alarm: "Screened Water Flow Rate LoLo" STOP Sump Pumps – this indicates a possible broken pipe or clogged pipe/pump. Also STOP EQ Pumps to prevent overflow in the container.
Sump Tank Level – LoLo	Occurs when Sump Tank level drops below the LoLo Level Set-Point	Alert: "Sump Tank - Level LoLo" STOP Sump Pumps
Sump Tank Level - HiHi	Occurs when Sump Tank level rises above HiHi Level Set-Point	Critical Alarm: "Sump Tank – Level HiHi" RUN both Sump Pumps in tandem and STOP EQ Pumps until Tank Level drops below the Hi Level Set-Point Note that an

		emergency overflow is installed on the Sump Tank that will allow a controlled overflow out of the container in case of emergencies.
Sump Tank Level Sensor Fault	Occurs if the transmitter returns non 4-20 mA signal	Critical Alarm: "Sump Pump – Level Sensor Fault" Continue Sump Pump in RUN until Level Sensor Fault cleared
Screened Water pH - Lo	Indicates pH is below the pH Lo Set-Point	Alert: "Screened Water pH Lo"
Screened Water pH - Hi	Indicates pH is above the pH Hi Set-Point	Alert: "Screened Water pH Hi"
Screened Water pH Sensor Fault	Occurs when sensor returns non 4-20 mA signal	Alert: "Screened Water pH Sensor Fault"
Screened Water Flowmeter Fault	Occurs if the flowmeter returns non 4-20 mA signal	Alarm: "Screened Water Flowmeter Fault" Continue Sump Pump in RUN

* If a "Fine Screen Fault" occurs and the screen stops operating properly, the Fine Screen will eventually blind with debris and the portion of feed flow entering that screen will overflow and bypass that screen. The operator must manually isolate the faulted screen to repair/replace it, while the remaining screen continues to operate. Each fine screen is sized to handle the full plant flow; however, a faulted screen must be repaired as soon as possible in order to ensure that downstream equipment is not affected.

4.3 - AEROBIC BIOLOGICAL TREATMENT

Screened sewage enters the Aerobic Tank (T-73000) where it is mixed with Return Activated Sludge (RAS) pumped from the Membrane Tanks (T-74000-1/2). The combined mixture called "Mixed Liquor" or "Activated Sludge" travels through the Aerobic Tank and overflows into a standpipe, where it falls by gravity into a downcomer pipe that splits into 2 lines that enter into each Membrane Tank.

The purpose of the aerobic biological treatment is to provide a residence time within which the mixed liquor encounters a dissolved oxygen concentration above 1 mg/L. This allows heterotrophic bacteria to consume organics and ammonia and convert them to carbon dioxide and nitrate. During this biological process the bacteria also consume oxygen and produce more bacteria. Oxygen supply is provided by pumping air from the Process Blowers (B-75240A/B) through the Fine Bubble Diffusers (FBD-73086) and into the mixed liquor in the Aerobic Tank. The Dissolved Oxygen (DO) concentration is continuously

measured by the DO sensor (AE-73094), and the pH and temperature are continuously monitored by the pH/Temperature Sensor (AIT-72093).

4.3.1 - AEROBIC BIOLOGICAL SYSTEM EQUIPMENT

ÉQUIPMENT	TAGS	QTY	DESIGN VALUE	NOTES
Aerobic Tank	T-73000	1	Volume = 63 m3	Cylindrical Tank
Process Blowers	B-75240A/B	2	153 m3/hr at 6.5 m H_2O	Duty/standby configuration
Blower Air Mass Flowmeter	FIT-75274	1	0-200 m^3/hr	
Fine Bubble Diffusers	FBD-73086	1	N/A	
Aerobic Tank Level Sensor	LT-73060	1	0 – 7 m	
Alkalinity Dosing Pumps	P-80100	2	0.18 m3/d each	Dosing will automatically be adjusted by the PLC to ensure adequate buffering is available in the water to achieve the target pH range
pH/Temp Sensor	AIT-72093	1	pH: 0-14 Temp: 0-50°C	Design value is pH 6-8
DO Sensor	AIT-72094	1	O2: 0-10 mg/L	Design value is 2 mg/L

4.3.1.1 - PROCESS BLOWERS

The Process Blowers are used to supply oxygen to the biomass in the Aerobic Tank. Two Process Blowers are supplied for the aerobic tank in a duty/standby configuration, so that if one blower goes offline the other one will automatically switch to RUN. This redundancy is included because the aerobic treatment process is a critical operation and the blowers must satisfy the oxygen requirement for a given BOD and NH3 loading rate. Under normal conditions, the air supply to a train will always RUN in order to provide oxygen to the bacterial population. If the

DO concentration drops below 1 mg/L the second blower will come on to supplement the air supply.

4.3.1.2 - ALKALINITY DOSING PUMPS

The dosing of sodium hydroxide is used to add alkalinity to the wastewater treatment system to satisfy the alkalinity requirements of the nitrification process where ammonia (NH3) is converted to nitrate (NO3). Alkalinity also serves to buffer the wastewater and prevent pH swings.

The Alkalinity Dosing Pumps (P-80100) transport sodium hydroxide into the RAS lines where it is mixed and sent to the Aerobic Tank. The dosing pumps will RUN when the pH drops below the Lo pH Set-Point until the pH increases to the Hi pH Set-Point. The dosing rate will be constant and can be adjusted by the operator manually.

When the system is in Production mode, the Alkalinity Dosing Pump will be in RUN. The actual stroke length of the Alkalinity Dosing Pumps remains constant (set up during commissioning).

4.3.2 - AEROBIC BIOLOGICAL SYSTEM HMI INPUTS

The following values are input on the HMI and can be adjusted to optimize system operation.

HMI INPUT	INITIAL VALUE
pH LoLo – Set-Point	6.0
pH Lo – Set-Point	6.5
pH Hi – Set-Point	7.0
pH HiHi – Set-Point	8.0
DO Lo – Set-Point	1.0
Aerobic Tank Level Set-Point	5.8 m
Aerobic Tank Level – LoLo Set-Point	5.4 m
Aerobic Tank Level - Lo Set-Point	5.6 m
Aerobic Tank Level - Hi Set-Point	5.9 m
Aerobic Tank Level - HiHi Set-Point	6.0 m
Process Blower Flow Rate Set-Point	153 m^3/h
Process Blower Flow Rate Lo Set-Point	50 m^3/h

Alkalinity Dosing Rate – Set-Point	100% stroke length
Alkalinity Tank Level – Lo Set-Point	Set in field

4.3.3 - AEROBIC BIOLOGICAL SYSTEM ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Aerobic Tank Level Sensor Fault	Occurs when level sensor returns non 4-20 mA signal	Alert: "Aerobic Tank Level Sensor Fault"
Aerobic Tank Level - Hi	Occurs when aerobic tank level rises above Hi Level Set-Point	Alert: "Aerobic Tank Level Hi"
Aerobic Tank Level - HiHi	Occurs when aerobic tank level rises above HiHi Level Set-Point	Alarm: "Aerobic Tank Level HiHi" Pipe to Membrane Tanks may be clogged or frozen. STOP EQ Pumps. Note that an emergency overflow is installed on the Aerobic Tank that will allow a controlled overflow in case of emergencies.
Aerobic Tank Level - Lo	Occurs when aerobic tank level drops below the Lo Level Set-Point	Alert: "Aerobic Tank Level Lo"
Aerobic Tank Level – LoLo	Occurs when aerobic tank level drops below the LoLo Level Set-Point	Alarm: "Aerobic Tank Level LoLo" Tank may be leaking; Alert operator to investigate immediately. STOP EQ Pumps.
Aerobic Tank pH - Lo	Indicates pH has dropped below the pH Lo Set-Point	Alert: "Aerobic Tank pH Lo, adjust Alkalinity Dosing Rate"
Aerobic Tank pH - Hi	Indicates pH has increased above the pH Hi Set-Point	Alert: "Aerobic Tank pH Hi, adjust Alkalinity Dosing Rate"
Aerobic Tank pH / Temperature Sensor Fault	Occurs when sensor returns non 4-20 mA signal	Alert: "Aerobic Tank pH / Temperature Sensor Fault"
Process Blower A Fault	Indicates a mechanical failure of Process Blower A	Alarm: "Process Blower A Fault; switch to Process Blower B"
Process Blower B Fault	Indicates a mechanical failure of Process Blower B	Alarm: "Process Blower B Fault; switch to Process Blower A"

Process Blower Flow Rate Lo	Occurs when Process Blower is in RUN and FIT-75274 reads an airflow rate lower than the Process Blower Flow Rate Lo Set-Point	Alert: “Process Blower Flow Rate Lo” Operator to investigate immediately; line may be broken or clogged
Alkalinity Dosing Pump Fault	Indicates a mechanical failure of the Alkalinity Dosing Pump	Alert: “Alkalinity Dosing Pump Fault” Switch to Backup Dosing Pump (installed on same skid)
Alkalinity Tank Level Lo	Occurs when alkalinity day tank level drops below Lo Level Set-Point	Critical Alarm: “Refill chemical tank for alkalinity adjustment”

4.4 - MEMBRANE FILTRATION

Mixed liquor flows by gravity from the Aerobic Tank (T-73000) into the Membrane Tanks (T-74000). Within each Membrane Tank, the Membrane Module (F-74000) filters the mixed liquor. The membranes have tiny pores (0.4µm) that prevent solids from entering the permeate side of the membrane, but allow the passage of water. Permeation occurs during the PRODUCTION mode at a rate that is, on average, equal to the feed flow rate to the train to prevent accumulation of liquid in the Aerobic Tank and Membrane Tanks.

To prevent solids accumulation on the surface of the membranes, membranes permeate for a period of time followed by a "Relax" step where permeation is stopped for a short period of time. The default cycle includes a 7 minute Permeation period followed by a 1 minute Relax period. During Production and Standby, a Membrane Air Scour Blower (B-75400) provides air to the integrated coarse bubble diffusers to provide air scouring and reduce sludge buildup on the membrane fibers.

To prevent excessive solids accumulation within the Membrane Tank, the mixed liquor is returned to the Aerobic Tank via the RAS pumps (P-74600). The MLSS concentration shall be maintained by daily wasting of MLSS to remove bacteria from the system at the same rate at which they grow. The required daily wasting volume can be estimated by comparing the MLSS measurements taken during sampling with the target MLSS concentration. Biological growth varies with a number of factors and, as the system is operated, a steady state growth will occur, leading to the development of a consistent sludge wasting volume. The daily wasting volume shall be calculated and a "suggested wasting volume" shall be updated within the Sludge Wasting Screen on the HMI. The operator can then choose to manually adjust the daily wasting volume once the need for adjustment is confirmed. This is to prevent improper wasting due to erroneous MLSS concentration measurements. The calculation for "suggested wasting volume" is given in Section 4.7.

4.4.1 - MEMBRANE FILTRATION SYSTEM EQUIPMENT

ÉQUIPMENT	TAGS	QTY	DESIGN VALUE	NOTES
Membrane Tank	T-74000	2	6.6 m^3 each	
Membrane Module	F-74000	2 (1 per train)	900 m2 450 m2 per module	
Membrane System Blower	B-75400	2	254 m^3/h per train	
Blower Air Mass Flowmeter	FIT-75474	2	0 – 300 m^3/h	

Permeate Pumps	P-79000	2	4.5 m3/hr	Timer required to monitor permeate/relax cycles
Permeate Flow Meter	FIT-79074	2	0-15 m^3/hr	
Membrane Tank Level Sensor	LT-74060	2	0 – 3.0 m	
Permeate Pressure Sensor	PT-79045	2	-100 to 100 kPa	
RAS Pumps	P-74600	2	18 m^3/hr	RAS pump also used for wasting sludge and draining the system
RAS Flow Meter	FIT-74674	2	0-25 m^3/hr	
UV System	UV-91000	2		inline

4.4.1.1 - PERMEATE PUMPS

The Permeate Pumps (P-79000) are used to transport filtered water (permeate) from the Membrane Tank (T-74000) through the Membrane Module (F-74000), through the Permeate Flow Meter (FIT-79074), to the UV Disinfection system (UV-91000) and finally to the Permeate Tank (T-79200). The pumps are equipped with VFDs so that they can control the flow rate of membrane filtration. The speed of the permeate pumps is adjusted to achieve the desired permeate flow rate.

The permeate pumps are also used to transport treated water back to the membranes during CEB and CIP events by actuating valves on the permeate lines to change the direction of flow.

PRODUCTION AND STANDBY MODE

During PRODUCTION mode the Permeate Pump cycles between RUN and STOP to accommodate the required “permeation” and “relax” steps. In normal operation the permeation step duration is 7 minutes and the relax step duration is 1 minute. The status (Permeation/Relax/Standby) as well as a timer showing the time left within a permeation or relax step will be displayed on the HMI.

During the permeation step, the PLC adjusts the Permeate Pump speed using a cascade PID loop with the pump VFD and permeate flow meter to maintain the Membrane Tank Level Set-Point.

The Process goes in to STANDBY mode when the Membrane Tank – Lo Level Set-Point is reached. This generally occurs where there is insufficient feed to the system. The process will return to PRODUCTION when the Membrane Tank Level reaches the Membrane Tank Level Set-Point.

Trans-Membrane Pressure (TMP)

The TMP is a measure of the degree of fouling that the membranes have experienced. It allows monitoring of changes in membrane permeability as a function of time to provide information on CEB and CIP performance and changes in feed water quality. The TMP is the change in pressure across the membrane and is calculated based on the membrane feed-side hydrostatic pressure minus the permeate-side pressure during permeation. It is calculated as the permeate-side pressure minus the feed side pressure during backward flow.

$$TMP\ (kPa) = Feed\ Pressure - Permeate\ Pressure$$

and

$$TMP_{CLEAN}\ (kPa) = Permeate\ Pressure - Feed\ Pressure$$

where,

$$Feed\ Pressure\ (kPa) = [Membrane\ Tank\ Level\ (m) - Midlevel\ of\ Membrane\ (m)] \times \frac{9.807\ kPa}{m\ H2O}$$

and

$$\begin{aligned} Permeate\ Pressure\ (kPa) \\ = Permeate\ Pressure\ Reading\ (kPa) \\ + \Big\{[Level\ of\ Pressure\ Transducer\ Installation\ (m) \\ - Midlevel\ of\ Membrane\ (m)] \times \frac{9.807\ kPa}{m\ H2O}\Big\} \end{aligned}$$

note that the "Midlevel of Membrane" and "Level of Pressure Transducer Installation" values are measured from the bottom of the membrane tank.

Flux and Permeability

The permeability is a calculated parameter that normalizes the TMP for different flow rates. The flow rate per unit membrane area is called the "Membrane Flux" and it is calculated based on the equation below:

$$Flux\ \left(\frac{L}{m^2 h}\right) or\ (Lmh) = \frac{Flow\ Rate\ \left(\frac{L}{min}\right) \times 60\left(\frac{min}{h}\right)}{Membrane\ Area\ (m^2)}$$

The permeability is the flux divided by the TMP as given below:

$$Permeability\ (Lmh/bar) = \frac{Flux\ (Lmh)}{TMP\ (kPa)}$$

Finally, to ensure accurate monitoring of permeability, the calculated permeability should be corrected for temperature. The following equation can be used to correct the permeability for temperature:

$$Permeability_{20^\circ C} = Permeability_{T^\circ C} \times 1.024^{(T-20)}$$

where T = the measured temperature.

4.4.1.2 - RETURN ACTIVATED SLUDGE (RAS) PUMPS

The RAS pumps are used to return solids from the Membrane Tanks to the front end of the Aerobic Tank. This ensures that the biomass separated from the liquid during membrane filtration does not accumulate excessively within the Membrane Tank.

When the MBR train associated with a RAS Pump is in PRODUCTION mode or STANDBY mode, the RAS Pump will RUN. The RAS Pump Flowrate is adjustable by manually throttling the RAS Pump isolation valve.

4.4.1.3 - MEMBRANE AIR SCOUR BLOWERS

The Membrane Air Scour Blowers are used to scour the membranes and reduce sludge buildup on the fibers. One blower is supplied per membrane tank. Under normal conditions, the blowers will always be in RUN.

4.4.1.4 - ULTRAVIOLET SYSTEM

The UV disinfection system operates continuously in all modes other than OFF to provide disinfection of permeate before it enters the Permeate Tank. The PLC has a counter that totalizes the total time that the UV unit operates and provides an Alert when the bulb life nears its expected design period. This warning occurs after 8,760 hours (1 year) of operation and the bulbs should be replaced on an annual basis.

4.4.2 - MEMBRANE FILTRATION SYSTEM HMI INPUTS

HMI INPUT	INITIAL VALUE
Production Mode: Permeate Cycle	7 minutes
Production Mode: Relax Cycle	1 minute
Membrane Tank Level Set-Point	1.90 m

Membrane Tank Level LoLo Set-Point	1.70 m
Membrane Tank Level Lo Set-Point	1.80 m
Membrane Tank Level Hi Set-Point	2.00 m
Membrane Tank Level HiHi Set-Point	2.20 m
TMP Hi Set-Point	30 kPa
TMP HiHi Set-Point	40 kPa
TMP_{CLEAN} HiHi Set-Point	14 kPa
Permeate Pump Flow Rate Set-Point	4.5 m3/hr
Permeate Pump Flow Rate LoLo Set-Point	1 m3/hr
RAS Pump Flow Rate LoLo Set-Point	9 m3/hr
Membrane Blower Flow Rate LoLo Set-Point	150 Nm^3/h
UV Intensity Lo	8.8 mW/cm^2

4.4.3 - MEMBRANE FILTRATION SYSTEM ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Membrane Tank 1 Level LoLo	Indicates Membrane Tank 1 level has reached LoLo level Set-Point	Alarm: “Membrane Tank 1 Level LoLo” Train in STANDBY until Membrane Tank 1 Level reaches Set-Point. STOP RAS Pump.
Membrane Tank 1 Level Lo	Indicates Membrane Tank 1 level has reached Lo level Setpoint	System goes into STANDBY.
Membrane Tank 1 Level Hi	Indicates Membrane Tank 1 level has reached Hi level Setpoint	Alert: “Membrane Tank 1 Level Hi”
Membrane Tank 1 Level HiHi	Indicates Membrane Tank 1 level has reached HiHi level Set-Point	Alarm: “Membrane Tank 1 Level HiHi” STOP EQ Pumps but continue running system in PRODUCTION until

		Membrane Tank 1 Level reaches Set-Point. Note that an emergency overflow is installed on both membrane tanks that will allow a controlled overflow out of the container in case of emergencies.
Membrane Tank 1 Level Sensor Fault	Occurs when level sensor returns a non 4-20 mA signal	Alert: "Membrane Tank 1 Level Sensor Fault" Permeate Pumps in both trains operate off Membrane Tank 2 Level Sensor; CEBs and CIPs suspended until sensor is repaired
Membrane Tank 2 Level LoLo	Indicates Membrane Tank 2 level has reached LoLo level Set-Point	Alarm: "Membrane Tank 1 Level LoLo" Train in STANDBY until Membrane Tank 1 Level reaches Set-Point. STOP RAS Pump.
Membrane Tank 2 Level Lo	Indicates Membrane Tank 2 level has reached Lo level Setpoint	System goes into STANDBY.
Membrane Tank 2 Level Hi	Indicates Membrane Tank 2 level has reached Hi level Setpoint	Alert: "Membrane Tank 2 Level Hi"
Membrane Tank 2 Level HiHi	Indicates Membrane Tank 2 level has reached HiHi level Set-Point	Alarm: "Membrane Tank 2 Level HiHi" STOP EQ Pumps but continue running system in PRODUCTION until Membrane Tank 2 Level reaches Set-Point. Note that an emergency overflow is installed on both membrane tanks that will allow a controlled overflow out of the container in case of emergencies.

