City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Conceptual Design Report

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T001744A

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1 Introduction

1.1 Background

CIMA+ was retained by the City of Hamilton (City) to develop a long-term plan and conceptual design to implement upgrades to the Dundas Wastewater Treatment Plant (WWTP).

The Dundas WWTP is a conventional activated sludge facility with nitrification and tertiary filtration providing treatment to the community of Dundas. The facility is located at 135 King St E in Dundas, Ontario, and is owned and operated by the City of Hamilton. The plant has a rated capacity of 18,200 m^3/d (MECP, 2001; MECP, 2010). The existing influent diversion chamber is designed to bypass all flows exceeding 42,200 m^3/d as per existing Certificate of Approval Number 3-1040-99-006 (MECP, 1999). The plant discharges treated effluent to Cootes Paradise, via the Desjardin’s Canal.

The plant consists of two treatment trains referred to as Plant A and Plant B constructed in 1962 and 1977, respectively. Plant A has a rated capacity of 6,100 m^3/d, while Plant B has a capacity of 12,100 m^3/d (MECP, 2010). Peak flows exceeding the capacity of the plant are diverted to the Dundas Equalization Tank (HC060) which discharges to the catchment of the Woodward Avenue WWTP. The existing Dundas WWTP has capacity limitations and is reaching the end of its service life.

Recognizing the sensitivity of the Cootes Paradise, the City, in consultation with the Hamilton Harbour Remedial Action Plan (HHRAP), has identified more stringent effluent criteria to be adopted at the facility when it is upgraded.

CIMA+ completed a review of best available technologies (BAT) for treatment to meet the more stringent criteria and developed a facility upgrade plan culminating in this Conceptual Design Report (CDR).

1.2 Summary of Technical Memoranda

CIMA+ developed a series of technical memoranda (TMs) in support of the facility upgrade plan, summarizing background information, establishing the design basis, documenting the evaluation of alterative solutions and selection of the preferred design concept. The TMs are provided as appendices to this CDR, with brief synopses provided below.

It should be noted that cost estimates were developed throughout this project and presented in the various TMs as the design concept was refined. Any discrepancies between estimates in the various TMs are due to more detailed information being available as the project progressed. Furthermore, the cost estimates presented in this report were developed using the City's standard project budgeting procedure and assumptions.

Design Basis

This TM documents the findings of a review of historical data to establish the WWTP operating baseline and establish a design basis for the capacity assessment and evaluation of alternatives. The design basis includes average day and peak flows, wastewater quality characteristics, and proposed effluent limits and objectives. This TM is included in **Appendix A1.**

Effluent Criteria

This TM documents the proposed effluent objectives to be used as the design basis for upgrades to the Dundas WWTP, based on consultation with the Hamilton Harbour Remedial Action Plan (HHRAP) Cootes-Grindstone Water Quality Targets Sub-Committee and confirmation from the Ministry of Environment, Conservation and Parks (MECP). This TM is included in **Appendix A2.**

Long List of Alternatives

This TM documents the evaluation of a long list of best available technologies (BAT) that were considered to upgrade the Dundas WWTP. This TM is included in **Appendix A3.**

Evaluation of Alternative Design Concepts

This TM documents the development and evaluation of alternative design concepts and the selection of a preferred design concept to upgrade Dundas WWTP. The alternative design concepts consisted of a combination of the shortlisted BAT in the Long List of Alternatives TM. Of the two shortlisted technologies for biological treatment (i.e., MBR and AGS), MBR was deemed preferred given site space constraints and the need to incorporate membrane filtration to achieve the stringent total phosphorus targets. This TM is included in **Appendix A4.**

Evaluation of Alternative Site Layouts

This TM documents the evaluation of two alternative site layouts to implement the preferred design concept, as determined and documented in the previous TM. This TM is included in **Appendix A5.**

Denitrification

This TM documents the evaluation of denitrification needs at the Dundas WWTP, completed by developing a BioWIN model for the proposed MBR WWTP. Various steady state scenarios were modelled with varied design parameters evaluated for nitrogen removal from the plant, while confirming that operating parameters and treatment objectives continues to be met as per TM: Design Basis and TM: Evaluation of Alternative Design Concepts. This TM is included in **Appendix A6.**

1.3 Purpose

The purpose of this conceptual design report (CDR) is to:

- Define the design basis for the Dundas WWTP upgrade;
- Describe the design components of each process area and related building mechanical, structural, architectural, and electrical requirements;
- Present a high-level implementation plan that addresses approvals requirements, construction sequencing, major tie-ins, and a schedule for design and construction; and,
- Provide a capital cost estimate for the Dundas WWTP upgrade.

2 Design Basis

2.1 Design Flows

Historical data plant flow and raw wastewater concentration data from 2017 to 2021 was reviewed and analyzed to develop a design basis. The design basis was confirmed after consultation with the HHRAP as documented in the *Effluent Criteria TM* (CIMA+, 2023). The facility would be designed to maintain its current rated capacity of 18,200 m^3/d. However, the proposed treatment processes would be designed to provide increased capacity during peak flow conditions. The recommended design flows for the upgraded Dundas WWTP are presented in **Table 2-1** below.

Table 2-1: Proposed Design Flows

Parameter	Design Value	Unit
Average Day Flow	18,200	m^3/d
Maximum Month Flow	22,750	m^3/d
Maximum Daily Flow	31,850	m^3/d

Parameter	Design Value	Unit
Peak Hourly Flow	36,400	m^3/d
Peak Instantaneous Flow (1)	42,200	m^3/d
Notes: 1. The existing influent diversion chamber is designed to bypass all flows exceeding 42,200 m^3/d as per existing Certificate of Approval Number 3-1040-99-006 (MECP, 1999).		