Membrane Tank 2 Level Sensor Fault	Occurs when level sensor returns a non 4-20 mA signal	Alert: "Membrane Tank 2 Level Sensor Fault" Permeate Pumps in both trains operate off Membrane Tank 1 Level Sensor; CEBs and CIPs suspended until sensor is repaired
Train 1 - TMP Hi	Indicates TMP has reached Hi Set-Point in Train 1.	Alert: "Train 1 TMP Hi - Schedule a CIP as soon as possible."
Train 1 - TMP HiHi	Indicates TMP has reached HiHi Set-Point in Train 1.	Alarm: "Train 1 TMP HiHi – CIP critical" – STOP Permeate Pump and run Train 2 only until alarm is cleared.
Train 1 – TMP_{CLEAN} Hi Hi	Indicates TMP has reached HiHi Set-Point in Train 1 during a CEB or CIP	Alarm: "Train 1 TMP_{CLEAN} HiHi – Check Cleaning Regimen" – STOP CEBs and CIPs on Train 1 until TMP alarm cleared.
Train 2 - TMP Hi	Indicates TMP has reached Hi Set-Point in Train 2	Alert: "Train 2 TMP Hi - Schedule a CIP as soon as possible."
Train 2 - TMP HiHi	Indicates TMP has reached HiHi Set-Point in Train 2	Alarm: "Train 2 TMP HiHi – CIP critical" – STOP Permeate Pump and run Train 1 only until alarm is cleared.
Train 2 – TMP_{CLEAN} HiHi	Indicates TMP has reached HiHi Set-Point in Train 2 during a CEB or CIP	Alarm: "Train 2 TMP_{CLEAN} HiHi – Check Cleaning Regimen" – STOP CEBs and CIPs on Train 2 until TMP alarm cleared.
Train 1 Permeate Pressure Sensor Fault	Occurs when pressure sensor returns a non 4-20 mA signal	Alarm: "Permeate Pressure Sensor Fault" – STOP Train 1 and RUN Train 2 only until pressure sensor is repaired
Train 2 Permeate Pressure Sensor Fault	Occurs when pressure sensor returns a non 4-20 mA signal	Alarm: "Permeate Pressure Sensor Fault" – STOP Train 2 and RUN Train 1 only until pressure sensor is repaired
Permeate Flow Rate LoLo (Train 1 or 2)	Occurs when Permeate Pump is in RUN and FIT-79074 reads less than the Permeate Flow Rate	Alarm: "Permeate Flow Rate LoLo – Train 1/2" STOP Permeate Pump 1/2–

	LoLo Set-Point	this indicates a possible broken pipe or clogged pipe/pump.
Permeate Pump Fault (Train 1 or 2)	Indicates a mechanical failure of the Permeate Pump	Alarm: “Permeate Pump Fault” Stop Feed to Train with Fault (close FV-74050).
Permeate Flow Meter Fault (Train 1 or 2)	Occurs when Permeate Flow Meter returns non 4-20 mA signal	Alert: “Permeate Flow Meter Fault” STOP CEBs and CIPs on that train until fault is cleared
RAS Pump Fault (Train 1 or 2)	Indicates a mechanical failure of the RAS Pump	Alarm: “RAS Pump Fault” Stop Feed to Train with Fault.
RAS Flow Meter Fault (Train 1 or 2)	Occurs when RAS Flow Meter returns non 4-20 mA signal	Alert: “RAS Flow Meter Fault” Disable Automatic Sludge Wasting
RAS Flow Rate LoLo (Train 1 or 2)	Occurs when RAS Pump is in RUN and FIT-74074 reads less than the RAS Flow Rate Lo Set-Point	Alarm: “RAS Flow Rate LoLo – Train 1/2" STOP RAS Pump 1/2 – this indicates a possible broken pipe or clogged pipe/pump.
Membrane Blower Fault (Train 1 or 2)	Indicates a mechanical failure of the Membrane Blower	Alarm: “Membrane Blower Fault” Stop Feed to Train (close FV-74050)
Membrane Blower Flow Rate LoLo (Train 1 or 2)	Occurs when Membrane Blower is in RUN and FS-75474 is tripped	Alarm: “Membrane Blower Flow Rate LoLo” Stop feed to Train with fault (close FV-74050) and indicate that operator must investigate (possible broken or clogged line)
UV System Fault (Train 1 or 2)	Indicates that the UV System has faulted	Alert: “UV System Fault – Train 1/2"
UV Bulb Life	Indicates UV System bulbs are nearing the end of predicted life	Alert: “Schedule UV Bulb Replacement”
UV Intensity	Monitors UV Intensity	Alert: “Schedule UV Bulb Replacement”

4.5 - MEMBRANE CLEANING

When a CEB or CIP is initiated, the Permeate Pump (P-79000) is used to transport treated water from the Permeate Tank (T-79200), through the Permeate Flow Meter (FIT-79074), Permeate Pump (P-79000), past the Air Release Valve (FV-31026) and into the membranes (F-74000). Cleaning chemicals are dosed inline to achieve the desired CEB or CIP concentration. For this mode, the flow direction is reversed automatically by switching electrically actuated valves to achieve the correct flow path. The PLC controls the permeate pump speed to achieve the "CEB/CIP Flow Rate," which is an input on the HMI.

4.5.1 - MEMBRANE CLEANING EQUIPMENT

4.5.1.1 - CLEANING CHEMICAL DOSING PUMPS

The CEB/CIP dosing pumps are used to inject chemicals into the cleaning chemical line when a CEB or CIP are conducted. The chemical is mixed with treated water that is pumped into the inside of the membranes to achieve the desired cleaning concentration.

There are two (2) Cleaning Chemical Dosing Pumps for the entire plant; one for dosing Sodium Hypochlorite (P-83500) and one for dosing Citric Acid (P-83700). These dosing pumps receive a digital signal from the PLC to initiate chemical dosing during CEB or CIP processes; however, they must be calibrated to provide the correct flow rate for a given application. Each dosing pump has feed lines to each train. When a CEB or CIP is conducted on Membrane Tank 1, for example, the dosing valve for Train 1 will open when the dosing pump is in RUN and the dosing valve for the other train remains closed. Since CEB processes are conducted on a weekly basis, the PLC will be programmed to ensure that the different trains schedule CEBs at different times. The CIP process is conducted relatively infrequently (quarterly). When a CIP is conducted, the Cleaning Chemical Dosing Pumps must be re-calibrated to achieve the higher concentration associated with CIPs and then returned to the CEB dosing rate after the CIP is completed.

A dedicated CEB/CIP screen can be found on the HMI where CEB events can be scheduled or manually started by the operator. During a CEB the HMI displays the current step in the sequence and the current status of the temporal and volumetric counters associated with each step. The same steps are used in a CEB and CIP but with different chemical dosing rates and soak durations. All CEB processes are initiated automatically based on a schedule that can be set on the HMI. Either chlorine or citric acid (one chemical only) can be selected as the CEB chemical. Since they are conducted on a weekly basis, a specific day of the week and time of day can be set. The day of the week is identified with a number (1-7; corresponding to Mon-Sun) and a second number defines the hour (1-24) based on a 24-hr clock. Note, that the system will be programmed such that only one train can operate a CEB or CIP at any given time.

CEB/CIP PREPARE

The Prepare Step is a short waiting step to allow the process changes to take effect. The membrane blower and RAS pump are turned OFF at the beginning of this Step and waiting allows the process to settle and adjust for the upcoming CEB/CIP.

CEB/CIP Injection

During the Injection Step, treated water from the Permeate Tank (T-79200) is drawn through the Permeate Pump (P-79000), through the Permeate Flow Meter (FIT-79074), past the Air Relief Valve (FV-31026) and then to the Membranes. The Dosing Pump, either NaOCl (P-83500) or Citric Acid (P-83700) starts and its associated Dosing Valve (FV-83576 for NaOCl or FV-83776 for Citric Acid) is opened. The cumulative volume of blended chemical as measured by FIT-79074 that is sent to the Membranes during the clean is totalized on a counter. Once the totalizer reaches the CEB or CIP Injection Volume Set-Point, the Injection step ends. The Air Relief Valve is opened during the CEB and CIP to allow the removal of air and prevent the possible build-up of pressure within the permeate line. The membranes must never experience a backpulse TMP (from the inside-out) greater than 14 kPa. The Permeate Pressure Sensor (PT-79045) monitors this pressure to ensure the limit is never breached; however, the air relief valve is designed as a back-up to never allow excessive pressures to occur in this line.

CEB/CIP Soak

The CEB/CIP Soak Step allows the membrane to be in contact with the cleaning chemical for a period of time to allow it to take effect. For CEBs this step is relatively short (2 minutes); for CIPs this lasts several hours to ensure adequate permeability recovery.

CEB/CIP Flush Step

The CEB/CIP Flush Step is similar to the Injection Step but without the chemical injection. Treated water is sent back to the membranes and flushes the chemical out of the membranes and into the activated sludge. At the beginning of this Step the RAS pump (P-74600) and Membrane Blower (B-7400) both RUN such that the chemical that is pushed into the Activated Sludge is diluted and consumed.

CEB/CIP Finish Step

The CEB/CIP Finish Step is designed to allow additional time for the Activated Sludge to recirculate in the bio-reactors. It is similar to Standby but with the feed valve to the train closed until the counter has reached the CEB or CIP Finish Step Duration Set-Point.

4.5.2 - MEMBRANE CLEANING HMI INPUTS

HMI INPUT	INITIAL VALUE
CEB/CIP Flow Rate	2 m^3/hr
CEB/CIP Maximum Pressure	+14 kPa
CEB Prepare Duration	60 s
CEB Injection Volume Set-Point	0.9 m^3
CEB Soak Duration	2 min
CEB Flush Volume Set-Point	0.9 m^3

CEB Finish Duration	30 s
CIP Prepare Duration	60 s
CIP Injection Volume Set-Point	0.9 m^3
CIP Soak Duration	240 min
CIP Flush Volume Set-Point	0.9 m^3
CIP Finish Duration	30 s

4.5.3 - MEMBRANE CLEANING ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Hypochlorite Dosing Valve Fault (Train 1 or 2)	Indicates a fault from the electrically actuated valve	Alarm: "Hypo Dosing Valve Fault, Train 1/2" STOP Hypo CEBs and CIPs until fault is cleared
Citric Acid Dosing Valve Fault (Train 1 or 2)	Indicates a fault from the electrically actuated valve	Alarm: "Citric Dosing Valve Fault, Train 1/2" STOP Citric Acid CEBs and CIPs until fault is cleared
Hypochlorite Dosing Pump Fault	Indicates a mechanical failure of the chemical dosing pump	Alarm: "Hypo Dosing Pump Fault" STOP Hypo CEBs and CIPs until fault is cleared
Citric Acid Dosing Pump Fault	Indicates a mechanical failure of the chemical dosing pump	Alarm: "Citric Dosing Pump Fault" STOP Citric Acid CEBs and CIPs until fault is cleared
Air Release Valve Fault (Train 1 or 2)	Indicates a fault from the electrically actuated valve	Alert: "Air Release Valve Fault – Train 1/2"

4.5.4 - CHEMICAL ADDITION CHART

CLEANING CHEMICAL	APPLICATION	RECIPE
Sodium Hypochlorite (NaOCl)	Sodium Hypochlorite is an oxidant and is used to provide cleaning of typical membrane foulants (organic foulants) for this application. This chemical should be used for cleaning as a first response and will provide good results most	STOCK NaOCl: 10.3% CEB Concentration: 300-500 mg/L CIP Concentration: 3-5 g/L Volume of chemical for a CEB: 7.5 L Volume of chemical for a CIP: 75 L Frequency of a CEB: weekly per train

	of the time.	Frequency of a CIP: quarterly per train
Citric Acid	Citric Acid is used to provide cleaning for the removal of inorganic substances from the membrane. In most cases this chemical is not required unless there is a concern of accumulation of inorganic substances.	STOCK Citric Acid: Powdered Form 100% CIP Concentration: 1% wt. Mass of chemical for a CIP: 10 kg Frequency of a CIP: annually per train

4.6 - PERMEATE POST-TREATMENT

Permeate from the UV system (UV-91000) flows to the combined Permeate Tank (T-79200), where it is stored temporarily for cleans or pumped to the discharge point by the effluent pumps (P-79600A/B).

4.6.1 - PERMEATE POST TREATMENT EQUIPMENT

ÉQUIPMENT	TAGS	QTY	DESIGN VALUE	NOTES
Permeate Tank	T-79200	1	1.5 m3	HDPE Rectangular Tank
Effluent Pumps	P-79600A/B	2	9 m3/hr each	Duty/standby configuration
Permeate Tank Level Sensor	LT-79060	1	0 – 1.5 m	
Effluent pH Sensor	AIT-79093	1	pH: 0 - 14	Target pH 6-8
Effluent Turbidity Sensor	AIT-79089	1	0-5 NTU	
Effluent Flowmeter	FIT-79274	1	0 - 15 m3/hr	Measures the effluent flow from the plant

4.6.1.1 - EFFLUENT PUMPS

The Effluent Pumps will operate based on the level in the Permeate Tank. The Effluent Pumps are each set up to operate at the design flow rate of the plant. This flow can be monitored using the effluent flowmeter (FIT-79274).

Under normal operation, one pump will operate. The single pump will RUN at the “Hi” Set-Point and turn STOP at the “Lo” Set-Point. In the event of an upset where the Permeate Tank level increases, an emergency backup is available to prevent overflowing from occurring. If the Permeate Tank level reaches the “HiHi” level, the second Effluent Pump will RUN to increase the flow from the system. Once the Permeate Tank level falls below the Lo Level Setpoint, both effluent Pumps will STOP. When the level rises above the “Hi” Set-Point again the system will continue operation as normal with one pump running.

The Effluent Pump status and Flow Rates are determined in response to the Permeate Tank Level Sensor (LT-79060) as follows:

TANK LEVEL	DESCRIPTION	NOTES
Below LoLo Level Set-Point	Notification	This is an alarm that indicates the Permeate Tank is empty and there is no permeate available for performing cleaning.
Below Lo Level Set-Point	STOP Effluent Pumps	This STOPs the Effluent Pumps from running and ensures adequate permeate is available for cleaning.
Above Hi Level Set-Point	RUN Effluent Pump.	During normal operation a single Effluent Pump is in RUN and the flow rate should be adjusted to be slightly higher than the Equalized Feed Flow Set-Point. The operator can manually adjust the flow if desired to meet specific plant needs. This will cause the Effluent Pump to RUN when the permeate tank hits the Hi level and continue until the permeate tank hits the Lo level.
Above HiHi Level Set-Point	RUN both Effluent Pumps.	When the Effluent Tank level increases to the HiHi Level Set-Point, a critical alert occurs and the second Effluent Pump will RUN. Both pumps will continue to RUN until the Permeate Tank level drops to the Lo Level Set-Point. With both pumps running, the total flow rate will increase to prevent an overflow. Note that an overflow line is installed on the Permeate tank to ensure any overflow is directed out of the container.

Note: Effluent Pump A and Effluent Pump B should alter operation after every time the pumps STOP unless a Pump Fault indicates otherwise. This will reduce the number of Starts/Stops that the pumps undergo as the level in the permeate tank moves from between the Hi and Lo Levels.

4.6.2 - PERMEATE POST TREATMENT HMI INPUTS

The following values are input on the HMI and can be adjusted to optimize system operation.

HMI INPUT	INITIAL VALUE
Permeate Tank Level Set-Point	1.0 m
Permeate Tank Level – LoLo Set-Point	0.8 m
Permeate Tank Level – Lo Set-Point	
Permeate Tank Level – Hi Set-Point	1.2 m
Permeate Tank Level – HiHi Set-Point	1.5 m
Effluent pH - Lo Set-Point	6.0
Effluent pH - Hi Set-Point	8.0
Effluent Turbidity - Hi Set-Point	2.0 NTU
Effluent Flow Rate - LoLo Set-Point	1 m3/hr

4.6.3 - PERMEATE POST TREATMENT ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Effluent Pump A Fault	Indicates mechanical failure of Effluent Pump A	Alert: “Effluent Pump A Fault” Turn Effluent Pump A to OFF and switch operation to Effluent Pump B
Effluent Pump B Fault	Indicates mechanical failure of Effluent Pump B	Alert: “Effluent Pump B Fault” Turn Effluent Pump B to OFF and switch operation to Effluent Pump A
Effluent Flow Rate - LoLo	Occurs when Effluent Pumps are ON and FIT-99274 reads less than the Effluent Flow Rate LoLo Set-Point	Alarm: “Effluent Flow Rate LoLo” STOP Effluent Pumps – this indicates a possible broken pipe or clogged pipe/pump.
Permeate Tank Level – LoLo	Occurs when Permeate Tank level drops below the LoLo Level Set-Point	Alert: “Permeate Tank - Level LoLo” STOP Effluent Pumps
Permeate Tank Level - HiHi	Occurs when Permeate Tank level rises above HiHi Level Set-Point	Critical Alarm: “Permeate Tank – Level HiHi” RUN both Effluent Pumps in tandem until Tank Level drops below

		the Hi Level Set-Point
Permeate Tank Level Sensor Fault	Occurs if the transmitter returns non 4-20 mA signal	Alert: "Permeate Tank – Level Sensor Fault" Continue Effluent Pump in RUN until Level Sensor Fault cleared
Effluent pH - Lo	Indicates pH is below the pH Lo Set-Point	Alert: "Effluent pH Lo"
Effluent pH - Hi	Indicates pH is above the pH Hi Set-Point	Alert: "Effluent pH Hi"
Effluent pH Sensor Fault	Occurs when sensor returns non 4-20 mA signal	Alert: "Effluent pH Sensor Fault"
Effluent Turbidity – Hi	Indicates turbidity is above the Turbidity – Hi Setpoint	Alert: "Effluent turbidity Hi"
Effluent Turbidity Sensor Fault	Occurs when sensor returns non 4-20 mA signal	Alert: "Effluent turbidity Sensor Fault"
Effluent Flowmeter Fault	Occurs if the flowmeter returns non 4-20 mA signal	Alarm: "Effluent Flowmeter Fault" Continue Effluent Pump in RUN

4.7 - SLUDGE HANDLING SYSTEM

The excess sludge that is produced within a bioreactor is known as Waste Activated Sludge (WAS). Each Return Activated Sludge (RAS) line has a tee after the RAS Flow Meter (FIT-74674) where the RAS can be redirected to the Sludge Storage Tank by opening the Sludge Wasting Valve (FV-96001). One Sludge Holding Tank is installed for both trains. Wasting occurs once per day based on an HMI input called "Daily Sludge Wasting Volume". A timer is implemented that allows wasting after 24 hours of plant operation as measured by flow from FIT-74674 (to the Aerobic Tank). This ensures that wasting occurs only during PRODUCTION. Since there are 2 Membrane Trains that both have the ability to conduct sludge wasting, wasting will be alternated between the two trains every other day.

Once the valve has been actuated to redirect the Sludge to the Sludge Storage Tank, the PLC uses the RAS Flow Meter to totalize the volume of sludge that is sent to the Sludge Storage Tank. Once the Daily Sludge Wasting Volume has been wasted, the valve closes and flow is directed back to the RAS line. The volume of sludge that needs to be wasted is a function of the MLSS measured in the Aerobic Tank and the BOD loading rate of the plant. The system will operate well with MLSS values in the range of 7-12 g/L, and this value can be adjusted for lower or higher BOD loading rates. The design MLSS value is 10 g/L. The system will automatically waste the "Daily Sludge Wasting Volume" input into the HMI. The required daily wasting value can be estimated based on the following equation (note: negative values will result in zero sludge wasting):

$$Calculated\ wasting\ volume\ to\ maintain\ MLSS\ concentration\ (m^3)$$

$$= 2\%\ of\ the\ volume\ of\ water\ treated\ yesterday + \frac{\left(1 - \frac{10\ g/L}{\text{MLSS}\ g/L}\right) \times 76\ m^3 (Total\ Process\ Volume)}{7\ days}$$

Where,

MLSS g/L = the measured MLSS concentration (based on a weekly sample taken from the Aerobic tank and analyzed for MLSS at a laboratory).

Recommendations:

- ***i) It is recommended that after start-up NO WASTING is conducted for the first 2 weeks of operation unless the MLSS is above 4 g/L.***
- ***ii) As of 2 weeks after biological seeding and steady process operation it is recommended to waste at least 1% of the total daily flow each day to prevent accumulation of inert solids as the bacteria concentration grows to the design values.***

The Sludge Storage Tank has a volume of 19 m^3 and is designed to handle the amount of sludge produced over a 5-7 day period at the maximum design flow rate. The Sludge Tank is aerated continuously by the Sludge Blower (B-75800) that feeds air to coarse bubble diffusers (CBD-96086) to

keep the sludge in an aerobic state and encourage aerobic digestion. The level of sludge in the Sludge Storage Tank is measured by the Sludge Storage Tank Level Sensor (LT-96060)..

In order to minimize the WAS volume, a decant/overflow line is installed in each sludge holding tank to allow it to act as a thickener. The WAS can be thickened (concentrated) by stopping aeration for a period of time (~1 hour) to allow the solids to settle. As the solids settle within the sludge tank an interface will appear between the clear liquid (called supernatant) and the concentrated sludge. The decant line is then opened manually by the operator, and the supernatant is sent back to the Sump Tank. This will allow the sludge concentration to be increased by 2-3 times the MLSS concentration. The PLC will notify the operator when the Sludge Tank reaches the Hi level and indicate that a decant should be conducted.

4.7.1 - SLUDGE HANDLING SYSTEM EQUIPMENT

EQUIPMENT	TAGS	CONFIGURATION	Design Value	NOTES
Sludge Storage Tank	T-96000	1	19 m^3	Minimum 5 day capacity
Coarse Bubble Diffusers	CBD-96086	1	N/A	
Sludge Blower	B-75800	1	50 m^3/hr at 3 m H_2O	
Sludge Storage Tank Level Sensor	LT-96060	1	0 – 2.5 m H_2O	
Sludge Wasting Valve	FV-96001	1	N/A	

4.7.1.1 - SLUDGE BLOWER

The Sludge Blower is used to supply oxygen to the Sludge Storage Tank in order to maintain an aerobic environment and provide mixing. One blower is supplied for the tank, and under normal conditions, the blower will always be in RUN.

4.7.2 - SLUDGE HANDLING SYSTEM HMI INPUTS

HMI INPUT	INITIAL VALUE
Daily Sludge Wasting Volume	4.3 m^3*
Sludge Storage Tank Level Hi	2.0 m

Sludge Storage Tank Level HiHi	2.2 m
Suggested Wasting Volume	"displayed based on calculated value" m^3

*Disable for the first 2 weeks of operation

4.7.3 - SLUDGE HANDLING SYSTEM ALARMS

ALARM OR ALERT	DESCRIPTION	ACTION
Sludge Storage Tank Level Hi	Indicates the level in the Sludge Storage Tank has reached the Hi Level Set-Point	Alert: "Sludge Storage Tank Level Hi. Conduct Decant; check new level and Schedule Sludge Truck Out."
Sludge Storage Tank Level HiHi	Indicates the level in the Sludge Storage Tank has reached the HiHi Level Set-Point	Alarm: "Sludge Storage Tank Level HiHi." Disable sludge wasting. Note that an emergency overflow in the Sludge Tank will direct excess volume to the Sump Tank.
Sludge Storage Tank Level LoLo	Indicates the level in the Sludge Storage Tank has reached the LoLo Level Set-Point and is at the Coarse Bubble Diffusers	Alert: "Sludge Storage Tank Level LoLo" STOP Sludge Blower until the level increases above the LoLo Level.
Sludge Tank Level Sensor Fault	Occurs when level sensor returns a non 4-20 mA signal	Alarm: "Sludge Tank Level Sensor Fault." STOP FV-96001 until fault cleared.

8.2 - ALARMS LIST

			Alarm List												
		CUSTOMER:	Meliadine		Created by:	Vincent Roberge		Revision:	00						
		PROJECT NUMBER:	U65875		Revised by:										
		DOCUMENT NUMBER:	U65875-10		Date:	30-06-2016									
P&ID TAG	PLC TAG	TYPE	DESCRIPTION (HMI MESSAGE)	When Active	Deadband	SETPOINT	UNITS	DELAY (s)	Severity	ACTION	Reset Required	SPMC Alarm	P&ID #	NOTES	Rev
NA		DIGITAL	Main Control Panel Emercengy Stop				-		4	Stop			NA		
NA		DIGITAL	Panel 120V Detect				-		4	Stop			NA		
NA		DIGITAL	Remote IO Emercengy Stop				-		4	Stop			NA		
NA		DIGITAL	RIO 120V Detect				-		4	Stop			NA		
FT-19274		ANALOG	Alm_Hi - FI-19274 Equalized Water From Equalization Tank Flow Indicating Transmitter High			9	m^3/h		3	Notification			U65875-C01-0110		0
FT-19274		ANALOG	Alm_LoLo - FI-19274 Equalized Water From Equalization Tank Flow Indicating Transmitter Low Low			1	m^3/h		4	Notification			U65875-C01-0110		0
FT-12274		ANALOG	Alm_Hi - FI-12274 Screened Water to Aerobic Tank Flow Indicating Transmitter High			9	m^3/h		4	Notification			U65875-C01-0110		0
FT-12274		ANALOG	Alm_Lo - FI-12274 Screened Water to Aerobic Tank Flow Indicating Transmitter Low			1	m^3/h		3	Notification			U65875-C01-0110		0
LT-12060		ANALOG	Alm_HiHi - LT-12060 Screened Water Tank T-12000 Level Transmitter High High			3,6	m		4	Stop EQ Pumps			U65875-C01-0110		0
LT-12060		ANALOG	Alm_LoLo - LT-12060 Screened Water Tank T-12000 Level Transmitter Low Low			0,3	m		4	Stop Sump Pumps, Notification			U65875-C01-0110		0
LAL-12061		DIGITAL	Alm_Lo - LAL-12061 Screened Water Tank T-12000 Low Level Switch				-		3	Stop Sump Pumps			U65875-C01-0110		0
LAH-12062		DIGITAL	Alm_Hi - LAH-12062 Screened Water Tank T-12000 High Level Switch				-		3	Start 2nd Pump, Stop EQ Pumps, Notification			U65875-C01-0110		0
YA-11200A		DIGITAL	Alm_YA - SCR11200A Fine Screen SCR-11200A Fault Alarm				-		3	Notification			U65875-C01-0110		0
YA-11200B		DIGITAL	Alm_YA - SCR11200B Fine Screen SCR-11200B Fault Alarm				-		3	Notification			U65875-C01-0110		0
YI-11200A		DIGITAL	Alm_YI - SCR11200A Fail To Start Alarm				-		3	Notification			U65875-C01-0110		0
YI-11200A		DIGITAL	Alm_YI - SCR11200A Fail To Stop Alarm				-		3	Notification			U65875-C01-0110		0
YI-11200B		DIGITAL	Alm_YI - SCR11200B Fail To Start Alarm				-		3	Notification			U65875-C01-0110		0
YI-11200B		DIGITAL	Alm_YI - SCR11200B Fail To Stop Alarm				-		3	Notification			U65875-C01-0110		0
FIT-11274		ANALOG	Alm_Hi - FIT-11274 Waste Water Flow Indicating Transmitter to Equalization Tanks High			106	m^3/h		3	Notification			U65875-C01-0190		0
FIT-11274		ANALOG	Alm_Lo - FIT-11274 Waste Water Flow Indicating Transmitter to Equalization Tanks Low			1	m^3/h		3	Notification			U65875-C01-0190		0
LT-19060A		ANALOG	Alm_HiHi - LT-19060A Equalization Tank T-19000A Level Transmitter High High			6	m		4	Critical Alarm			U65875-C01-0190		0
LT-19060A		ANALOG	Alm_Hi - LT-19060A Equalization Tank T-19000A Level Transmitter High			4	m		3	Notification; equalization tank level High			U65875-C01-0190		0
LT-19060A		ANALOG	Alm_Lo - LT-19060A Equalization Tank T-19000A Level Transmitter Low			1	m		3	No Action			U65875-C01-0190		0
LT-19060A		ANALOG	Alm_LoLo - LT-19060A Equalization Tank T-19000A Level Transmitter Low Low			0,8	m		4	Stop pump; train in standby			U65875-C01-0190		0
LT-19060B		ANALOG	Alm_HiHi - LT-19060B Equalization Tank T-19000A Level Transmitter High High			6	m		4	Critical alarm			U65875-C01-0190		0
LT-19060B		ANALOG	Alm_Hi - LT-19060B Equalization Tank T-19000A Level Transmitter High			4	m		3	Notification; equalization tank level high			U65875-C01-0190		0
LT-19060B		ANALOG	Alm_Lo - LT-19060B Equalization Tank T-19000A Level Transmitter Low			1	m		3	No Action			U65875-C01-0190		0
LT-19060B		ANALOG	Alm_LoLo - LT-19060B Equalization Tank T-19000A Level Transmitter Low Low			0,8	m		4	Stop pump; train in stanby			U65875-C01-0190		0
YA-19200A		DIGITAL	Alm_YA - P19200A Equalization pump P-19200A Fault Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
YA-19200B		DIGITAL	Alm_YA - P19200B Equalization pump P-19200B Fault Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
YI-19200A		DIGITAL	Alm_YI - P19200A Fail To Start Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
YI-19200A		DIGITAL	Alm_YI - P19200A Fail To Stop Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
YI-19200B		DIGITAL	Alm_YI - P19200B Fail To Start Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
YI-19200B		DIGITAL	Alm_YI - P19200B Fail To Stop Alarm				-		4	Stop pump; Use Standby Pump; Notification			U65875-C01-0190		0
LT-72060		ANALOG	Alm_HiHi - LT-72060 Aerobic Tank T-73000 Level Transmitter High High			6,2	m		3	Stop EQ Pumps; Notification			U65875-C01-0720		0
LT-72060		ANALOG	Alm_Hi - LT-72060 Aerobic Tank T-73000 Level Transmitter High			6	m		3	Notification			U65875-C01-0720		0
LT-72060		ANALOG	Alm_Lo - LT-72060 Aerobic Tank T-73000 Level Transmitter Low			4	m		3	Notification			U65875-C01-0720		0
LT-72060		ANALOG	Alm_LoLo - LT-72060 Aerobic Tank T-73000 Level Transmitter Low Low			3	m		4	Stop EQ Pumps; Notification			U65875-C01-0720		0
PT-79045-1		ANALOG	Alm_HiHi - DP-79045-1 Pressure Transmitter Train 1 High High			40	kPa		4	Notification; Conduct CIP ASAP			U65875-C01-0740		0
PT-79045-1		ANALOG	Alm_Hi - DP-79045-1 Pressure Transmitter Train 1 High			30	kPa		3	Notification to Schedule CIP ASAP			U65875-C01-0740		0
PT-79045-1		ANALOG	Alm_Lo - DP-79045-1 Pressure Transmitter Train 1 Low			3	kPa		3	No Action			U65875-C01-0740		0
PT-79045-1		ANALOG	Alm_LoLo - DP-79045-1 Pressure Transmitter Train 1 Low Low			1	kPa		3	Notification			U65875-C01-0740		0
PT-79045-2		ANALOG	Alm_HiHi - DP-79045-2 Pressure Transmitter Train 2 High High			40	kPa		4	Notification; Conduct CIP ASAP			U65875-C01-0740		0
PT-79045-2		ANALOG	Alm_Hi - DP-79045-2 Pressure Transmitter Train 2 High			30	kPa		3	Notification to Schedule CIP ASAP			U65875-C01-0740		0
PT-79045-2		ANALOG	Alm_Lo - DP-79045-2 Pressure Transmitter Train 2 Low			3	kPa		3	No Action			U65875-C01-0740		0
PT-79045-2		ANALOG	Alm_LoLo - DP-79045-2 Pressure Transmitter Train 2 Low Low			1	kPa		4	Notification			U65875-C01-0740		0
LT-74060-1		ANALOG	Alm_HiHi - LT-74060-1 Membrane Tank T-74000-1 Level Transmitter Train 1 High High			2,2	m		4	Feed to Train (Close FV-74050-1) until Tank level reaches "Lo" Set-Point			U65875-C01-0740		0
LT-74060-1		ANALOG	Alm_Hi - LT-74060-1 Membrane Tank T-74000-1 Level Transmitter Train 1 High			2	m		3	Notification			U65875-C01-0740		0
LT-74060-1		ANALOG	Alm_Lo - LT-74060-1 Membrane Tank T-74000-1 Level Transmitter Train 1 Low			1,8	m		3	System goes into STANDBY			U65875-C01-0740		0
LT-74060-1		ANALOG	Alm_LoLo - LT-74060-1 Membrane Tank T-74000-1 Level Transmitter Train 1 Low Low			1,7	m		4	Train in STANDBY until Membrane Tank 1 Level reaches Set-Point. STOP RAS Pump			U65875-C01-0740		0
LT-74060-2		ANALOG	Alm_HiHi - LT-74060-2 Membrane Tank T-74000-2 Level Transmitter Train 2 High High			2,2	m		4	Feed to Train (Close FV-74050-2) until Tank level reaches "Lo" Set-Point			U65875-C01-0740		0
LT-74060-2		ANALOG	Alm_Hi - LT-74060-2 Membrane Tank T-74000-2 Level Transmitter Train 2 High			2	m		3	Notification			U65875-C01-0740		0
LT-74060-2		ANALOG	Alm_Lo - LT-74060-2 Membrane Tank T-74000-2 Level Transmitter Train 2 Low			1,8	m		3	System goes into STANDBY			U65875-C01-0740		0
LT-74060-2		ANALOG	Alm_LoLo - LT-74060-2 Membrane Tank T-74000-2 Level Transmitter Train 2 Low Low			1,7	m		4	Train in STANDBY until Membrane Tank 1 Level reaches Set-Point. STOP RAS Pump			U65875-C01-0740		0
FT-79074-1		ANALOG	Alm_Lo - FT-79074-1 Permeate Flow Indicating Transmitter Train 1 Low			1	m^3/h		3	Notification			U65875-C01-0740		0
FT-79074-2		ANALOG	Alm_Lo - FT-79074-2 Permeate Flow Indicating Transmitter Train 2 Low			1	m^3/h		3	Notification			U65875-C01-0740		0
FT-74674-1		ANALOG	Alm_Lo - FT-74674-1 RAS/WAS Flow Indicating Transmitter Train 1 Low			9	m^3/h		3	Notification			U65875-C01-0740		0
FT-74674-2		ANALOG	Alm_Lo - FT-74674-2 RAS/WAS Flow Indicating Transmitter Train 2 Low			9	m^3/h		3	Notification			U65875-C01-0740		0
YA-79000-1		DIGITAL	Alm_YA - P79000A Permeate Pump P-79000-1 Fault Feedback Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YA-79000-2		DIGITAL	Alm_YA - P79000B Permeate Pump P-79000-2 Fault Feedback Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YI-79000-1		DIGITAL	Alm_YI - P79000A Fail To Start Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YI-79000-1		DIGITAL	Alm_YI - P79000A Fail To Stop Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YI-79000-2		DIGITAL	Alm_YI - P79000B Fail To Start Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YI-79000-2		DIGITAL	Alm_YI - P79000B Fail To Stop Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YA-79000-1		DIGITAL	Alm_YA - P79000-1 RAS/WAS Pump P-74600-1 Fault Feedback Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YA-79000-2		DIGITAL	Alm_YA - P79000-2 RAS/WAS Pump P-74600-2 Fault Feedback Alarm				-		4	Stop permeation; show an Alarm			U65875-C01-0740		0
YI-74600-1		DIGITAL	Alm_YI - P74600A Fail To Start Alarm				-		4	Train in stanby			U65875-C01-0740		0
YI-74600-1		DIGITAL	Alm_YI - P74600A Fail To Stop Alarm				-		4	Train in stanby			U65875-C01-0740		0
YI-74600-2		DIGITAL	Alm_YI - P74600B Fail To Start Alarm				-		4	Train in stanby			U65875-C01-0740		0
YI-74600-2		DIGITAL	Alm_YI - P74600B Fail To Stop Alarm				-		4	Train in stanby			U65875-C01-0740		0
FT-75074		ANALOG	Alm_LoLo - FT-75074 Air to Equalization Tank Flow Indicator Transmitter Low Low			120	m^3/h		3	Notification			U65875-C01-0750(1/2)		0
FT-77274		ANALOG	Alm_LoLo - FT-75274 Air to Aerobic Tank Flow Indicating Transmitter Low Low			50	m^3/h		4	Notification			U65875-C01-0750(1/2)		0
YA-75000		DIGITAL	Alm_YA - B75000 Equalization Blower B-75000 Fault Feedback Alarm				-		4	Notification			U65875-C01-0750(1/2)		0
YI-75000		DIGITAL	Alm_YI - B75000 Fail To Start Alarm				-		4	Notification			U65875-C01-0750(1/2)		0
YI-75000		DIGITAL	Alm_YI - B75000 Fail To Stop Alarm				-		4	Notification			U65875-C01-0750(1/2)		0
YA-75240A		DIGITAL	Alm_YA- B75240A Process Blower B-75240A Fault Feedback Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
YI-75240A		DIGITAL	Alm_YI - B75240A Fail To Start Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
YI-75240A		DIGITAL	Alm_YI - B75240A Fail To Stop Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
YA-75240B		DIGITAL	Alm_YA- B75240B Process Blower B-75240B Fault Feedback Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
YI-75240B		DIGITAL	Alm_YI - B75240B Fail To Start Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
YI-75240B		DIGITAL	Alm_YI - B75240B Fail To Stop Alarm				-		4	Turn blower Off; Turn Standby Blower ON			U65875-C01-0750(1/2)		0
FT-75474A		ANALOG	Alm_LoLo - FT-75474A Air to Membrane Train 1 Flow Indicating Transmitter Low Low			150	m^3/h		4	Train 1 in Standby; Notification			U65875-C01-0750(2/2)		0
FT-75474B		ANALOG	Alm_LoLo - FT-75474B Air to Membrane Train 2 Flow Indicating Transmitter Low Low			150	m^3/h		4	Train 2 in Standby; Notification			U65875-C01-0750(2/2)		0