2.2 Design Wastewater Characteristics

The proposed design concentrations are presented in **Table 2-2.** These values are based on historical data averages.

Table 2-2: Proposed Design Concentrations and Loadings

Parameter	Design Value
Carbonaceous Biological Oxygen Demand ($cBOD_5$)	158 mg/L
Total Suspended Solids (TSS)	224 mg/L
Total Phosphorus (TP)	5 mg/L
Total Kjeldahl Nitrogen (TKN)	34 mg/L
Temperature	15 °C
Alkalinity	200 mg/L as $CaCO_3$

It should be noted that no data was available on influent alkalinity. It is recommended that a full wastewater characterization be completed during the design phase.

2.3 Effluent Criteria

The effluent objectives and limits are subject to approval by the Ministry of Environment, Conservation and Parks (MECP). However, the proposed effluent criteria have been accepted in principle by the HHRAP Cootes Paradise Subcommittee and the Royal Botanical Gardens (RBG) (see **Appendix A2**). The proposed effluent criteria include stringent ammonia and total phosphorus treatment objectives. Total nitrogen (TN) removal would not be required during the initial upgrades. However, the proposed conceptual design includes allowances to remove some TN. This is in line with the

City's goals of environmental stewardship and implementing advanced technologies at their facilities.

The proposed design criteria are presented in **Table 2-3.**

Table 2-3: Proposed Design Effluent Limits and Objectives

Parameter	Proposed Objective	Unit
$cBOD_5$	3.0	mg/L
TSS	2.0	mg/L
TP	0.05	mg/L
TAN May 1 – October 31 November 1 – April 30	 0.3 0.5	 mg/L mg/L
Total Residual Chlorine (May 1 to October 31)	0.00	mg/L
E. coli (2) (May 1 to October 31)	100	organisms per 100 mL
pH	6.0 to 9.5	-
Notes: 1. Based on monthly average for all parameters except for E. coli, which is based on monthly geometric mean density.		

3 Conceptual Design

3.1 Process Design

Conceptual equipment sizing and specifications for each unit process are provided below. The design concept is based on a single technology for each process. A technology was adopted for the purposes of this CDR to facilitate site layout and cost estimation. Further review of alternative technologies is recommended during preliminary design to confirm the preferred technologies for each unit process.

3.1.1 Overall Process Description

The new process facilities would be constructed east of the existing plant site in the area currently occupied by Martino Park. The new treatment facilities would be constructed while the existing plant continues to operate.

The proposed upgrades would include the following:

- Modifications to influent sewers
- Modifications to the existing Influent Diversion Chamber
- New Sewage Pumping Station (SPS) and forcemain
- New Headworks Facility complete with screening and grit removal
- New Odour Control Facility
- New Chemical Storage
- New Membrane Bioreactor (MBR) trains (including aeration tanks and membrane filtration system)
- New UV disinfection system
- New sludge handling facility and storage tanks
- New gravity sewer connection to existing outfall
- New Centre of Excellence and Administration Building
- New Maintenance Facility

A process flow diagram is included in the conceptual design drawing set in **Appendix B.**

When the new treatment facilities are commissioned, the existing King Street SPS, Plant A and Plant B can be decommissioned, and the existing site may be repurposed to construct a new distribution yard and/or to accommodate future plant capacity expansions.

3.1.2 Hydraulic Profile

The conceptual hydraulic profile of the proposed plant upgrade is included in **Appendix B.**

The 375 mm diameter sewers discharging to the King Street SPS would be diverted to discharge to the proposed new SPS. The SPS would discharge via forcemain to the existing Influent Diversion Chamber. A new gravity sewer would be constructed to direct flows from the Influent Diversion Chamber to the new Headworks. Wastewater would be screened and degritted and then would flow by gravity to the new aeration tanks in the MBR facility. Permeate from the MBR facility would be pumped to a new UV disinfection facility and then would be conveyed by gravity to the existing outfall at Desjardins Canal.

3.1.3 Flow Measurement

Plant flow would be measured at three locations in the treatment process:

- Flow pumped by the new SPS would be measured with a magnetic flow meter, located on the forcemain in the station.
- The flow from the headworks to the aeration tanks would be measured with a flow meter located in a chamber in the yard.
- The final effluent would be measured by a effluent Parshall flume, located downstream of the UV disinfection system.

Additionally, flow measurement would be provided for:

- Air flow rate from blower to each aeration tank;
- Sludge flow rate at discharge of each RAS/WAS pump;
- Sludge flow rate on the common RAS/WAS discharge header prior to the sludge storage tanks; and,
- Sludge flow rate from storage tanks to disposal trucks.

3.1.4 Influent Sewage Pumping Station and Influent Diversion Chamber

3.1.4.1 Design Overview

The SPS would convey flows currently pumped by the King Street SPS to the Influent Diversion Chamber. The SPS would consist of a rectangular structure with a below-grade wet well to house three submersible pumps.

Key features of the SPS include:

- Three submersible chopper pumps in a two duty/one standby configuration;
- All valves located in a below-grade valve room to provide non-restricted access to pump isolation valves and flow meter;
- An above grade bypass blind flanged connection;
- Stainless Steel 316L discharge pipe, in accordance with the City’s standards to provide enhanced corrosion resistance;
- Access hatch above each pump with davit arms for pump maintenance;
- A passive odour control system capturing odorous air vented from the wet well; and,
- Separate electrical room with exterior access only.

The SPS would consist of a substructure and a superstructure. The substructure would consist of two separate below grade structures: a wet well and a valve chamber. A 575 mm diameter concrete pipe would convey influent to the wet well. The pumps would convey the wastewater to a common 250 mm diameter discharge header, which would transition to a 300 mm diameter forcemain discharging to the existing Influent Diversion Chamber. Each pump would have an individual discharge header with a non-rising knife gate to provide isolation.