P&ID TAG	PLC TAG	TYPE	DESCRIPTION (HMI MESSAGE)	When Active	Deadband	SETPOINT	UNITS	DELAY (s)	Severity	ACTION	Reset Required	SPMC Alarm	P&ID #	NOTES	Rev
FT-75874		ANALOG	Alm_LoLo - FT-75874 Sludge Aeration Air Flow Indicating Transmitter Low Low			25	m^3/h		4	Notification			U65875-C01-0750(2/2)		0
YA-75400A		DIGITAL	Alm_YA - B75400A Membrane Blower B-75400A Fault Feedback Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YI-75400A		DIGITAL	Alm_YI - B75400A Fail To Start Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YI-75400A		DIGITAL	Alm_YI - B75400A Fail To Stop Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YA-75400B		DIGITAL	Alm_YA - B75400B Membrane Blower B-75400B Fault Feedback Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YI-75400B		DIGITAL	Alm_YI - B75400B Fail To Start Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YI-75400B		DIGITAL	Alm_YI - B75400B Fail To Stop Alarm				-		4	Train in stanby turn blower Off			U65875-C01-0750(2/2)		0
YA-75800		DIGITAL	Alm_YA - B75800 Sludge Blower B-75800 Fault Feedback Alarm				-		4	Notification			U65875-C01-0750(2/2)		0
YI-75800		DIGITAL	Alm_YI - B75800 Fail To Start Alarm				-		4	Notification; Turn Blower Off			U65875-C01-0750(2/2)		0
YI-75800		DIGITAL	Alm_YI - B75800 Fail To Stop Alarm				-		4	Notification; Turn Blower Off			U65875-C01-0750(2/2)		0
LT-79060		ANALOG	Alm_HiHi - LT79060 Permeate Tank Level Transmitter High High			1,5	m		4	Critical Alarm; Both Trains in Standby			U65875-C01-0790		0
LT-79060		ANALOG	Alm_Hi - LT79060 Permeate Tank Level Transmitter High			1,2	m		3	Notification			U65875-C01-0790		0
LT-79060		ANALOG	Alm_Lo - LT79060 Permeate Tank Level Transmitter Low				m		3	Notification			U65875-C01-0790		0
LT-79060		ANALOG	Alm_LoLo - LT79060 Permeate Tank Level Transmitter Low Low			0,8	m		4	Notification; Disable CEB until Level reaches Low Level			U65875-C01-0790		0
YA-79600A		DIGITAL	Alm_YA - P79600A Effluent Pump P-79600A Fault Feedback Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YI-79600A		DIGITAL	Alm_YI - P79600A Fail To Start Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YI-79600A		DIGITAL	Alm_YI - P79600A Fail To Stop Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YA-79600B		DIGITAL	Alm_YA - P79600B Effluent Pump P-79600B Fault Feedback Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YI-79600B		DIGITAL	Alm_YI - P79600B Fail To Start Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YI-79600B		DIGITAL	Alm_YI - P79600B Fail To Stop Alarm				-		4	Use Standby Pump			U65875-C01-0790		0
YA-83700		DIGITAL	Alm_YA - P83700 Citric Acid Pump P-83700 Fault Feedback Alarm				-		4	Notification			U65875-C01-0800(1/2)		0
YA-83500		DIGITAL	Alm_YA - P83500 Sodium Hypochlorite P-83500 Fault Feedback Alarm				-		4	Notification			U65875-C01-0800(1/2)		0
YA-80500A		DIGITAL	Alm_YA - P80500A Alkalinity Pump P-80500A Fault Feedback Alarm				-		4	Notification; Use Standby Pump			U65875-C01-0800(2/2)		0
YA-80500B		DIGITAL	Alm_YA - P80500B Alkalinity Pump P-80500B Fault Feedback Alarm				-		4	Notification; Use Standby Pump			U65875-C01-0800(2/2)		0
LT-96060		ANALOG	Alm_HiHi - LT-96060 Sludge Holding Tank T-96000 Level Transmitter High High			2,2	m		4	Notification; stop sludge wasting			U65875-C01-0960		0
LT-96060		ANALOG	Alm_Hi - LT-96060 Sludge Holding Tank T-96000 Level Transmitter High			2	m		3	Notification to schedule sludge truck out			U65875-C01-0960		0

8.3 - I/O LIST

CUSTOMER: Meliadine STP
PROJECT NUMBER: U65875
DOCUMENT NUMBER: U65875-I11-0001

Created by: Philippe Leroux
Revised by: Etienne Roy
Date: 2016-08-10

Revision: 3

NAME	INSTRUMENT / DESCRIPTION	I/O ADDRESS	SIGNAL	PANNEL / JB	LOCATION	MODULE	P&ID #	Rev
	MAIN CONTROL PANEL (RACK 0)							
IX_MCP_AU	Main Control Panel Emergency Stop		24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_MCP_RESET	Alarm Reset		24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_MCP_120V	Panel 120V Detect		24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_LE_74068	Container Leak Detector		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_YA_83500	Sodium Hypochlorite Pump P-83500 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-800 (1/2)	1
IX_YA_75000	Equalization Blower B-75000 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YI_75000	Equalization Blower B-75000 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YA_75800	Sludge Blower B-75800 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0750 (2/2)	1
IX_YI_75800	Sludge Blower B-75800 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0750 (2/2)	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_YA_74600_1	RAS/WAS Pump P-74600-1 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YI_74600_1	RAS/WAS Pump P-74600-1 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YA_79000_1	Permeate Pump P-79000-1 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YI_79000_1	Permeate Pump P-79000-1 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YA_91000_1	UV-91000-1 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_YA_74600_2	RAS/WAS Pump P-74600-2 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YI_74600_2	RAS/WAS Pump P-74600-2 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YA_79000_2	Permeate Pump P-79000-2 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YI_79000_2	Permeate Pump P-79000-2 Running Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
IX_YA_91000_2	UV-91000-2 Fault Feedback		24 VDC	MCP-102	2	BMXDDI3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	2	BMXDDI3202K	NA	1
IX_YA_75240A	Process Blower B-75240A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YI_75240A	Process Blower B-75240A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YA_75400A	Membrane Blower B-75400A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (2/2)	1
IX_YI_75400A	Membrane Blower B-75400A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (2/2)	1
IX_YA_79600A	Effluent Pump P-79600A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0790	1
IX_YI_79600A	Effluent Pump P-79600A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0790	1
IX_YA_11200A	Fine Screen SCR-11200A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YI_11200A	Fine Screen SCR-11200A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YA_12200A	Sump Pump P-12200A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YI_12200A	Sump Pump P-12200A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YA_19200A	Equalization pump P-19200A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0190	1
IX_YI_19200A	Equalization pump P-19200A Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0190	1
IX_YA_80500A	Alkalinity Pump P-80500A Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-800 (2/2)	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
IX_YA_75240B	Process Blower B-75240B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YI_75240B	Process Blower B-75240B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (1/2)	1
IX_YA_75400B	Membrane Blower B-75400B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (2/2)	1
IX_YI_75400B	Membrane Blower B-75400B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0750 (2/2)	1
IX_YA_79600B	Effluent Pump P-79600B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0790	1
IX_YI_79600B	Effluent Pump P-79600B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0790	1
IX_YA_11200B	Fine Screen SCR-11200B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YI_11200B	Fine Screen SCR-11200B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YA_12200B	Sump Pump P-12200B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YI_12200B	Sump Pump P-12200B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0110	2
IX_YA_19200B	Equalization pump P-19200B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0190	1
IX_YI_19200B	Equalization pump P-19200B Running Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-0190	1
IX_YA_80500B	Alkalinity Pump P-80500B Fault Feedback		24 VDC	MCP-102	3	BMXDDI3202K	U65875-C01-800 (2/2)	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
Spare			24 VDC	MCP-102	3	BMXDDI3202K	NA	1
OX_YC_74600_1	RAS/WAS Pump P-74600-1 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_YC_91000_1	UV-91000-1 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_YC_79000_1	Permeate Pump P-79000-1 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79001_1	Valve FV-79001-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79001_1	Valve FV-79001-1 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79002_1	Valve FV-79002-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79002_1	Valve FV-79002-1 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79098_1	Valve FV-79098-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79098_1	Valve FV-79098-1 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79099_1	Valve FV-79099-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79099_1	Valve FV-79099-1 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_96001_1	Valve FV-96001-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_96001_1	Valve FV-96001-1 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FY_83598_1	Citric Acid Dosing Pump Valve FV-83598-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FY_83798_1	Hypochlorite Dosing Pump Valve FV-83798-1 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	4	BMXDDO3202K	NA	1
OX_YC_74600_2	RAS/WAS Pump P-74600-2 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_YC_91000_2	UV-91000-2 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_YC_79000_2	Permeate Pump P-79000-2 Start Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79001_2	Valve FV-79001-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79001_2	Valve FV-79001-2 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79002_2	Valve FV-79002-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79002_2	Valve FV-79002-2 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79098_2	Valve FV-79098-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79098_2	Valve FV-79098-2 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_79099_2	Valve FV-79099-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_79099_2	Valve FV-79099-2 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_96001_2	Valve FV-96001-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_96001_2	Valve FV-96001-2 Close Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FY_83598_2	Citric Acid Pump Valve FV-83598-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
OX_FY_83798_2	Hypochlorite Dosing Pump Valve FV-83798-2 Open Command		24 VDC	MCP-102	4	BMXDDO3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	4	BMXDDO3202K	NA	1
OX_YC_75240A	Process Blower B-75240A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (1/2)	1
OX_YC_75400A	Membrane Blower B-75400A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (2/2)	1
OX_YC_79600A	Effluent Pump P-79600A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0790	1
OX_YC_19200A	Equalization Pump P-19200A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0190	1
OX_YC_75240B	Process Blower B-75240B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (1/2)	1
OX_YC_75400B	Membrane Blower B-75400B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (2/2)	1
OX_YC_79600B	Effluent Pump P-79600B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0790	1
OX_YC_19200B	Equalization Pump P-19200B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0190	1
OX_YC_75000	Equalization Blower B-75000 Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (1/2)	1
OX_YC_75800	Sludge Blower B-75800 Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0750 (2/2)	1
OX_YC_11200A	Fine Screen SCR-11200A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0110	2
OX_YC_12200A	Sump Pump P-12200A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0110	2
OX_YC_11200B	Fine Screen SCR-11200B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0110	2
OX_YC_12200B	Sump Pump P-12200B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0110	2
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
OX_YC_80500A	Alkalinity Pump P-80500A Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-800 (2/2)	1
OX_YC_80500B	Alkalinity Pump P-80500B Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-800 (2/2)	1
OX_YC_83500	Sodium Hypochlorite Pump P-83500 Start Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-800 (1/2)	1

NAME	INSTRUMENT / DESCRIPTION	I/O ADDRESS	SIGNAL	PANNEL / JB	LOCATION	MODULE	P&ID #	Rev
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
OX_FYO_31026_1	Valve FV-31026-1 Open Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_31026_1	Valve FV-31026-1 Close Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1

NAME	INSTRUMENT / DESCRIPTION	I/O ADDRESS	SIGNAL	PANNEL / JB	LOCATION	MODULE	P&ID #	Rev
OX_FYO_74050_1	Valve FV-74050-2 Open Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_74050_1	Valve FV-74050-2 Close Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_31026_2	Valve FV-31026-2 Open Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_31026_2	Valve FV-31026-2 Close Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYO_74050_2	Valve FV-74050-2 Open Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
OX_FYC_74050_2	Valve FV-74050-2 Close Command		24 VDC	MCP-102	5	BMXDDO3202K	U65875-C01-0740	1
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
Spare			24 VDC	MCP-102	5	BMXDDO3202K	NA	1
IX_FIT_11274	Waste Water Flow Indicating Transmitter to Equalization Tanks		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0190	1
IX_FIT_79074_1	Permeate Flow Indicating Transmitter Train 1		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0740	1
IX_FIT_74674_1	RAS/WAS Flow Indicating Transmitter Train 1		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0740	1
IX_FIT_79074_2	Permeate Flow Indicating Transmitter Train 2		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0740	1
IX_FIT_74674_2	RAS/WAS Flow Indicating Transmitter Train 2		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0740	1
IX_FIT_75474A	Air to Membrane Train 1 Flow Indicating Transmitter		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0750 (2/2)	1
IX_FIT_75474B	Air to Membrane Train 2 Flow Indicating Transmitter		4-20 ma	MCP-102	6	BMXAMI0810	U65875-C01-0750 (2/2)	1
Spare			4-20 ma	MCP-102	6	BMXAMI0810	NA	3
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	3
IX_FIT_79274	Effluent Discharge Flow Indicating Transmitter		4-20 ma	MCP-102	7	BMXAMI0810	U65875-C01-0790	1
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	7	BMXAMI0810	NA	1
	MAIN CONTROL PANEL (RACK 1)							
Spare			4-20 ma	MCP-102	0	BMXAMI0810	NA	2
Spare			4-20 ma	MCP-102	0	BMXAMI0810	NA	2
Spare			4-20 ma	MCP-102	0	BMXAMI0810	NA	2
IX_AIT_79089	Effluent Discharge Turbidity Indicating Transmitter		4-20 ma	MCP-102	0	BMXAMI0810	U65875-C01-0790	1
IX_AIT_79093	Effluent Discharge pH Indicating Transmitter		4-20 ma	MCP-102	0	BMXAMI0810	U65875-C01-0790	1
IX_AIT_91000_1	UV lamp UV-91000-1 intensity		4-20 ma	MCP-102	0	BMXAMI0810	U65875-C01-0740	1
IX_AIT_91000_2	UV lamp UV-91000-2 intensity		4-20 ma	MCP-102	0	BMXAMI0810	U65875-C01-0740	1
IX_SI_19200A	Equalization Pump P-19200A Speed Feedback		4-20 ma	MCP-102	0	BMXAMI0810	U65875-C01-0190	1
IX_SI_19200B	Equalization Pump P-19200B Speed Feedback		4-20 ma	MCP-102	1	BMXAMI0810	U65875-C01-0190	1
IX_SI_79000_1	Permeate Pump P-79000-1 Speed Feedback		4-20 ma	MCP-102	1	BMXAMI0810	U65875-C01-0740	1
IX_SI_79000_2	Permeate Pump P-79000-2 Speed Feedback		4-20 ma	MCP-102	1	BMXAMI0810	U65875-C01-0740	1
Spare			4-20 ma	MCP-102	1	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	1	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	1	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	1	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	1	BMXAMI0810	NA	1
IX_LT_19060A	Equalization Tank T-19000A Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0190	1
IX_LT_19060B	Equalization Tank T-19000B Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0190	1
IX_LT_72060	Aerobic Tank T-73000 Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0720	1
IX_LT_74060_1	Membrane Tank T-74000-1 Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0740	1
IX_LT_74060_2	Membrane Tank T-74000-2 Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0740	1
IX_LT_79060	Permeate Tank T-79200 Level Transmitter		4-20 ma	MCP-102	2	BMXAMI0810	U65875-C01-0790	1
Spare			4-20 ma	MCP-102	2	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	2	BMXAMI0810	NA	1
IX_PT_79045_1	Pressure Transmitter Train 1		4-20 ma	MCP-102	3	BMXAMI0810	U65875-C01-0740	1
IX_PT_79045_2	Pressure Transmitter Train 2		4-20 ma	MCP-102	3	BMXAMI0810	U65875-C01-0740	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
Spare			4-20 ma	MCP-102	3	BMXAMI0810	NA	1
OX_SC_80500A	Alkalinity Pump P-80500A Speed Command		4-20 ma	MCP-102	4	BMXAMO0410	U65875-C01-800 (2/2)	1
OX_SC_80500B	Alkalinity Pump P-80500B Speed Command		4-20 ma	MCP-102	4	BMXAMO0410	U65875-C01-800 (2/2)	1
OX_SC_83500	Sodium Hypochlorite Pump P-83500 Speed Command		4-20 ma	MCP-102	4	BMXAMO0410	U65875-C01-800 (1/2)	1
Spare			4-20 ma	MCP-102	4	BMXAMO0410	NA	1
OX_SC_19200A	Equalization Pump P-19200A Speed Command		4-20 ma	MCP-102	5	BMXAMO0410	U65875-C01-0190	1
OX_SC_19200B	Equalization Pump P-19200B Speed Command		4-20 ma	MCP-102	5	BMXAMO0410	U65875-C01-0190	1
Spare			4-20 ma	MCP-102	5	BMXAMO0410	NA	1
Spare			4-20 ma	MCP-102	5	BMXAMO0410	NA	1
OX_SC_79000_1	Permeate Pump P-79000-1 Speed Command		4-20 ma	MCP-102	6	BMXAMO0410	U65875-C01-0740	1
OX_SC_79000_2	Permeate Pump P-79000-2 Speed Command		4-20 ma	MCP-102	6	BMXAMO0410	U65875-C01-0740	1
Spare			4-20 ma	MCP-102	6	BMXAMO0410	NA	1
Spare			4-20 ma	MCP-102	6	BMXAMO0410	NA	1
	REMOTE IO PANEL							
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
IX_RIO_120V	Panel 120V Detect		24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
IX_LE_11068	Container Leak Detector		24 VDC	RIO-101	1	BMXDDI3202K	U65875-C01-0110	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
IX_LSL_12061	Screened Water Tank T-12000 Low Level Switch		24 VDC	RIO-101	1	BMXDDI3202K	U65875-C01-0110	1
IX_LSH_12062	Screened Water Tank T-12000 High Level Switch		24 VDC	RIO-101	1	BMXDDI3202K	U65875-C01-0110	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
IX_YA_83700	Citric Acid Pump P-83700 Fault Feedback		24 VDC	RIO-101	1	BMXDDI3202K	U65875-C01-800 (1/2)	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1
Spare			24 VDC	RIO-101	1	BMXDDI3202K	NA	1

NAME	INSTRUMENT / DESCRIPTION	I/O ADDRESS	SIGNAL	PANNEL / JB	LOCATION	MODULE	P&ID #	Rev
OX_FY_11221A	Fine Screens A Inlet Control Valve FV-11221A Open Command		24 VDC	RIO-101	2	BMXDDO3202K	U65875-C01-0110	1
OX_FY_11221B	Fine Screens A Inlet Control Valve FV-11221B Open Command		24 VDC	RIO-101	2	BMXDDO3202K	U65875-C01-0110	1
OX_FY_11221C	Fine Screens B Inlet Control Valve FV-11221C Open Command		24 VDC	RIO-101	2	BMXDDO3202K	U65875-C01-0110	1
OX_FY_11221D	Fine Screens B Inlet Control Valve FV-11221D Open Command		24 VDC	RIO-101	2	BMXDDO3202K	U65875-C01-0110	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
OX_YC_83700	Citric Acid Pump P-83700 Start Command		24 VDC	RIO-101	2	BMXDDO3202K	U65875-C01-800 (1/2)	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
Spare			24 VDC	RIO-101	2	BMXDDO3202K	NA	1
IX_FIT_19274	Equalized Water From Equalization Tank Flow Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0110	1
IX_FIT_12274	Screened Water to Aerobic Tank Flow Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0110	1
IX_FIT_75074	Air to Equalization Tank Flow Indicator Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0750 (1/2)	3
IX_FIT_75274	Air to Aerobic Tank Flow Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0750 (1/2)	3
IX_AIT_11094	Screened Water to Aerobic Tank pH Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0110	1
IX_AIT_72092	Water to Membrane Tank Temperature Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0720	2
IX_AIT_72093	Water to Membrane Tank pH Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0720	2
IX_AIT_72094	Water to Membrane Tank Dissolved Oxygen Indicating Transmitter		4-20 ma	RIO-101	3	BMXAMI0810	U65875-C01-0720	2
IX_LT_12060	Screened Water Tank T-12000 Level Transmitter		4-20 ma	RIO-101	4	BMXAMI0810	U65875-C01-0110	1
IX_LT_96060	Sludge Holding Tank T-96000 Level Transmitter		4-20 ma	RIO-101	4	BMXAMI0810	U65875-C01-0960	1
IX_FIT_75874	Sludge Aeration Air Flow Indicating Transmitter (2-WIRE)		4-20 ma	RIO-101	4	BMXAMI0810	U65875-C01-0750 (2/2)	2
Spare			4-20 ma	RIO-101	4	BMXAMI0810	NA	1
Spare			4-20 ma	RIO-101	4	BMXAMI0810	NA	1
Spare			4-20 ma	RIO-101	4	BMXAMI0810	NA	1
Spare			4-20 ma	RIO-101	4	BMXAMI0810	NA	1
Spare			4-20 ma	RIO-101	4	BMXAMI0810	NA	1
OX_SC_83700	Citric Acid Pump P-83700 Speed Command		4-20 ma	RIO-101	5	BMXAMO0410	U65875-C01-800 (1/2)	1
Spare			4-20 ma	RIO-101	5	BMXAMO0410	U65875-C01-800 (2/2)	1
Spare			4-20 ma	RIO-101	5	BMXAMO0410	U65875-C01-800 (1/2)	1
Spare			4-20 ma	RIO-101	5	BMXAMO0410	U65875-C01-800 (1/2)	1

SECTION 9 - DRAWINGS AND DIAGRAMS

9.1 - PIPING AND INSTRUMENTATION DIAGRAMS (P&IDS)

VALVE SYMBOLS

N.OPEN N.CLOSED

- BALL
- V-BALL
- BUTTERFLY
- DIAPHRAGM
- GATE
- GLOBE
- NEEDLE
- PLUG
- SAMPLE/DRAIN
- CHECK
- BACKFLOW PREVENTER
- 3-WAY, 4-WAY
- PRESSURE REGULATING
- BACK PRESSURE REGULATING
- FLOW CONTROL
- 2-WAY SOLENOID
- 3-WAY SOLENOID
- 4-WAY SOLENOID
- AIR RELEASE
- VACUUM BREAKER
- PRESSURE RELEASE
- SLUICE GATE/WEIR

VALVE ACTUATOR SYMBOLS

- PNEUMATIC (FAIL LAST POSITION)
- PNEUMATIC FAIL CLOSE
- PNEUMATIC FAIL OPEN
- ELECTRIC
- DIAPHRAGM
- POSITIONER (ANY ACTUATOR TYPE)
- HAND OVERRIDE (ANY ACTUATOR TYPE)
- TRAVEL STOPS (ANY ACTUATOR TYPE)

FLOWMETER SYMBOLS

INTEGRAL | CLOSE COUPLED | REMOTE

- MAGNETIC
- PADDLE
- VORTEX
- DP/ORIFICE
- THERMAL
- ROTAMETER

INSTRUMENTATION SYMBOLS

LOCALLY MOUNTED	IN CONTROL PANEL	DESCRIPTION
X	X	DISCRETE INSTRUMENT
	X	PRIMARY PLC OR DCS SHARED CONTROL
	X	SECONDARY PLC OR DCS SHARED CONTROL
	X	COMPUTER FUNCTION

INSTRUMENT FUNCTIONS

- K — SIGNAL PROCESSING FUNCTION
- A/M — AUTO/MANUAL
- Σ — ADDITION/SUMMATION
- Δ — DIFFERENTIAL
- ◇ — INTERLOCK LOGIC FUNCTION
- ⅀/n — AVERAGING

INSTRUMENT CONNECTIONS

- SOCKETWELD
- THREADED
- WELDED

PIPING SYMBOLS

- FLANGED CONNECTION
- THREADED CONNECTION
- BLIND FLANGE
- DOUBLE CONTAINMENT
- QUICK DISCONNECT VICTAULIC
- x" INSULATION THICKNESS — INSULATION
- QUICK DISCONNECT CAMLOK
- x" INSULATION THICKNESS — HEAT TRACING E=ELECTRIC S=STEAM G=GLYCOL
- CAPPED PIPE END
- DRAIN OUTLET
- UNION
- REDUCER ECCENTRIC REDUCER
- EXPANSION/FLEXIBLE/ ISOLATION JOINT

PIPING ABBREVIATIONS

316 SS	316 STAINLESS STEEL
304 SS	304 STAINLESS STEEL
316L SS	LOW CARBON 316 STAINLESS STEEL
304L SS	LOW CARBON 304 STAINLESS STEEL
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
DI	DUCTILE IRON
HDPE	HIGH-DENSITY POLYETHYLENE
PE	POLYETHYLENE
PVC	POLYVINYL CHLORIDE
RLCS	RUBBER LINED CARBON STEEL
SCH.	SCHEDULE
SDR	STANDARD DIMENSION RATIO
CML	CEMENT MORTAR LINED

LINE SYMBOLOGY

- MAIN PROCESS LINE
- SECONDARY PROCESS LINE
- PROCESS LINE, BY OTHERS
- COMM LINK (EX. PLC TO HMI)
- COMM LINK (EX. PLC TO DCS)
- ELECTRIC WIRING
- PNEUMATIC LINE
- LINE JUMPER
- PIPE DISCONTINUATION
- FLOW DIRECTION ARROWS
- 4" 316 SS SCH.10 — LINES SIZE/ MATERIAL IDENTIFIER
- SKID BOUNDARY — SKID BY H_2O Innovation / BY OTHERS
- REVISION
- LINES TO/FROM OTHER SHEETS — DESCRIPTION — C01-0001 SHT 1 — DESTINATION

PUMP SYMBOLS

- CENTRIFUGAL
- CHEMICAL METERING
- DIAPHRAGM
- POSITIVE DISPLACEMENT
- VACUUM
- SUBMERSIBLE OR FLOATING
- VERTICAL TURBINE
- PERISTALTIC/HOSE

MISCELLANEOUS EQUIPMENT SYMBOLS

- CARTRIDGE FILTER HOUSING
- AUTOMATIC STRAINER
- SILENCER
- MIXER
- STATIC MIXER
- RESIN TRAP
- MOTOR
- EDUCTOR OR VENTURI
- Y STRAINER
- CONICAL OR TEMPORARY STRAINER
- PULSATION DAMPENER
- DIAPHRAGM
- FLOW ORIFICE
- AIR COMPRESSOR
- RUPTURE DISK (PRESSURE)
- RUPTURE DISK (VACUUM)
- SPECTACLE BLIND (NORMALLY OPEN, NORMALLY CLOSED)
- INJECTION QUILL
- FILTER
- REFRIGERATED AIR DRYER
- TANK
- MMF TANK
- IMMERSED HEATER
- IN-LINE HEATER
- ULTRASONIC LEVEL TRANSMITTER
- FLOAT-STYLE LEVEL TRANSMITTER
- CHEMICAL CONTAINMENT
- CALIBRATION COLUMN
- MEMBRANE
- UV STERILIZER
- DIFFUSERS:
  - COARSE BUBBLE
  - FINE BUBBLE
- POSITIVE DISPLACEMENT BLOWER
- REGENERATIVE BLOWER
- CENTRIFUGAL BLOWER
- TURBOCHARGER
- BIO-WHEEL
- MANWAY

FLOW INSTRUMENTS

FAH	FLOW ALARM HIGH
FAL	FLOW ALARM LOW
FCV	FLOW CONTROL VALVE
FE	FLOW ELEMENT
FI	FLOW INDICATOR
FIC	FLOW INDICATING CONTROLLER
FIT	FLOW INDICATING TRANSMITTER
FR	FLOW RECORDING
FSH	FLOW SWITCH HIGH
FSL	FLOW SWITCH LOW
FV	FLOW CONTROL OR ON/OFF VALVE
FQ	FLOW TOTALIZER
FX	ELEMENT CONTROLLED BY FLOW
FY	FLOW SIGNAL CONVERT, I/P, OR SOLN

PRESSURE INSTRUMENTS

PAH	PRESSURE ALARM HIGH
PAL	PRESSURE ALARM LOW
PC	PRESSURE CONTROLLER
PCV	SELF REG PRESS CONTROL VALVE
PDH	DIFFERENTIAL PRESSURE HIGH
PDI	DIFFERENTIAL PRESSURE INDICATOR
PDIT	DIFF PRESS INDICATING TRANSMITTER
PDSH	DIFFERENTIAL PRESS SWITCH HIGH
PG	PRESSURE GAUGE
PI	PRESSURE INDICATOR
PIC	PRESSURE INDICATING CONTROLLER
PIT	PRESSURE INDICATING TRANSMITTER
PSH	PRESSURE SWITCH HIGH
PSL	PRESSURE SWITCH LOW
PSV	SELF REG PRESS SAFETY VALVE
PT	PRESSURE TRANSMITTER
PX	ELEMENT CONTROLLED BY PRESSURE
PY	PRESS SIGNAL CONVERT, I/P, OR SOLN
PSLH	PRESSURE SWITCH LOW HIGH

LEVEL INSTRUMENTS

LAH	LEVEL ALARM HIGH
LAL	LEVEL ALARM LOW
LCV	SELF REG LEVEL CONTROL VALVE
LE	LEVEL ELEMENT
LG	LEVEL GAUGE
LI	LEVEL INDICATOR
LIC	LEVEL INDICATING CONTROLLER
LIT	LEVEL INDICATING TRANSMITTER
LSH	LEVEL SWITCH HIGH
LSL	LEVEL SWITCH LOW
LT	LEVEL TRANSMITTER
LV	LEVEL CONTROL OR ON/OFF VALVE
LX	ELEMENT CONTROLLED BY LEVEL
LY	LEVEL SIGNAL CONVERT, I/P, OR SOLN

TEMPERATURE INSTRUMENTS

TAH	TEMPERATURE ALARM HIGH
TAL	TEMPERATURE ALARM LOW
TC	TEMPERATURE CONTROLLER
TE	TEMPERATURE ELEMENT
TG	TEMPERATURE GAUGE
TI	TEMPERATURE INDICATOR
TIC	TEMP INDICATING CONTROLLER
TIT	TEMP INDICATING TRANSMITTER
TSH	TEMPERATURE SWITCH HIGH
TSL	TEMPERATURE SWITCH LOW
TT	TEMPERATURE TRANSMITTER
TV	TEMP CONTROL OR ON/OFF VALVE
TX	ELEMENT CONTROLLED BY TEMP
TY	TEMP SIGNAL CONVERT, I/P, OR SOLN

ELECTRICAL ABBREVIATIONS

JB	JUNCTION BOX
MCP	MAIN CONTROL PANEL
RIO	REMOTE I/O PANEL
PP	POWER PANEL
VFD	VARIABLE FREQUENCY DRIVE
HOA	HAND-OFF-AUTO

ANALYTICAL INSTRUMENTS

AAH	ANALYTICAL ALARM HIGH
AAL	ANALYTICAL ALARM LOW
AE	ANALYTICAL ELEMENT
AI	ANALYTICAL INDICATOR
AIC	ANAL INDICATING CONTROLLER
AIT	ANAL INDICATING TRANSMITTER
ASH	ANALYTICAL SWITCH HIGH
ASL	ANALYTICAL SWITCH LOW
AT	ANALYTICAL TRANSMITTER
AX	ELEMENT CONTROLLED BY ANALYTICAL
AY	ANALYTICAL SIGNAL CONVERT, I/P, OR SOL

MISCELLANEOUS INSTRUMENTS

HS	HAND SWITCH
HI	HAND SWITCH POSITION INDICATOR
II	CURRENT INDICATOR
QQI	TOTALIZER INDICATOR
SC	SPEED CONTROLLER
SI	SPEED INDICATOR
YA	MOTOR ALARM
YC	MOTOR CONTROL
YI	MOTOR ON/OFF INDICATOR
ZIC	SWITCH CLOSE INDICATOR
ZIO	SWITCH OPEN INDICATOR
ZSC	POSITION SWITCH CLOSED
ZSO	POSITION SWITCH OPEN
ZT	POSITION TRANSMITTER
ZI	POSITION INDICATOR

VALVES & EQUIPMENT

AC	AIR COMPRESSOR
ARV	AIR RELEASE VALVE
AS	AIR SUPPLY
B	BLOWER
BT	BULK TOTE
CBD	COARSE BUBBLE DIFFUSER
CV	CHECK VALVE
ED	EDUCTOR
F	FILTER
FBD	FINE BUBBLE DIFFUSER
FL	FAIL LAST (DEFAULT IF NOT SHOWN)
FC	FAIL CLOSED
FO	FAIL OPEN
FQG	CALIBRATION COLUMN
H	HEATER
HCV	HAND CONTROL VALVE
HTR	HEATER
HV	HAND VALVE
M	MOTOR
MX	MIXER
P	PUMP
RT	RESIN TRAP
ST	SPILL TANK
STR	STRAINER
T	TANK
UV	ULTRAVIOLET
HV	HAND VALVE
MV	MULTI FUNCTION VALVE

OTHER ABBREVIATIONS

CAP	CAPACITANCE
CIP	CLEAN-IN-PLACE
COND	CONDUCTIVITY
DO2	DISSOLVED OXYGEN
ESP	EMERGENCY STOP
IA	INSTRUMENT AIR
I/P	CURRENT TO PNEUMATIC CONVERTER
ORP	OXIDATION REDUCTION POTENTIAL
pH	HYDROGEN ION
RES	RESISTIVITY
RTD	RESISTANCE TEMP DETECTOR
SOL	SOLENOID
SP	SET POINT
uS	MICROSIEMENS
MIT	MEMBRANE INTEGRITY TEST

DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±
DECIMALS: 0.X ±0.030; 0.XX ±0.015; 0.XXX ±0.5"
ANGLES ±0.5°
HOLE SIZES ±
HOLE CENTERS ±
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

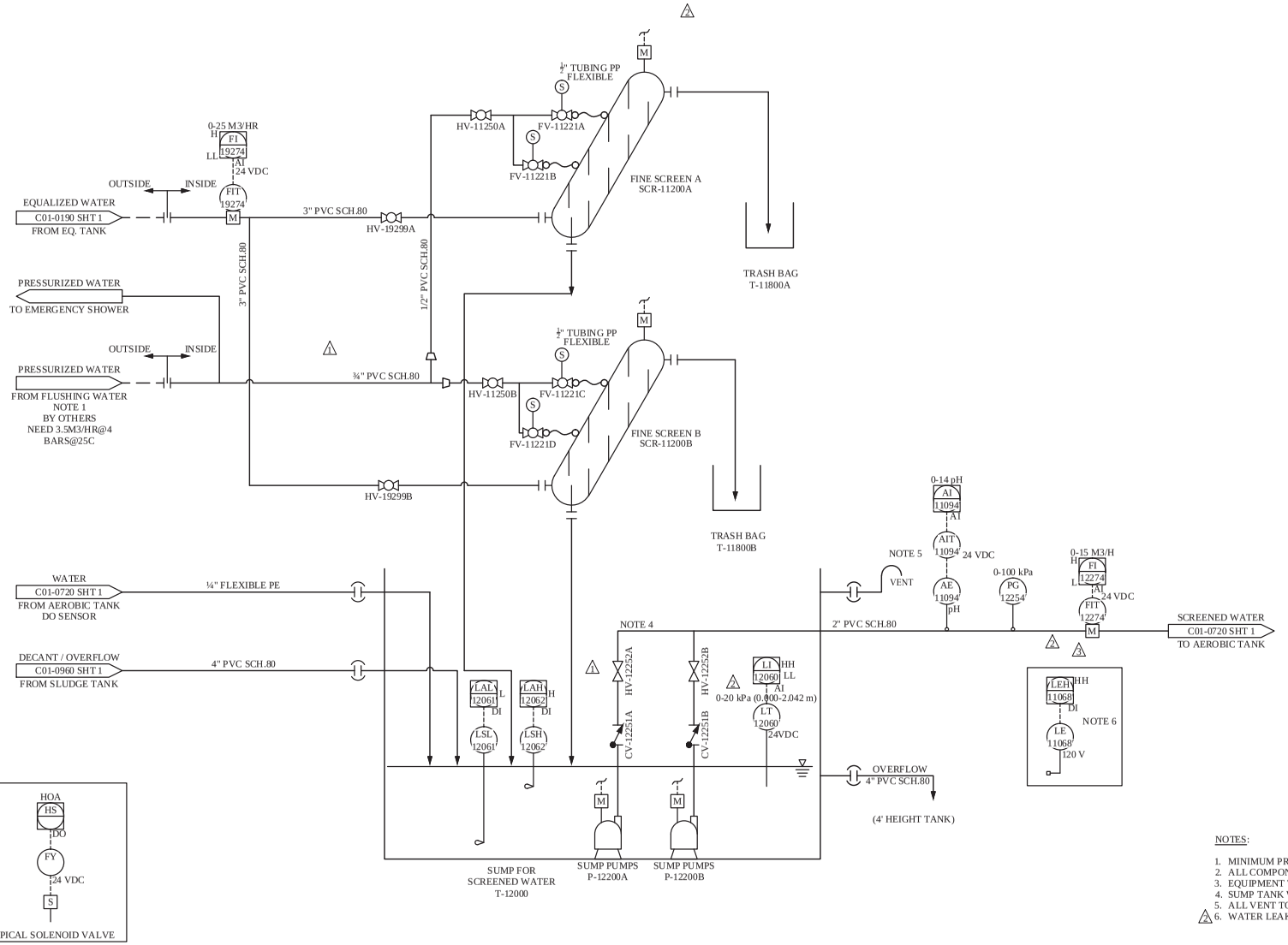
TITLE:
PROCESS AND INSTRUMENTION DIAGRAMS LEGEND

SCALE: N/A

DRAWING NUMBER: U65875--C01-0001

SHEET: 1 □/1

REVISION 04



NOTES:

1. MINIMUM PRESSURE OF 40 PSIG REQUIRED.
2. ALL COMPONANTS GOING IN TO THE RIO-101.
3. EQUIPMENT TO BE PLACED IN CONTAINER #1.
4. SUMP TANK WITH COVER.
5. ALL VENT TO OUTSIDE.
6. WATER LEAK DETECTOR.

NOTE:
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THE PURPOSE OF THIS DOCUMENT IS TO FACILITATE THE INSTALLATION, MAINTENANCE AND OPERATION OF THE EQUIPMENT REPRESENTED BY SAID PRINT. NO OTHER USE OF THIS DOCUMENT SHALL BE MADE WITHOUT EXPRESS WRITTEN CONSENT FROM H_2O INNOVATION.