3.1.4.2 Design Basis and Specifications

The design basis and specifications for the SPS are presented in **Table 3-1**. An equipment cutsheet is included in **Appendix C1.**

Table 3-1: SPS Design Basis

Parameter	Design Value	Unit
Peak Instantaneous Flow	21,430	m^3/d
Pumps		
Number of Pumps	3 (2 duty, 1 standby)	-
Type	Chopper Type Submersible	-
Pump Capacity, per pump	124	L/s
TDH	15.1	m
Rated Power, per pump	26 (35)	kW (hp)
Control	VFD	-
Wet Well		
Volume	161.6	m^3
Discharge Header / Forcemain		
Diameter[1]	250 – 300	mm
Material	Stainless steel 316L/PVC beyond SPS	-

Notes:

1. Diameter of discharge header in wet well to be 250 mm with an increaser to a 300 mm diameter forcemain.

3.1.4.3 Operating Philosophy and Instrumentation

Pump start, stop and speed would be automatically controlled based on wet well level setpoints and level readings from a level transmitter in the wet well. Float back-up controls consistent with the City’s design standards would also be provided.

3.1.5 Headworks

3.1.5.1 Design Overview

The raw wastewater would flow from the Influent Diversion Chamber to the inlet of the Headworks facility by gravity. The Headworks would provide pre-treatment to remove rags, larger objects, grit and other particles from the influent to protect downstream pumps, valves, pipes, and other equipment from damage and clogging.

The design concept involves fine screening (6 mm opening) followed by grit removal, and then by finer screening (2 mm opening). The screening systems would be equipped with washer compactors and screenings conveyance systems and the grit removal system would include a grit classifier system. The Headworks would be sized to provide firm capacity, i.e., each screen and grit removal system would have the capacity to ability to handle the design peak instantaneous flows. A bypass channel bypassing flows through to a manually cleaned bar screen would be provided.

The Headworks would consist of the following components:

- Two fine screens (6 mm opening), each complete with a washer compactor;
- One manual screen;
- One screenings conveyor;
- Two vortex grit tanks, each complete with a grit pump and grit classifier;
- Two band screens with provisions for a future third band screen;
- One washer compactor for two band screens;
- One odor control unit;
- Two channel mixing blowers;
- A utility water connection and hose station for washdown; and,
- Disposal bin areas.

Screenings and dewatered grit would be discharged to disposal bins located on the lower level of the Headworks facility. An access platform for inspection and maintenance of the screens would be provided.

The new Headworks facility would be a single storey building with a basement. The ground level would consist of the process area, an electrical room, and a mechanical room. The process area would consist of a lower level, flush with the exterior driveway, and an upper level, raised approximately 1 m. The electrical and mechanical rooms would be on the upper level of the process area.

The inlet channel would split into three parallel channels for fine screening, with the middle channel equipped with a manually cleaned bar screen. The fine screens and their associated washer / compactor units would be located on the upper level of the process area. The screenings would be conveyed to the disposal bins on the lower level.

The two grit removal units would be located downstream of the screen channels. Grit pumps would be located below the tanks within a pump room in the basement of the Headworks facility. The grit pumps would convey grit to the grit classifiers located on the lower level of the process area. Screenings from the fine screens and grit would discharge into a common screw conveyor to the disposal bins in the bin room of the facility. A separate bin room would capture screenings from the extra fine screens.

Downstream of the grit removal units, there would be three channels for band screens. The middle channel would allow for future installation of a third band screen. The band screens and their associated washer / compactor units would be located on the upper level of the process area. The screenings would be conveyed to disposal bins on the lower level.

An odour control unit and fan would be located in the process area on the upper level.

To mitigate the risk of surcharge of the membrane tanks during a power failure, a bypass chamber would be located between the Headworks discharge and the flow meter chamber upstream of the Aeration Tanks to allow flow to be diverted to the existing Equalization Tank east of the site.

Conceptual design drawings are provided in **Appendix B.**

3.1.5.2 Design Basis and Specifications

Fine Screening

The design basis and specifications for the perforated fine screens and manual screen are presented in **Table 3-2.** Equipment cutsheets are included in **Appendix C2.**

Table 3-2: Fine Screening Design Basis

Parameter	Design Value	Unit
Average Day Flow	18,200	m^3/d

Parameter	Design Value	Unit
Peak Instantaneous Flow	42,200	m^3/d
Design Peak Flow, per screen	42,200	m^3/d
Downstream Water Depth At ADF At PIF	 0.48 0.78	 m m
Perforated Fine Screens		
Number of Screens	2 (2 duty)	-
Rated Capacity, per screen	42,200	m^3/d
Type of Screen	Perforated Fine	-
Screen Opening	6	mm
Screen Channel Width	1.524	m
Screen Channel Depth	1.50	m
Angle of Screen Inclination	60	degrees
Upstream Water Depth at PIF and 50% Blinding	1.26	m
Screen Power, per screen	0.74 (1)	kW (hp)
Manual Screen		
Number of Screens	1	-
Rated Capacity, per screen	42,200	m^3/d
Type of Screen	Bar	-
Bar Spacing	12.7	mm
Screen Channel Width	1.524	m
Screen Channel Depth	1.50	m
Angle of Screen Inclination	60	degrees
Washer / Compactor		

Parameter	Design Value	Unit
Number of Units	2 (1 / screen)	-
Loading Capacity	2	m^3/hr
Volume Reduction	Up to 70	%
Dryness	Up to 60	%
Organics Reduction	Up to 90	%
Washer / Compactor Power, per unit	1.5 (2)	kW (hp)
Screenings Conveyor		
Number of Unit	1	-
Type of Conveyor	Shaftless Screw	
Transport Mode	Pushing	
Solids Loading Capacity	2.4	m^3/hr