DRAWING REVISION

REV	DATE (dd/mm/yyyy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge to strength water systems

UNLESS NOTED OTHERWISE
INTERPRETATION ANSI Y14.5
TOLERANCES
FRACTIONS ±1/32
DECIMALS .X ±0.030
.XX ±0.015
.XXX ±0.010
ANGLES ±1°
HOLE SIZES ±1/64
HOLE CENTERS ±1/32
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

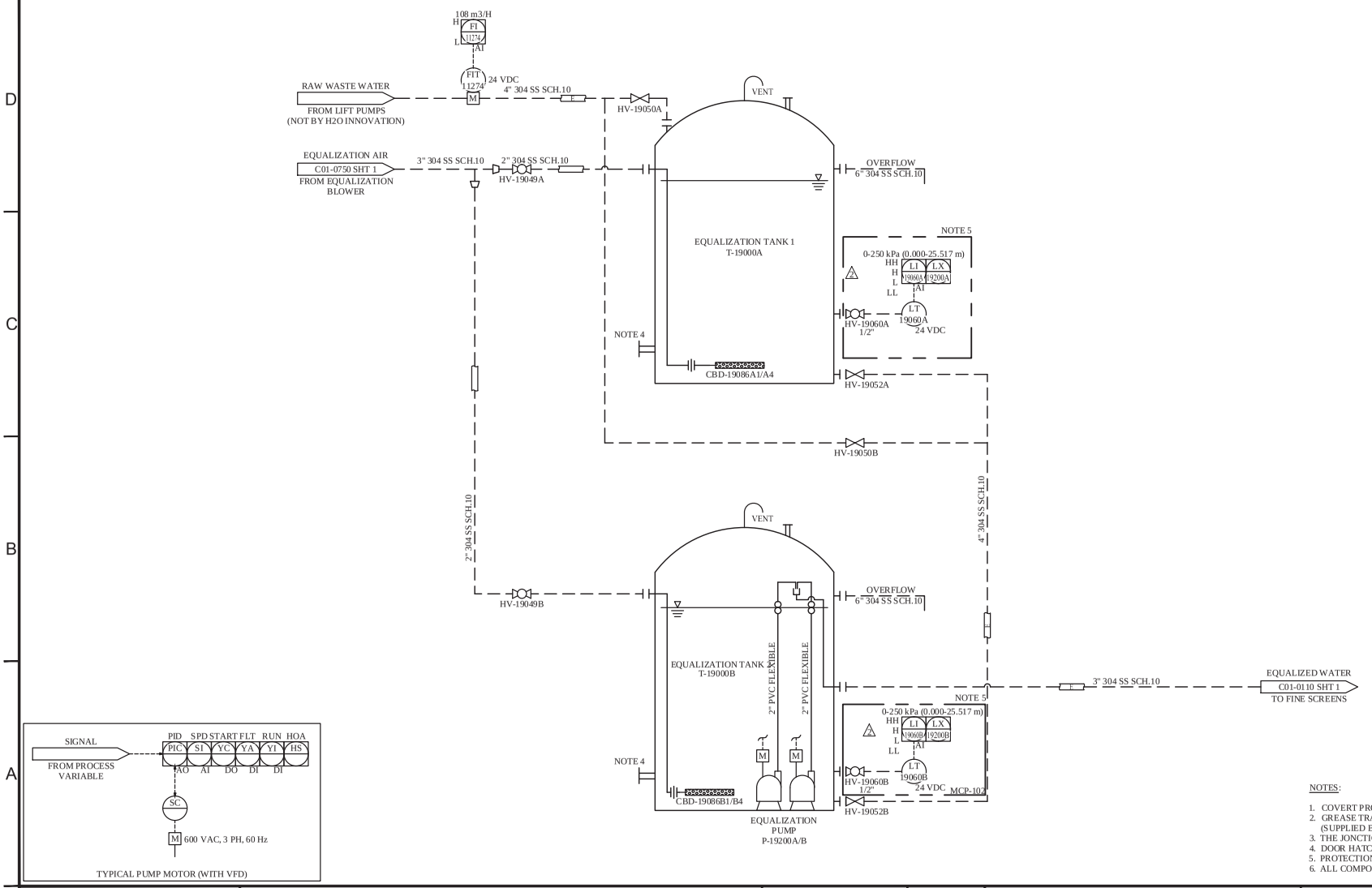
TITLE:
RAW WATER SCREENING
PROCESS & INSTRUMENTATION DIAGRAM

SCALE: N/A

DRAWING NUMBER: U65875-C01-0110

SHEET: 1 □1

REVISION 04



NOTES:

1. COVERT PROVIDE BUT NOT INSTALL.
2. GREASE TRAP TO BE INSTALLED UPSTREAM OF STP (SUPPLIED BY H2O INNOVATION, INSTALLED BY OTHERS)
3. THE JONCTION BOX IS HOOK ON THE EQUALIZATION TANK.
4. DOOR HATCH ACCESS.
5. PROTECTION COVER.
6. ALL COMPONANTS GOING INTO THE MCP-102

DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge in motion water in progress

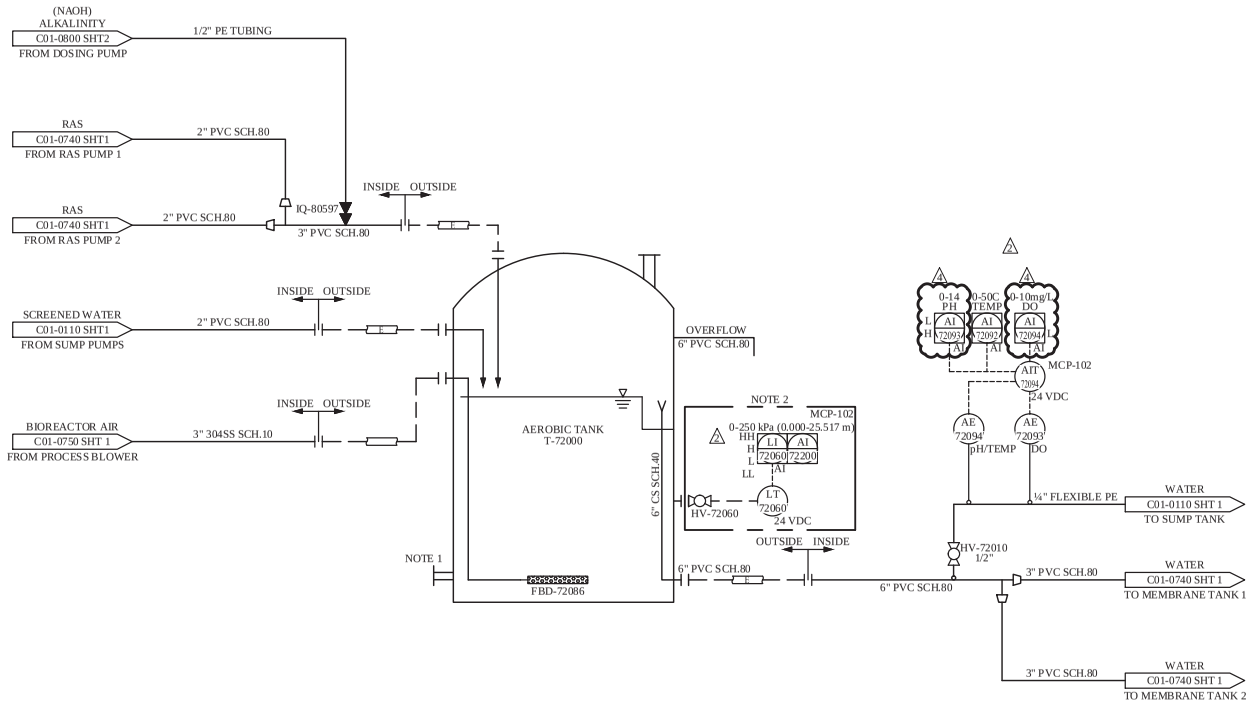
UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/64
DECIMALS X.X: ±0.030
X.XX: ±0.015
X.XXX: ±0.5°
ANGLES: ±0.5°
HOLE SIZES: ±1/64
HOLE CENTERS: ±1/64
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

TITLE:
FEED WATER EQUALIZATION
PROCESS & INSTRUMENTATION DIAGRAM

SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-C01-0190	04
	SHEET: 1 OF 1	



NOTES:

1. DOOR HATCH ACCESS.
2. PROTECTION COVER.

NOTE:
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DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge in advanced water purification

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/64"
DECIMALS: X.X ±0.030, X.XX ±0.015, X.XXX ±0.5°
ANGLES: ±0.5°
HOLE SIZES: ±1/64"
HOLE CENTERS: ±1/64"
DO NOT SCALE PRINTS

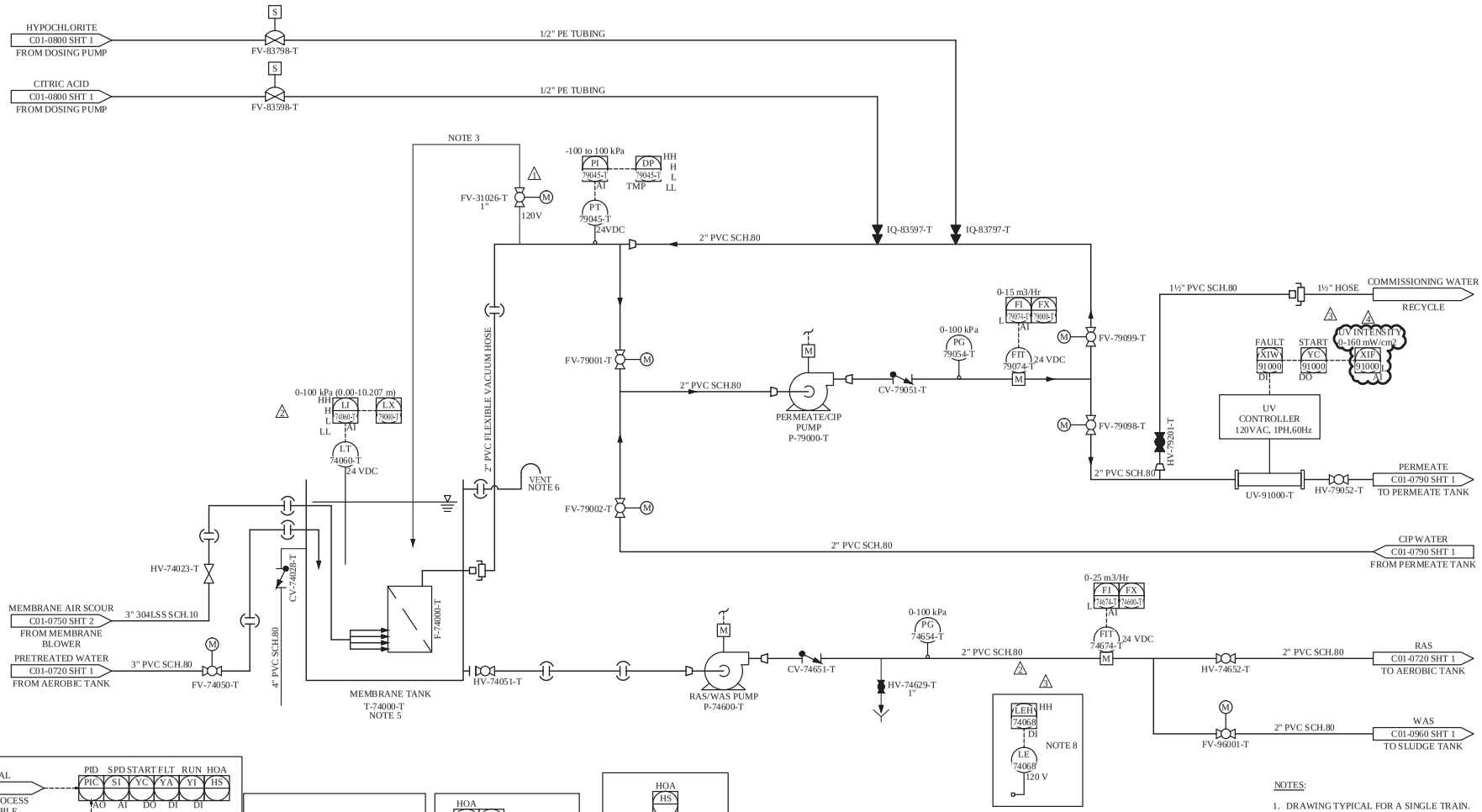
MELIADINE STP

216 M3/DAY

TITLE:
AEROBIC TANK
PROCESS & INSTRUMENTATION DIAGRAM

SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-C01-0720	04

SHEET: 1 OF 1



NOTES:

1. DRAWING TYPICAL FOR A SINGLE TRAIN. A TOTAL OF 2 TRAINS ARE PROVIDED.
2. TAG NUMBERS OF EQUIPMENT ON EACH TRAIN TO SUBSTITUTE TRAIN NUMBER FOR 'T'.
3. HEIGHT OF 4.6 FT REQUIRED ABOVE MEMBRANE TANK LIQUID.
4. ALL COMPONANTS GOING INTO MCP-102.
5. MBR TANK WITH COVER.
6. ALL VENT TO OUTSIDE
7. EQUIPMENT TO BE PLACED IN CONTAINER #2.
8. WATER LEAK DETECTOR.

DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge in advanced water purification

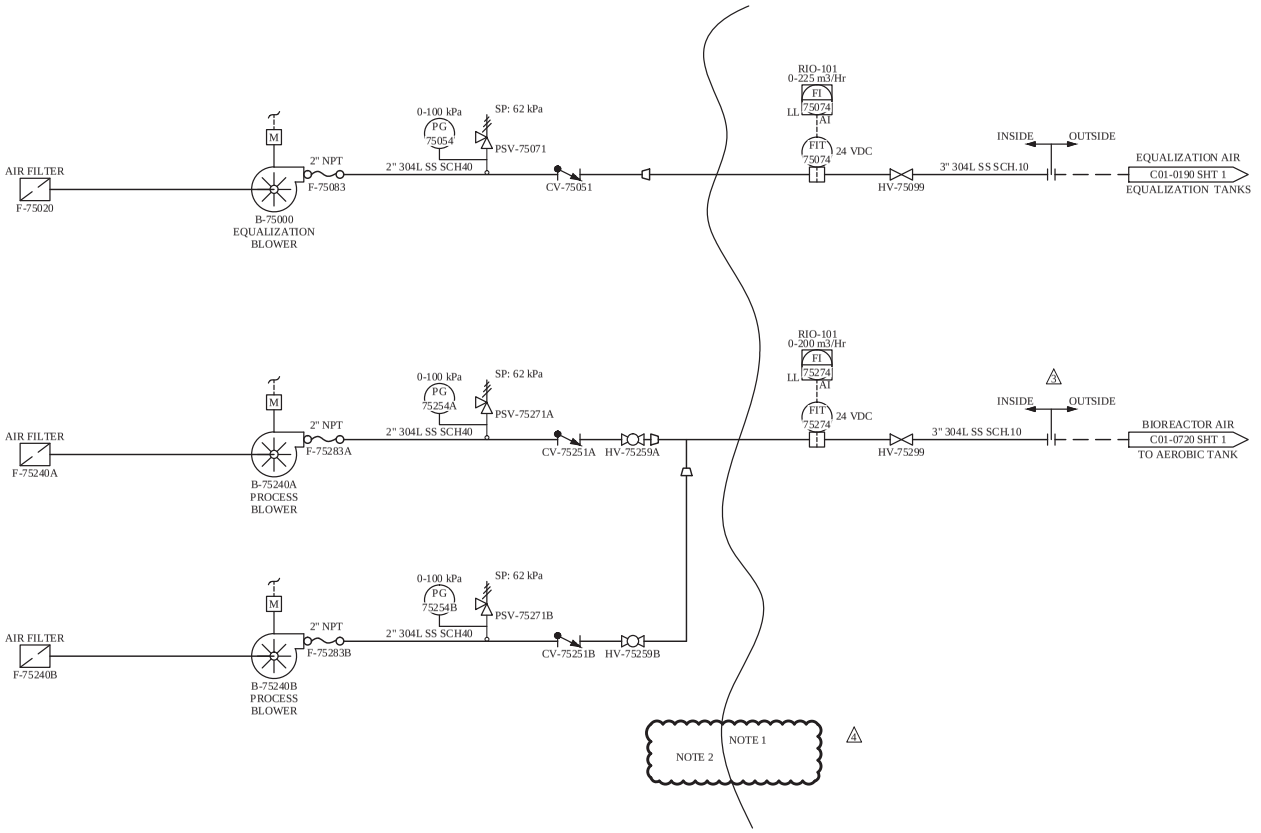
UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±
DECIMALS: X.X ±0.030, X.XX ±0.015, X.XXX ±0.5°
ANGLES ±
HOLE SIZES ±
HOLE CENTERS ±
DO NOT SCALE PRINTS

MELIADINE STP

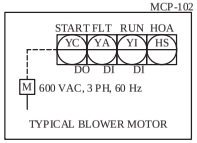
216 M3/DAY

TITLE:
MEMBRANE FILTRATION
PROCESS & INSTRUMENTATION DIAGRAM

SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-C01-0740	04
	SHEET: 1 OF 1	



MCP-102



TYPICAL BLOWER MOTOR

NOTES:

1. EQUIPMENT TO BE PLACED IN CONTAINER #1.
2. EQUIPMENT TO BE PLACED IN CONTAINER #2.

NOTE:
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DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge to shape our water future

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±
DECIMALS X.X: ±0.030
X.XX: ±0.015
X.XXX: ±0.5°
ANGLES: ±
HOLE SIZES: ±
HOLE CENTERS: ±
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

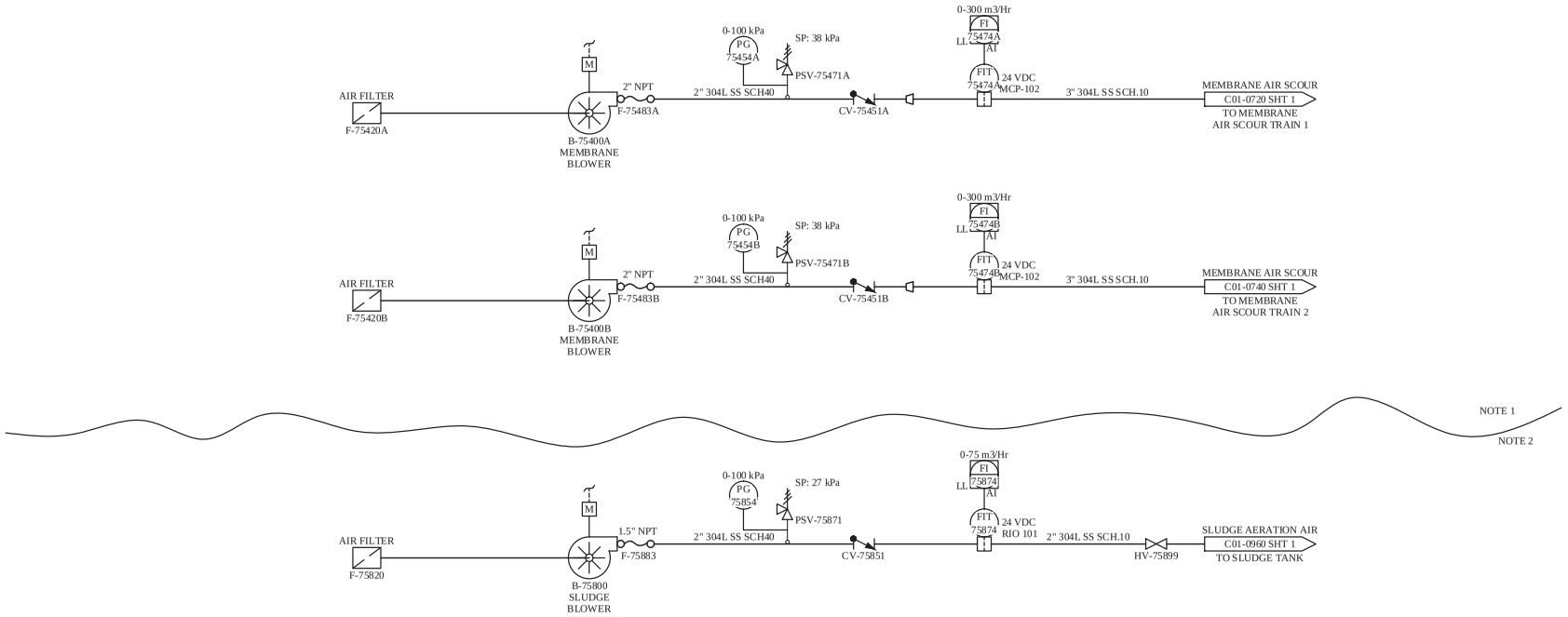
TITLE:
BLOWERS FOR MBR SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM

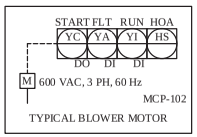
SCALE: N/A

DRAWING NUMBER: U65875-C01-0750

SHEET: 1 □ 2

REVISION 04





NOTES:

1. EQUIPMENT TO BE PLACED IN CONTAINER #2.
2. EQUIPMENT TO BE PLACED IN CONTAINER #1.

DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge in motion water & garbage

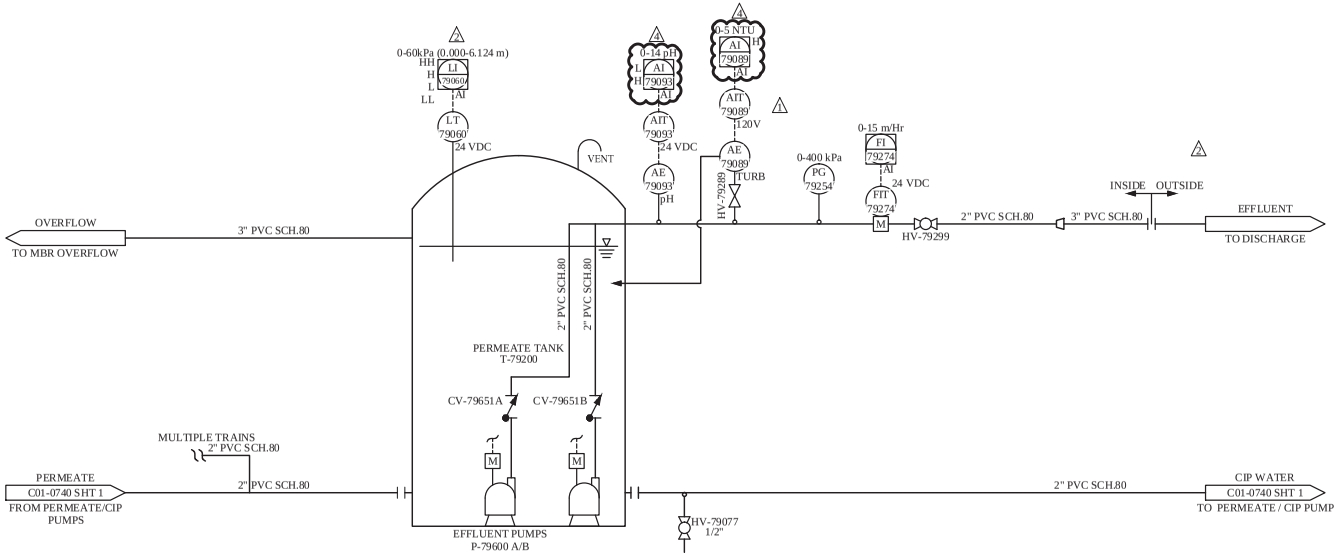
UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/64"
DECIMALS 0.X: ±0.030
0.0 X: ±0.015
0.00 X: ±0.5°
ANGLES: ±0.5°
HOLES SIZES: ±1/64"
HOLE CENTERS: ±1/32"
DO NOT SCALE PRINTS

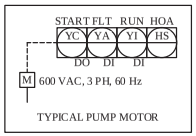
MELIADINE STP

216 M3/DAY

TITLE:
BLOWERS FOR MBR SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM

SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-C01-0750	04
	SHEET: 2 OF 2	





NOTES:

1. ALL COMPONANTS GOING INTO MCP-102.
2. EQUIPMENT TO BE PLACED IN CONTAINER #2.

NOTE:
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DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

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knowledge to shape our water challenges

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/64"
DECIMALS X.X: ±0.030
X.XX: ±0.015
X.XXX: ±0.5°
ANGLES: ±1°
HOLE SIZES: ±1/64"
HOLE CENTERS: ±1/32"
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

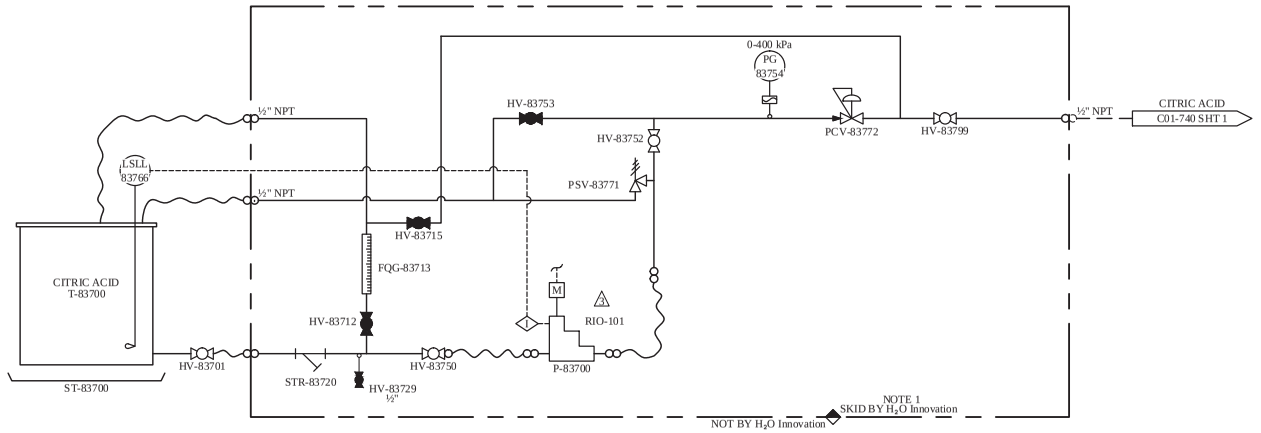
TITLE:
PERMEATE TANK
PROCESS & INSTRUMENTATION DIAGRAM

SCALE: N/A

DRAWING NUMBER: U65875-C01-0790

SHEET: 1 OF 1

REVISION 04

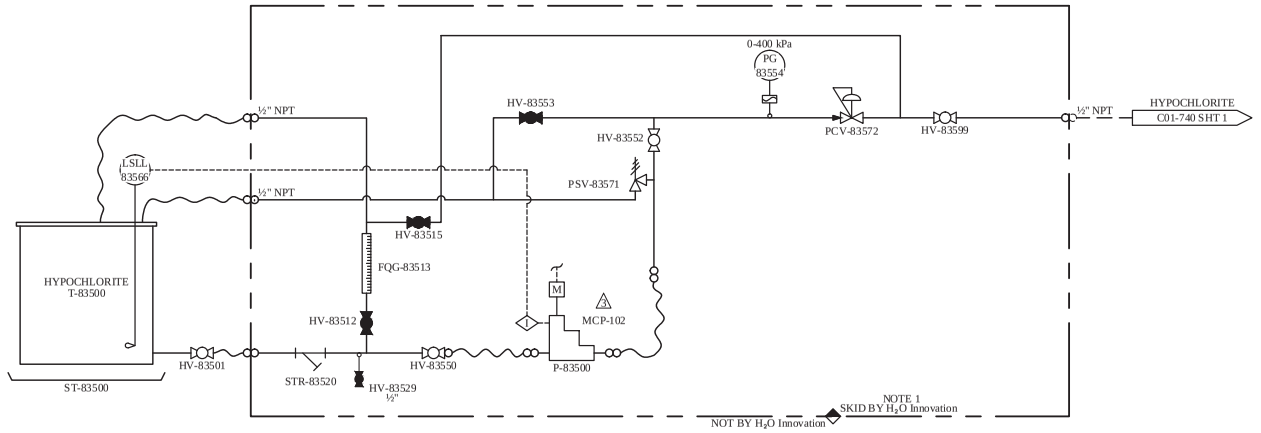


CITRIC ACID, 50 % SOLUTION DOSING SYSTEM

3

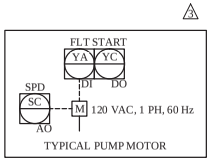
NOTE 2

NOTE 1



SODIUM HYPOCHLORITE, 10.3 % DOSING SYSTEM

3



TYPICAL PUMP MOTOR

NOTES:

3 1. EQUIPMENT TO BE PLACED IN CONTAINER #2.
3 2. EQUIPMENT TO BE PLACED IN CONTAINER #1.

DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

h2o innovation
knowledge in chemical water & process

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±
DECIMALS X.X: ±0.030
X.XX: ±0.015
X.XXX: ±0.5°
ANGLES: ±
HOLE SIZES: ±
HOLE CENTERS: ±
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

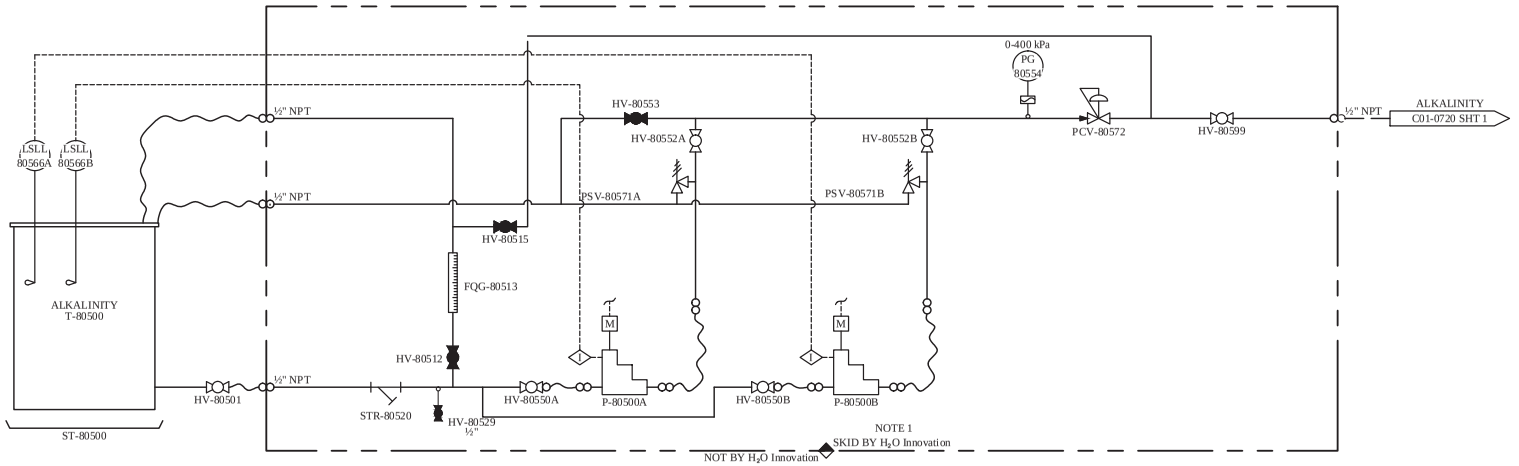
TITLE:
DOSING SKIDS - CLEANING CHEMICALS
PROCESS & INSTRUMENTATION DIAGRAM

SCALE: N/A

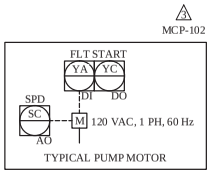
DRAWING NUMBER: U65875-C01-0800

SHEET: 1 □ 2

REVISION 04



ALKALINITY ADJUSTMENT CHEMICAL DOSING SYSTEM



NOTES:

1. EQUIPMENT TO BE PLACED IN CONTAINER #2.

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DRAWING REVISION

REV	DATE (dd/mm/yy)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
04	02/08/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

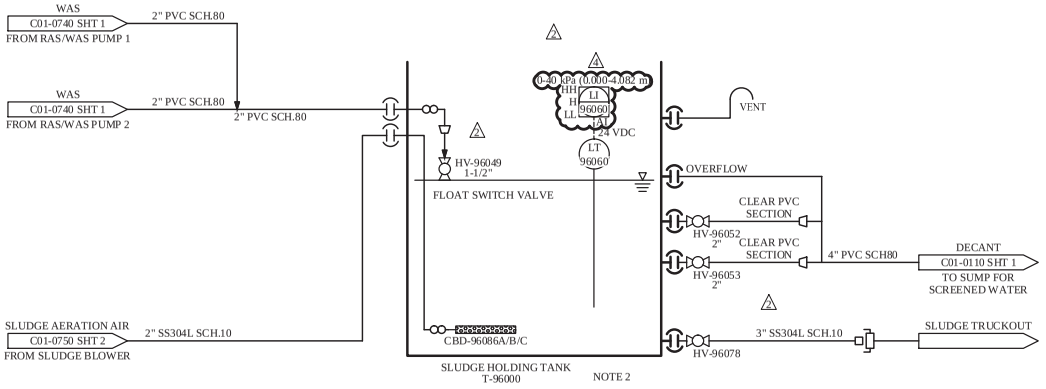
UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±⅛"
DECIMALS X.X: ±0.030
X.XX: ±0.015
X.XXX: ±0.5°
ANGLES: ±½°
HOLE SIZES: ±⅛"
HOLE CENTERS: ±⅛"
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

TITLE:
DOSING SKIDS - ALKALINITY
PROCESS & INSTRUMENTATION DIAGRAM

SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-C01-0800	04
	SHEET: 2 OF 2	



NOTES:

1. ALL COMPONANTS GOING INTO RIO 101.
2. SLUDGE HOLDING TANK WITH COVER.
3. ALL VENT TO OUTSIDE.

NOTE:
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DRAWING REVISION

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03	25/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
02	13/07/2016	REVISED AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
01	11/07/2016	CHANGE SUMP TANK BALL TO GATE VALVE,SOLENOID TO ELECTRIC VALVE,TURBIDITY METER TO 120V	M.P.	H.S.	H.C.	H.C.
00	21/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

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knowledge to share, solutions to perform

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±
DECIMALS 0.X: ±0.030
0.0 X: ±0.015
0.00 X: ±0.5°
ANGLES: ±
HOLE SIZES: ±
HOLE CENTERS: ±
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

TITLE:
SLUDGE HANDLING SYSTEM
PROCESS & INSTRUMENTATION DIAGRAM

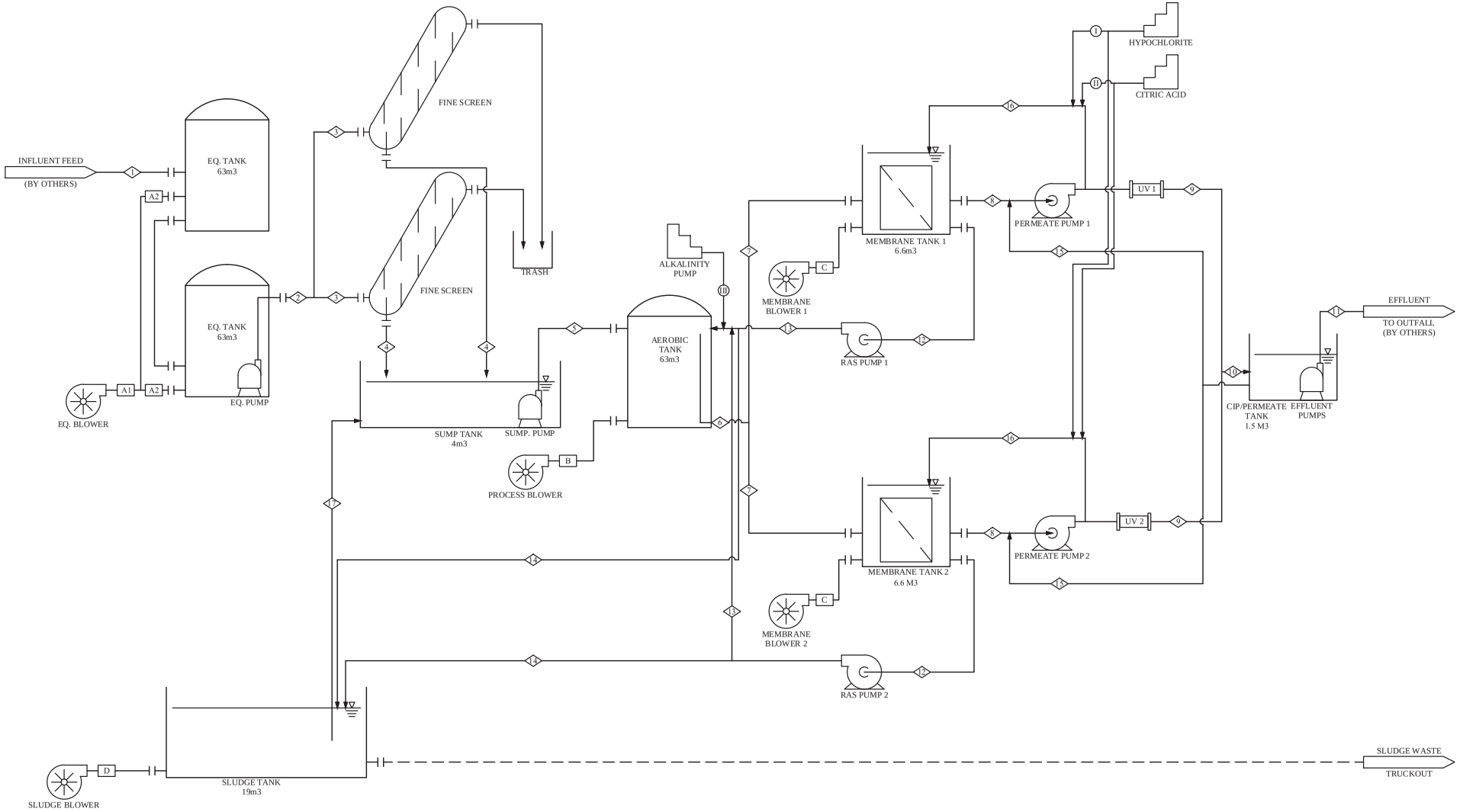
SCALE: N/A

DRAWING NUMBER: U65875-C01-0960

SHEET: 1 OF 1

REVISION 04

9.2 - PROCESS FLOW DIAGRAMS (PFD)



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DRAWING REVISION

REV	DATE (DD/MM/YYYY)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
1	07/07/2016	REVISE AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
0	30/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

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knowledge to shape our water challenges

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES
FRACTIONS: ±⅛"
DECIMALS: 0.X: ±0.030
0.XX: ±0.015
ANGLES: ±0.5°
HOLE SIZES: ±⅛"
HOLE CENTERS: ±⅛"
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

TITLE:
PROCESS FLOW DIAGRAM

SCALE: N/A

DRAWING NUMBER: U65875-C11-0001

SHEET: 1 □ 2

REVISION 1

Line Number	Description	Design Flow	Max Flow
1	Raw Feed	2549 m3/d	2549 m3/d
2	Equalized Feed	216 m3/d	216 m3/d
3	Equalized Feedwater to Screens	108 m3/d	216 m3/d
4	Screened Wastewater	108 m3/d	216 m3/d
5	Pumped Screened Flow from Sump	216 m3/d	216 m3/d
6	Common Aerated MLSS	1080 m3/d	1080 m3/d
7	Aerated MLSS	540 m3/d	540 m3/d
8	Permeate	108 m3/d	216 m3/d
9	UV Treated Effluent	108 m3/d	216 m3/d
10	Common UV Treated Effluent	216 m3/d	216 m3/d
11	Pumped Effluent	216 m3/d	216 m3/d
12	RAS from Membrane Tank	432 m3/d	432 m3/d
13	RAS from Membrane Tank to Process Tank	432 m3/d	432 m3/d
14	WAS from Membrane Tank	432 m3/d	432 m3/d
15	Effluent from CIP Tank for CIP	45 m3/d (over 30 min during CIP)	45 m3/d (over 30 min during CIP)
16	Pumped Effluent to Membrane Tank for CIP	45 m3/d (over 30 min during CIP)	45 m3/d (over 30 min during CIP)
17	Decanted Sludge Waste	approx 108 m3/d	approx 108 m3/d
⚠ I	Hypochlorite (10.3%)	1.2 m3/d Note 2	1.2 m3/d Note 2
II	Citric Acid (50%)	1.2 m3/d Note 2	1.2 m3/d Note 2
III	NaOH (25%) Alkalinity	0.17 m3/d Note 3	0.17 m3/d Note 3
A1	Combined Equalization Tank Air Note 1	220 m3/hr	220 m3/hr
A2	Individual Equalization Tank Air Note 1	110 m3/hr	110 m3/hr
B	Process Blower Air Note 1	153 m3/hr	153 m3/hr
C	Membrane Air Scour Air Note 1	254 m3/hr	254 m3/hr
D	Sludge Tank Air Note 1	50 m3/hr	50 m3/hr

Note 1 10% variation in the stated flows is acceptable

⚠

Note 2 Hypochlorite will dose 2.2 L + holdup volume over approximately 30 minutes during a CEB and 22L + holdup volume over approximately 30 minutes during a CIP; therefore, instantaneous flow is max 1.2 m3/d. Citric acid will dose over 22L + holdup volume over approximately 30 minutes during a CIP, i.e., instantaneous flow is max 1.2 m3/d. For hypochlorite, CEBs are conducted weekly (2.2 L x 48 cleans/year x 2 trains) and CIPs are quarterly (22 L x 4 cleans/year x 2 trains). For citric acid, CIPs are anticipated to be annual (22 L x 1 clean/year x 2 trains).