Grit Removal

The design basis and specifications for the vortex grit tanks are presented in Table 3-3. An equipment cutsheet is included in **Appendix C2.**

Table 3-3: Grit Removal Design Basis

Parameter	Design Value	Unit
Average Day Flow	18,200	m^3/d
Peak Instantaneous Flow	42,200	m^3/d
Design Peak Flow, per screen	42,200	m^3/d
Number of Grit Tanks	2 (1 duty / 1 standby)	-
Grit Tank Rated Capacity, per tank	42,200	m3/d
Type of Grit Tank	Vortex	-
Grit Tank Diameter	3.5	m

Parameter	Design Value	Unit
Grit Tank Upper Chamber Depth	2.43	m
Grit Tank Lower Chamber Depth	1.83	m
Grit Removal Efficiency	95% of grit greater than 50 mesh size 85% of grit greater than 70 mesh but less than 50 mesh and 65% of the grit greater than 100 mesh but less than 70 mesh	
Grit Agitator Power, per tank	5.6 (7.5)	kW (hp)
Head Loss at Peak Flow	78	mm
Grit Pumps		
Number of Pumps	2 (1 / tank)	-
Grit Pump Rated Capacity, per pump	13	L/s
Grit Pump Head, per pump	12.0	m
Grit Pump Power, per pump	7.5 (10)	kW (hp)
Grit Classifiers		
Number of Grit Classifiers	2	-
Extraction Flow from Grit Pump	13	L/s
Grit Recovery c/w 200 Mesh Particles	95	%
Inlet Pressure Drop	8.5	psi
Hopper Hydraulic Capacity	51	m^3/hr
Solid Handling Capacity	3	m^3/hr
Grit Classifier Power, per classifier	Min. 1.5	kW

Extra-Fine Screening

The design basis and specifications for the band screens are presented in **Table 3-4.** An equipment cutsheet is included in **Appendix C2.**

Table 3-4: Extra-Fine Screening Design Basis

Parameter	Design Value	Unit
Average Day Flow	18,200	m3/d
Peak Instantaneous Flow	42,200	m^3/d
Design Peak Flow, per screen	42,200	m^3/d
Downstream Water Depth, at PIF	0.60	m
Number of Screens	2 (2 duty with third channel for future expansion)	-
Rated Capacity, per screen	42,200	m^3/d
Type of Screen	Band	-
Screen Opening	2	mm
Screen Channel Width	1.524	m
Screen Channel Depth	1.83	m
Upstream Water Depth at PIF and 50% Blinding	1.1	m
Screen Power, per screen	1.5	kW
Washer Compactor		
Number of Washer Compactors	1 (for two band screens)	-
Loading Capacity	2	m^3/hr
Volume Reduction	Up to 70	%
Dryness	Up to 60	%
Organics Reduction	Up to 90	%
Washer / Compactor Power, per unit	1.5 (2)	kW (hp)

Channel Mixing Blowers

The specifications for the channel mixing blower are presented in **Table 3-5.**

Table 3-5: Channel Mixing Blowers Design Specifications

Parameter	Design Value	Unit
Number of Blowers	2 (1 duty / 1 standby)	-
Rated Capacity, per blower	100	Sm^3/hr
Type of Blower	Positive Displacement	-
Blower Power, per blower	3.7	kW

3.1.5.3 Operating Philosophy and Instrumentation

Fine Screens

Raw wastewater would flow into a new inlet channel and split between the parallel fine screening channels. Each screening channel would be equipped with an inlet and outlet isolation gate. The number of fine screens on-line would be based on flow set-points to maintain hydraulic capacity, minimize screen wear, and maximize channel velocities.

Influent would flow through the fine screen and screened solids would be discharged into the hopper of a washer/compactor unit. The screenings would be washed and then pressed through a discharge chute for dewatering before conveyance to disposal bins.

Operation of the screen wash system would be automatically initiated based on an operator adjustable wastewater level differential across the screen or a pre-set time between cycles. The cleaning system could also be set to operate continuously. The operator would be able to select the operating mode and adjust settings via a local control panel (LCP) or through the plant SCADA system. Once a screen wash cycle is initiated, the washer/compactor unit and duty conveyors would automatically start and remain operational until the end of the cycle.

Grit Removal

Screened influent wastewater would be directed towards the vortex grit removal tanks. Circular flow within the tanks would be induced by a propeller enhancing the vortex pattern causing denser grit to drop out to the hopper at the bottom of each tank. The grit tanks would be put in service as required, by opening the actuated inlet and outlet gates automatically and starting the propeller drive, based on the influent flows. The influent flow would be calculated based on the inlet channel levels prior to entering Headworks.

The grit slurry would be pumped to two grit classifiers which separate the organics and excess water from the grit and convey the grit to conveyors discharging into disposal bins.

The grit pumping cycle would be initiated by the plant SCADA system based on an operator-adjustable timer or totalized flow (i.e., more frequent grit removal during storm events). The time between cycles would be set to minimize plugging of the grit tank hoppers. The operation of the grit classifiers would be synchronized with the grit pumps.

Extra-Fine Screens

Screened and degritted influent wastewater would be directed to the band screens. Each screening channel would be equipped with an inlet and outlet isolation gate. The number of band screens on-line would be based on flow set-points to maintain hydraulic capacity, minimize screen wear, and maximize channel velocities.

Influent would flow through the band screen and screened solids would be discharged into the hopper of a washer/compactor unit. The screenings would be washed and then pressed through a discharge chute for dewatering before conveyance to disposal bins.

Operation of the screen wash system would be automatically initiated based on an operator adjustable wastewater level differential across the screen or a pre-set time between cycles. The cleaning system could also be set to operate continuously. The operator would be able to select the operating mode and adjust settings via a local control panel (LCP) or through the plant SCADA system. Once a screen wash cycle is initiated, the washer/compactor unit and duty conveyors would automatically start and remain operational until the end of the cycle.