Note 3 NaOH will dose continuously while flow is entering the plant to regulate alkalinity and pH levels

DRAWING REVISION

REV	DATE (DD/MM/YY)	REVISION DESCRIPTION	DRAWN	CHKD	ENG	APPVD
1	07/07/2016	REVISE AS PER COMMENT	M.P.	H.S.	H.C.	H.C.
0	30/06/2016	PRELIMINARY	M.P.	H.S.	H.C.	H.C.

UNLESS NOTED OTHERWISE
INTERPRETATION: ANSI Y14.5
TOLERANCES: FRACTIONS ±; DECIMALS X.X ±0.030, X.XX ±0.015, X.XXX ±0.5°; ANGLES ±; HOLE SIZES; HOLE CENTERS
DO NOT SCALE PRINTS

MELIADINE STP

216 M3/DAY

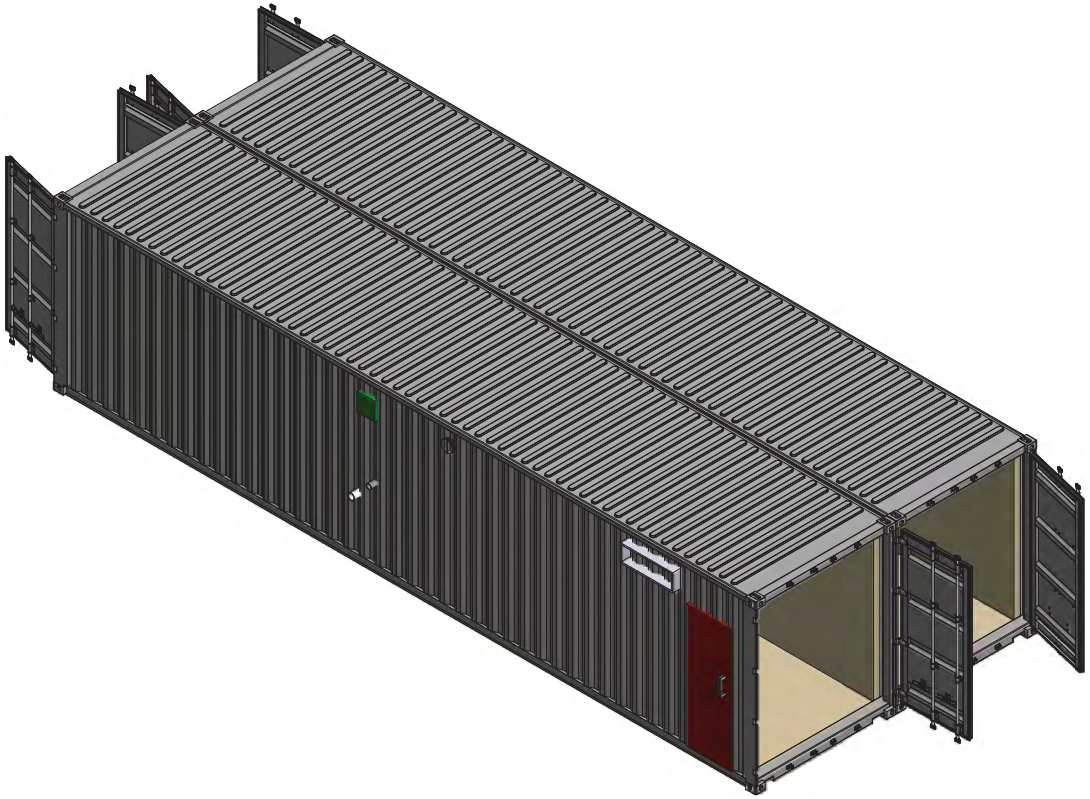
TITLE:
PROCESS FLOW DIAGRAM

SCALE: N/A

DRAWING NUMBER: U65875-C11-0001 SHEET: 2 of 2

REVISION: 1

9.3 - GENERAL ARRANGEMENT DRAWINGS



ISO VIEW

NOTES:

1. REFERENCE P&ID #U65875-C01-0001.
2. BOLTS AND NUTS ARE STAINLESS STEEL TYPE 316. WASHERS AND LOCK WASHERS ARE STAINLESS STEEL TYPE 316 PER ASTM F436 AND F844. MECHANICAL PROPERTIES PER CONDITION CW OF ASTM F593. DIMENSION PER ASME B18.2.1. THREADS PER ANSI B1.1 CLASS 2A.
3. STRUCTURAL STEEL WELDING AS PER CODE OF STANDARD PRACTICE, CSA W47.1 AND CSA W59.
4. NO VERTICAL DOWN WELDS ARE ALLOWED UNLESS CERTIFIED PER CSA W59 AND APPROVED BY H_2O INNOVATION.
5. STITCH WELDS ARE NOT ALLOWED UNLESS APPROVED BY H_2O INNOVATION.
6. HOLLOW STRUCTURAL STEEL SECTIONS PER ASTM A500, GRADE B.
7. STRUCTURAL CHANNEL, ANGLES, AND PLATE PER ASTM A36.
8. SAND BLAST FRAME TO SSPC-SP10 FINISH, ACCEPTABLE FOR POWDER COAT OR PAINTING.
9. APPLY ONE (1) COAT, WITH MINIMUM DRY FILM THICKNESS (DFT) PER COAT OF 4 TO 7 MILS, OF POLYAMIDE EPOXY PRIMER. PITT-GUARD 95-245 SERIES FROM PPF OR APPROVED EQUAL.
10. APPLY TWO (2) COATS, WITH MINIMUM DRY FILM THICKNESS (DFT) PER COAT OF 2 TO 3 MILS, OF ACRYLIC ALIPHATIC URETHANE PAINT. PITTHANE ULTRA 95-812 SERIES (TINTED TO MATCH RAL5010) FROM PPG OR APPROVED EQUAL. TO ACHIEVE FINAL 8 TO 13 MILS TOTAL DRY FILM THICKNESS.
11. ALL STAINLESS STEEL TO BE WELDED TO ASME B31.1, 100 PERCENT PENETRATION AND BACK GASSED WITH ARGON.
12. FINISHED FABRICATION OF STAINLESS STEEL SPOOLS MUST BE HYDROSTATICALLY TESTED TO 1.5 TIMES OPERATING PRESSURE. OPERATING PRESSURE SHALL BE XXX.
13. ALL PVC PIPE TO BE SCHEDULE 80, GRAY, U.N.O. PIPE MATERIAL TO CONFORM TO ASTM D1784. PHYSICAL DIMENSIONS, SCHEDULES, AND TOLERANCES TO CONFORM TO ASTM D1785.
14. ALL PVC FITTINGS TO BE SCHEDULE 80, GRAY. SOCKET FITTINGS TO CONFORM TO ASTM D2467.
15. PVC FLANGES 3" AND LARGER TO BE VAN STONE STYLE WITH GLASS FILLED PVC RING, U.N.O. PVC FLANGES 2-½" AND SMALLER TO BE VAN STONE STYLE WITH PVC RING, UNO PVC FLANGES TO MEET CLASS 150 BOLT HOLE PATTERN PER ANSI B16.5.
16. PVC PRIMER TO CONFORM TO ASTM F656. PVC SOLVENT CEMENT TO CONFORM TO ASTM D2564.
17. ALL GASKETS TO CONFORM TO ASTM F477.
18. FINISHED FABRICATION OF PVC/CPVC SPOOLS MUST BE HYDROSTATICALLY TESTED TO 50 PSI.
19. UNWITNESSED TEST REPORT MUST BE PROVIDED.
20. MATERIAL TEST REPORTS (MTR) TO BE PROVIDED FOR ALL MATERIAL.
21. APPROXIMATE SHIPPING WEIGHT: 225,537 LBS.

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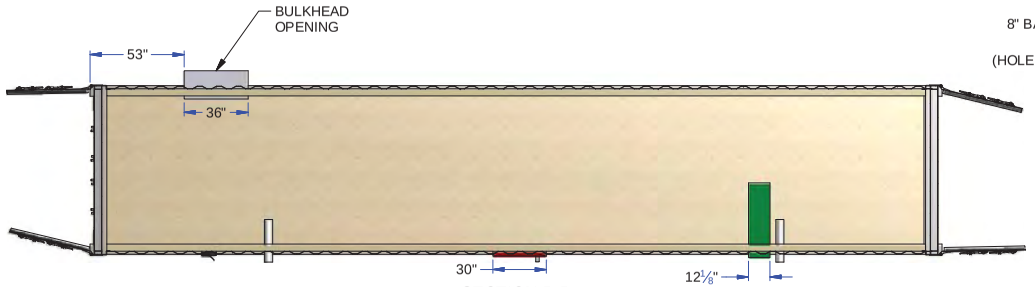
INTERPRETATION ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/--
DECIMALS: 0.X: ±0.03 / 0.XX: ±0.01 / 0.XXX: ±0.005
ANGLES: ±0.5°
HOLE SIZES: ±1/--
HOLE CENTERS: ±1/--
DO NOT SCALE PRINTS

MELIADINE, NU

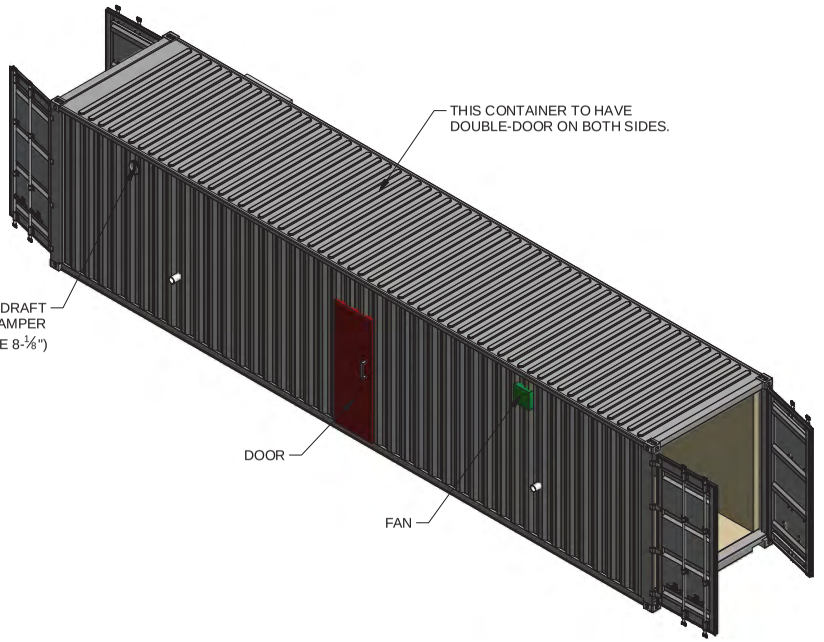
PROJECT NAME

TITLE:
WASTE WATER CONTAINER
GENERAL ARRANGEMENT

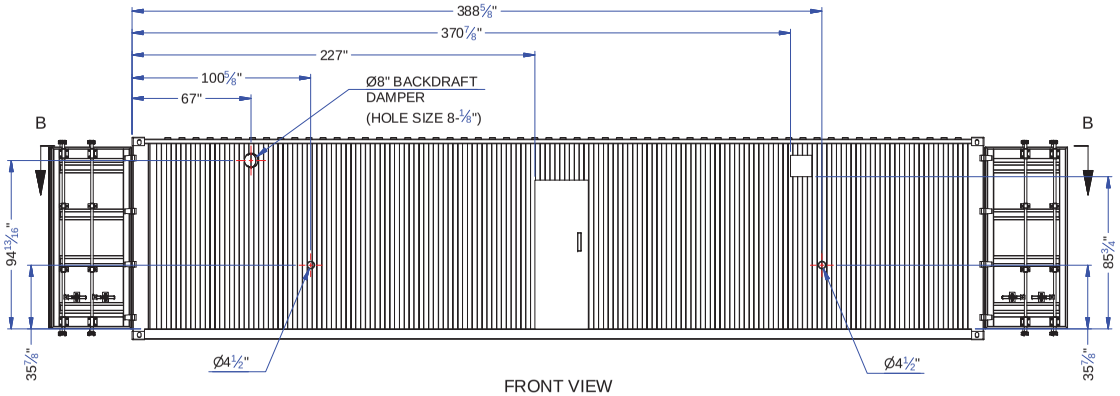
SCALE:	DRAWING NUMBER:	REVISION
N/A	U65875-B01-0001 SHEET: 1 OF 3	00



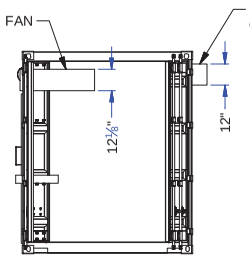
SECTION B-B



ISO VIEW
MEMBRANE TANK



FRONT VIEW



RIGHT VIEW

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INTERPRETATION ASME Y14.5
TOLERANCES
FRACTIONS: ±1/-
DECIMALS 0 PL: ±0.03
1 PL: ±0.01
2 PL: ±0.01
ANGLES: ±0.5°
HOLE SIZES: +/-
HOLE CENTERS: +/-
DO NOT SCALE PRINTS

MELIADINE, NU

PROJECT NAME

TITLE:
WASTE WATER CONTAINER
GENERAL ARRANGEMENT

SCALE:	DRAWING NUMBER:	REVISION
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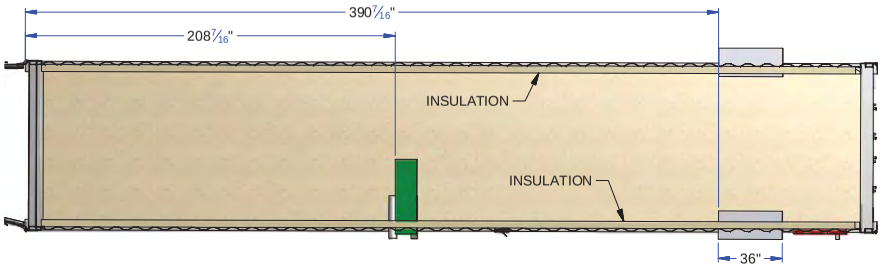
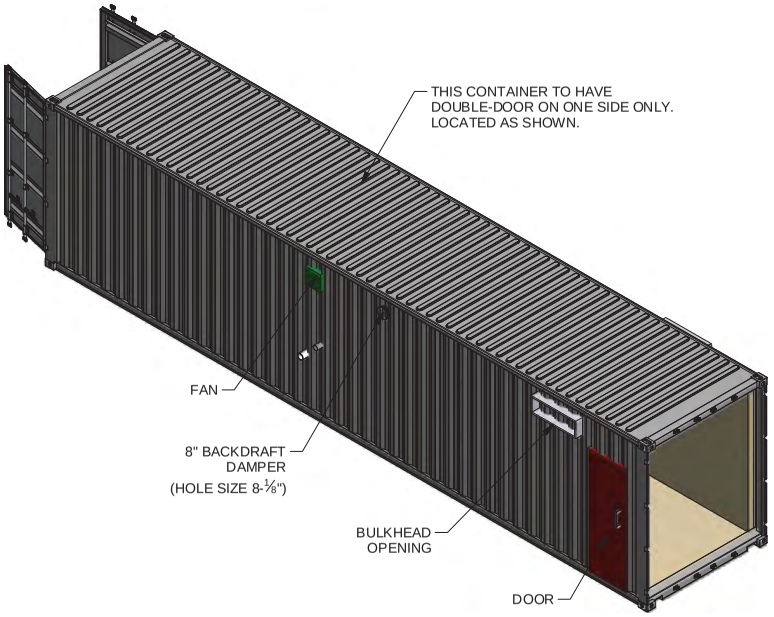
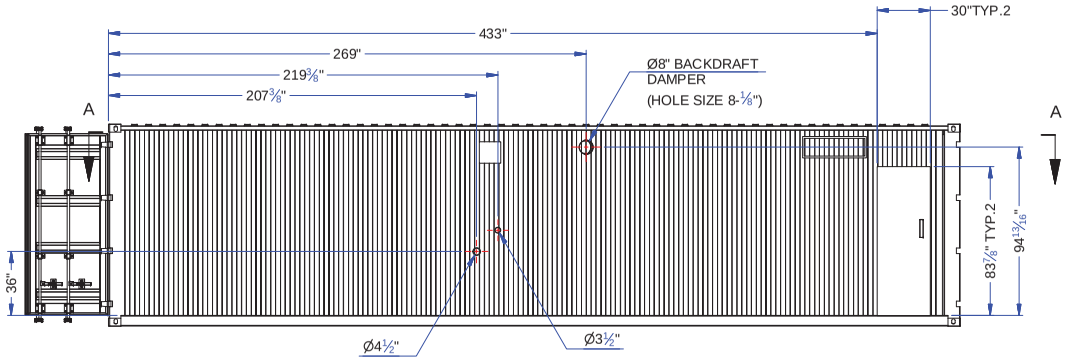


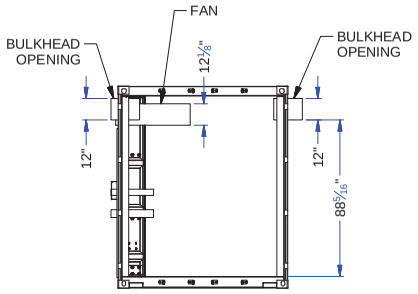
SECTION A-A



ISO VIEW
SLUDGE CONTAINER



FRONT VIEW



RIGHT VIEW

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INTERPRETATION ANSI Y14.5
TOLERANCES
FRACTIONS: ±1/--
DECIMALS 0.X: ±0.03
0.XX: ±0.01
0.XXX: ±0.005
ANGLES: ±0.5°
HOLE SIZES: +/-
HOLE CENTERS: +/-
DO NOT SCALE PRINTS

MELIADINE, NU

PROJECT NAME

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