3.1.6 Odour Control

3.1.6.1 Design Overview

Odourous air would be collected from the Headworks’ inlet, screening channels, and grit removal influent and effluent channels.

An odour control unit (OCU) would be located in the Headworks facility. An evaluation will be required during detailed design to confirm the preferred odour control technology.

Channels and effluent launders would be covered with gasketed checkered plate to minimize the amount of odourous air being released into the environment. Channel mixing would be provided within the Headworks channels to prevent the deposition of solids and reduce the potential for odour generation.

3.1.6.2 Design Basis and Specifications

The design basis and specifications for the odour control unit are presented in **Table 3-6.**

Table 3-6: Odour Control Design Basis

Parameter	Design Value	Unit
Design Average / Peak Inlet H_2S Conc.	10 / 20	ppm
Inlet Air Temperature	8 to 15	°C
Inlet Relative Humidity	30 to 90	%
Type of Odour Treatment	Carbon Adsorber	-
Number of Units	1	-
Odorous Air Flow Rate	3,600	m^3/hr
H_2S Removal Efficiency	99% removal when inlet H2S concentration is in the range of 1-20 ppm 5 ppm average concentration	
Carbon Bed		
Type	Carbon Filter, Single Bed	-
Material of Construction	FRP Tower	-
Number of Units	1	-
Maximum Pressure Drop	< 75	mm WC
Contact Time	3	Sec
Number of Fan	1	-
Fan Power	5.6 kW, 575/3/60	

3.1.6.3 Operating Philosophy and Instrumentation

The odour control unit would draw air from the headspace in the covered channels and grit removal tanks and treat it before releasing to the environment. The odour control unit would be designed to operate continuously and would be monitored and controlled through the plant SCADA system.

3.1.7 Membrane Bioreactor Biological Treatment System

3.1.7.1 Design Overview

After screening and grit removal, the wastewater would flow into a channel, where it would be split between the three aeration tanks. Treated water from the aeration tanks would enter the MBR cassettes tanks.

Permeate from the MBR system would be forced through the membranes via permeate pumps and directed to a backpulse tank. Recycle pumps return the sludge from the membrane cassette tanks to the aeration tanks, where it would be mixed with the incoming influent screened wastewater. Excess sludge would be wasted from the system to the sludge storage tank using recycle pumps.

Aeration blowers would be housed in a new Blower Building located north of the aeration tanks, directly adjacent to Aeration Tank no. 1. The Blower Building would consist of a single floor at ground level. The building would consist of three independent rooms, the mechanical room, the aeration blower room, and the chemical room for ferric sulphate. Each room would only be accessible by exterior doors. The aeration blower room would also have access to the walkways surrounding the aeration tanks.

A new Membrane and UV Building would be located east of the aeration tanks. The building consists of two floors, a ground level and a basement. The entire basement comprises the MBR pump room, which houses the permeate pumps, RAS / WAS pumps, process piping, and air compressors. There are two stairwells which provide access. The upper level consists of two parts, the membrane equipment part and the UV disinfection part. The main floor would include the membrane cassette tanks, an electrical room, a MBR blower room, a chemical room, and two stairwells that provide access to the basement.

The biological treatment system would have the volumes noted in **Table 3-7** below.

Table 3-7: MBR Tank Volumes

Tank	No. of Tanks	Volume per Tank (m^3)	Total Volume (m^3)
Aeration Tank	3	3,000	9,000
Membrane Tank	4	158	634

Tank	No. of Tanks	Volume per Tank (m^3)	Total Volume (m^3)
Backpulse Tank	1	188	188

It should be noted that this conceptual design is based on equipment information provided by Veolia Water Technologies. It is recommended that an evaluation of alternative MBR technologies be conducted during the design phase.

3.1.7.2 Design Basis and Specifications

Aeration Tanks

The drawings included in **Appendix B** show three aeration tanks in a single pass configuration. However, an evaluation should be conducted during the design phase to assess the merits of three-pass aeration tanks.

Each tank would have a small swing anoxic selector zone for filamentous bacteria mitigation that makes up 600 m^3 (20%) of each tank. The swing anoxic zone requires mixing to sufficiently suspend and distribute solids. The provision of a swing anoxic zone has the benefit of reducing aeration requirements and improving sludge settleability. The aeration tanks are proposed to have a 6 m SWD to minimize footprint. The aeration tanks were conservatively sized for an MLSS concentration of 6,000 mg/L.

The Denitrification TM in **Appendix A6** includes additional discussion on potential options to size the anoxic volume and return rate to enhance denitrification.

The design basis and specifications for the aeration tanks are presented in **Table 3-8.**

Table 3-8: Aeration Tanks Design Basis

Parameter	Design Value	Unit
Average Day Flow	18,200	m^3/d
Solids Retention Time (SRT)	18	days
Mixed Liquor Suspended Solids Concentration	6,000	mg/L
Maximum RAS Rate	100%	-
BOD Yield	1.16	g TSS / g BOD
WAS Production at ADF	3,338	kg/d
Number of Tanks	3	-

Parameter	Design Value	Unit
Type of Tank	Rectangular	
Tank Configuration	3	passes per tank
Dimensions L W SWD	 46 12 6	 m m m
Total Volume, per tank	3,000	m^3
Swing Anoxic Zone	20% of tank volume	-
Anoxic Volume, each tank	600	m^3
Aerobic Volume, each tank	2,400	m^3
Submersible Mixers		
Number of Mixers, each anoxic zone	1	-
Anoxic Zone Mixer Power, each	11	kW

Aeration System

The design biological oxygen demands are summarized below in **Table 3-9.** The aeration system design is based on oxygen demands at average day BOD_5 and TKN loading. The air demands were developed to allow for efficient blower turndown over the full range of operating conditions.

Table 3-9: Air Flow Design Basis

Parameter	Minimum	Average	Peak	Unit
Total Oxygen Demand	119	238	501	kg/hour
Air Requirement	3,100	6,200	13,200	Sm^3/hour

Notes:

1. Minimum oxygen demand based on average design loading with a minimum diurnal peaking factor of 0.5.

2. Peak oxygen demand based on maximum month design loading (cBOD5 peaking factor of 1.4 and TKN peaking factor of 1.6) with a maximum diurnal peaking factor of 1.4.

MECP guidelines establish minimum air requirements to provide adequate mixing in aeration tanks. For aeration tanks with fine bubble diffusion, the minimum mixing air requirements are 0.61 L/m^{2}s (MECP, 2008). The corresponding minimum air requirement for the new aeration tanks would be 3,300 Sm^3/hour. As shown in the air flow design basis in **Table 3-9** above, the minimum air provided for process demands would not provide sufficient mixing to satisfy MECP requirements. Thus, the minimum air demand is governed by mixing requirements.

Air supply to the aeration tanks would be provided by four blowers (three duty and one standby), on the main floor of the new Blower Building. The conceptual design was based on the use of dual core high speed turbo blowers (HSTB). However, further technology evaluation is recommended during preliminary design to confirm preferred technology. The aeration tanks would be furnished with fine bubble membrane disk diffusers connected to the air piping system to deliver the air throughout the tanks. The process blower and air piping specifications are summarized in **Table 3-10** below.

Table 3-10: Process Blower and Air Piping Specifications

Parameter	Design Value	Unit
Blowers		
Number of Blowers	4 (3 duty / 1 standby)	-
Type of Blower	Turbo	-
Motor Power, each	112 (150)	kW (hp)
Capacity (Air Flow Rate), each	4,400	Sm^3/hour
Inlet Pressure	99	kPa
Diffusers		
Diffuser Type	9” Fine bubble disc	-
Diffuser Size	2	mm
Number of Diffusers, per tank	392	-

Parameter	Design Value	Unit
Piping Material	PVC Sch. 40 c/w SS Supports	

Membrane Cassette Tanks

The membranes separate the sludge portion of the wastewater from the liquid treated portion. There would be four MBR cassette tanks, sized to provide firm capacity for maximum month flow.

Each membrane cassette tank would be provided with a motor-operated inlet sluice gate, an energy dissipating baffle, two membrane cassettes, level instrumentation, and a motor-operated outlet sluice gate.

The design basis and specifications for the membrane cassette tanks are presented in **Table 3-11**. Additional equipment information is included in **Appendix C3.**

Table 3-11: Membrane Design Basis

Parameter	Design Value	Unit
Average Day Flow	18,200	m^3/d
Maximum Daily Flow	31,850	m^3/d
Peak Hourly Flow	36,400	m^3/d
Design Flow, per 3 tanks	22,750	m^3/d
Aerobic SRT	20	days
MLSS Concentration	8,000	mg/L
Number of Tanks	4	-
Tank Dimensions L W SWD	 16.40 2.44 3.96	 m m m
Tank Volume	158	m^3
Number of Cassettes, per tank	6	-
Number of Modules, per cassette	64	-
Type of Cassette	ZW500EV	-

As part of the membrane system scope of supply, two (1 duty + 1 standby) compressors with dryers would be provided. These compressors would provide air for the membrane system's pneumatically-operated valves any other pneumatically-operated equipment in the plant. These units would be located in the Membrane Equipment and Disinfection Building.

Scour Blowers

Four scour blowers would be located in the Membrane Equipment and Disinfection Building. Each blower would provide scour for one of the membrane tanks.

The design specifications for the scour blowers are presented in **Table 3-12.** An equipment cutsheet is included in **Appendix C3.**

Table 3-12: Scour Blower Design Specifications

Parameter	Design Value	Unit
Number of Blowers	4 (3 duty / 1 standby)	-
Type of Blower	Positive Displacement	
Capacity	3,000	Sm^3/hr
Motor	82 (110)	kW (hp)

Permeate Pumps and Backpulse Tank

As noted above, this conceptual design is based on equipment information provided by Veolia Water Technologies. The permeate pump system consists of four pumps, one per membrane train. These pumps would pull biologically treated effluent through the membrane cassettes and discharge permeate to the backpulse tank.

The design specifications for the permeate pumps and backpulse tank are presented in **Table 3-13** and **Table 3-14**, respectively. An equipment cutsheet is included in **Appendix C3.**

Table 3-13: Permeate Pumps Design Specifications

Parameter	Design Value	Unit
Number of Pumps	4 (4 duty)	-
Type of Pump	Rotary Lobe	-

Parameter	Design Value	Unit
Instantaneous Permeate Flow at ADF, per train	63	L/s
Instantaneous Permeate Flow at PHF, per train	147	L/s
Power, per pump	56 (75)	kW (hp)
TDH	1.5 – 10.7	m

Table 3-14: Backpulse Tank Design Specifications

Parameter	Design Value	Unit
Number of Tanks	1	-
Tank Dimensions		
L	16.81	m
W	2.45	m
SWD	4.50	m
Tank Volume	185	m^3

RAS / WAS Pumps

The design specifications for the RAS / WAS pumps are presented in **Table 3-15.** An equipment cutsheet is included in **Appendix C3.**

Table 3-15: RAS/WAS Pumps Design Specifications

Parameter	Design Value	Unit
Number of Pumps	4 (1 per tank)	-
Type of Pump	Centrifugal	-
Capacity	244	L/s
Head	2.4 – 3.6	m TDH
Power	30 (40)	kW (hp)

3.1.7.3 Operating Philosophy and Instrumentation

Aeration Tanks

Each aeration tank would be equipped with a swing anoxic/aerobic zone. Submersible mixers would be provided in each anoxic zone. The design would allow for two different operating modes:

- In Aerobic mode, all mixers would be off, and the tank would be mixed and aerated using the aeration blowers and air delivery system.
- In Anoxic mode, all mixers would be on to mix the anoxic zone and the air control valve supplying the swing zone diffusers would be closed. This mode is expected to be the normal operation mode of the aeration tanks.

Aeration System

Each aeration blower would be equipped with a dedicated local control panel complete with Programmable Logic Controller (PLC) controlled by one Master Control Panel (MCP) located in the Blower Building.

Four control modes would be available for process aeration:

- **Dissolved Oxygen (DO) Control via Calculated Target Air Flow (Compound Loop):** This control strategy would seek to maintain a set dissolved oxygen concentration in the aeration tank. The measured DO concentration within the tank would modify the air flow set point, and the measured air flow would modulate the control valve position. The set point for the air flow control loop would be cascaded from the DO control loop.
- **Dissolved Oxygen (DO) Control via Direct Position Control (Step Control):** This control strategy would maintain a set dissolved oxygen concentration in the aeration tanks by controlling the flow control valve position, which ultimately would modify the air flow supplied to each zone. This mode of control can be used when the associated air flowmeter is out of service for maintenance or during startup of a tank.
- **Fixed Air Flow Control:** This control strategy would maintain a fixed air flow set point to the aeration tank. A Target Fixed Air Flow Setpoint would be entered by the operator at the SCADA HMI, and the control valve would be modulated to maintain this air flow rate to aeration tank. This mode of control can be used when DO probe is out of service for maintenance or during startup of a tank. In the fixed air flow mode, the air flow setpoint would be copied from a diurnal air flow setpoint table. This control mode would allow operators to input a typical diurnal air flow pattern for each tank and pass.

- **Ammonia Based Aeration Control:** This control strategy would maintain a TAN set point in the aeration tanks. The measured TAN within the tank would modify the DO set point, and the DO concentration within the tank would ultimately modify the air flow set point. The set point for the air flow control loop would be cascaded from the DO control loop and the set point for the DO control loop would be cascaded from the TAN control loop.

Consideration should be given to the installation of N_2O monitoring sensors to provide the ability to monitor and optimize process control to reduce N_2O emissions.

Permeate Pumps

The permeate pumps would operate across the entire flow range using VFDs and would be sized to meet the peak hour rate. Permeate pump speed would be controlled to roughly match the influent flow meter and would be fine-tuned to maintain a consistent level in the membrane cassette tanks.

Backpulse Tank

The tank would have a dissolved oxygen (DO) probes and transmitters for measuring DO. A level element with indicating transmitter and a high-high float switch would also be provided in the tank.

RAS / WAS Pumps

The RAS / WAS pumps would be operated either locally or remotely via the plant SCADA system. Under normal operation, the RAS / WAS pump suction and discharge valves would be kept open, and the duty pump would continuously run to return activated sludge to the aeration tank. The RAS / WAS pumps would be operated in either a target flow rate mode or an effluent flow-paced mode. In target flow rate mode, the flow would automatically adjust to maintain an operator specified constant flow. In effluent flow paced mode, the flow would automatically adjust to maintain an operator specified percent of effluent flow rate (typically 4 to 6 times). The signal from each RAS / WAS flow meter would be used as process feedback for the RAS / WAS flow control. The operator would enter a minimum and maximum flow setpoint and the RAS flow would be maintained between these setpoints regardless of the mode selected.

3.1.8 Effluent Disinfection

3.1.8.1 Design Overview

The UV disinfection system would be located in a separate part of the Membrane Equipment and Disinfection Building on the ground level.

UV disinfection would be provided in three UV channels, with two channels acting as duty and the other as bypass/allowance for a future UV unit. The UV equipment and associated electrical equipment would be located in the Membrane and Disinfection Building. Each channel would consist of three banks (two duty, one standby) of UV lamps. The banks would be mounted in series for disinfection reliability and to ensure uninterrupted service during cleaning and other required maintenance. Each channel would be equipped with an inlet slide gate and fixed effluent level control weir to keep the UV lamps submerged. After discharging over the weir, the flow would travel through a Parshall flume and then to the outlet sewer leading to the outfall.

A UV transmittance of 65% was assumed to size the UV system. This is typical of a secondary treatment facility with iron salt dosing for phosphorus removal. However, it is recommended that a collimated beam testing study be conducted to confirm the UV transmittance values to be used for design.

3.1.8.2 Design Basis and Specifications

The design basis and specifications for the UV disinfection units are presented in **Table 3-16.** This conceptual design is based on Trojan's UVsigna system. An equipment cutsheet is included in **Appendix C4.**

Table 3-16: UV Disinfection Design Basis

Parameter	Design Value	Unit
Peak Hourly Flow	36,400	m^3/d
Minimum UV Transmittance	65%	-
TSS	30	mg/L
Disinfection Limit	100	E. coli / 100 mL
Number of Channels	3 (1 duty, 1 standby, 1 future)	-
Channel Dimensions		
L	10.3	m
W	1	m
D	2.3	m

Parameter	Design Value	Unit
Number of Banks, per channel	3 (2 duty, 1 standby)	-
Number of Lamps, per bank	12	-
Maximum Power Draw	37.9	kW

3.1.8.3 Operating Philosophy and Instrumentation

The lamps would increase and decrease in intensity based on flow taken from the measuring device tracking effluent discharge. During periods of higher flow, the intensity of the bulbs would automatically increase.

Any UV system gradually accumulates a coating on the quartz sleeves housing the lamps. This routine fouling must be removed periodically. The UV system would have an in-channel cleaning system which reduces maintenance. The UV intensity sensor continually monitors UV lamp output. When intensity drops, the automatic wiping system, would begin cleaning the lamps and sensor sleeves simultaneously. is to be operated once daily and the wipers are to be replaced once every two years. The wiper assembly consists of a submersible wiper drive on each UV module that drives the wiper carriage assembly along the module. Attached wiper canisters surround the quartz sleeves and are filled with a cleaning gel. The gel contacts the lamp sleeves between the two wiper seals and cleans the lamps. Cleaning takes place while the lamps are submerged and in operation.

3.1.9 Chemical Addition

3.1.9.1 Design Overview

It is anticipated the new WWTP would require, at minimum, three chemical systems:

- Ferric Sulphate for phosphorus removal
- Citric Acid for membrane cleaning (e.g. removing organic foulants from the membrane)
- Sodium Hypochlorite for membrane cleaning (e.g. removing inorganic scaling from the membrane)

The ferric sulphate system would be housed in a separate chemical room in the Blower Building, described in **Section 3.1.7**. A single tank and the chemical pumps would be housed in a concrete spill containment area located within the room.

The citric acid and sodium hypochlorite systems would be housed in a chemical room in the Membrane Equipment and UV Building, described in **Section 3.1.7**. A single tank would be provided for each chemical along with dedicated chemical feed pumps. The tank and pumps would be housed in individual concrete spill containment areas located within the room.

All chemical rooms would allow for chemical delivery by truck. There would be external fill stations for each chemical complete with cam-lock connections and piping directly to each chemical tank for filling. Consideration should be given during preliminary design to providing two chemical tanks located outdoors in a containment area.

The ferric sulphate, citric acid, and sodium hypochlorite systems would be designed to meet MECP requirements for storage and handling of hazardous substances. The chemical would be stored in tanks in a containment are providing 110% containment.

3.1.9.2 Design Basis and Specifications

Phosphorus Removal

The design specifications for the phosphorus removal system are presented in **Table 3-17.** An equipment cutsheet is included in **Appendix C3.**

Table 3-17: Phosphorus Removal Chemical Design Specifications

Parameter	Design Value	Unit
Chemical	Ferric Sulphate	-
Phosphorus Removal Chemical Storage[1]		
Number of Storage Tanks	1	-
Storage Volume, each tank	45	m^3
Phosphorus Removal Chemical Supply		
Number of Dosing Trains	4	-
Chemical Flow, each	1.6	m^3/hour

Notes:

1. Total storage volume sized for a full load from a chemical delivery truck plus a 25% safety factor.
2. Consideration should be given during preliminary design to providing two chemical tanks located outdoors in a containment area.

Membrane Cleaning

There would be two chemical systems for membrane cleaning: one for citric acid and one for sodium hypochlorite. The design specifications for citric acid and sodium hypochlorite are described in **Table 3-18** and **Table 3-19,** respectively.

Table 3-18: Citric Acid Chemical System Design Specifications

Parameter	Design Value	Unit
Chemical	Citric Acid	-
Chemical Storage[1]		
Number of Storage Tanks	1	-
Storage Volume, each tank	2	m^3
Phosphorus Removal Chemical Supply		
Number of Dosing Pumps	2 (1 duty / 1 standby)	-
Chemical Flow, each	Max. 1.3	L/s

Table 3-19: Sodium Hypochlorite Chemical System Design Specifications

Parameter	Design Value	Unit
Chemical	Sodium Hypochlorite	-
Chemical Storage[1]		
Number of Storage Tanks	1	-
Storage Volume, each tank	2	m^3
Phosphorus Removal Chemical Supply		
Number of Dosing Trains	2 (1 duty / 1 standby)	-
Chemical Flow, each	Max. 1.3	L/s

3.1.9.3 Operating Philosophy and Instrumentation

The chemical dosing rate would be controlled based an operator-adjustable target chemical dose rate. The chemical feed flow would be regulated by an actuated control valve to achieve the desired flow target.

3.1.10 Sludge Storage System

3.1.10.1 Design Overview

Sludge from the membrane tanks would be conveyed to a holding facility on site for storage until disposal. The sludge would be stored in two covered tanks on site, each equipped with a mixing system. The sludge loading pumps would convey sludge from the tanks to trucks for transport to disposal.

The system would include provisions to allow decanting / supernating from the sludge storage tanks to provide gravity thickening.

The Sludge Control Building would be constructed between the two storage tanks. The building would consist of a room to house the sludge mixing pump and two sludge loading pumps and separate electrical room.

3.1.10.2 Design Basis and Specifications

The design basis for the sludge storage system is presented in **Table 3-20.**

Table 3-20: Sludge Storage Design Basis

Parameter	Design Value	Unit
Storage Required	7	Days
Solids Production	4,800	kg/d
% Solids Concentration after decanting	1	%
Storage Volume Required	3,400	m^3

3.1.11 Outfall Modification

3.1.11.1 Design Overview

A new gravity sewer would be installed to tie into the existing outfall to Desjardins Canal. The new gravity sewer would extend from the discharge of the effluent disinfection to an existing maintenance hole on King Street connecting to the existing 750 mm diameter outfall.

3.1.12 Administration Building

3.1.12.1 Design Overview

The Administration Building would be located at the south end of the site. It would serve as an entry beacon to visitors and people driving or walking on King Street. This building will also be the main control point for access to the site for both staff and visitors.

The building would include the following architectural programmatic spaces:

- Offices and workstations
- Meeting spaces and boardrooms
- Operational laboratory
- SCADA control room
- Locker rooms
- Washrooms
- Lunchroom
- Touchdown areas

The building would provide access to other plant areas including the Membrane and UV Disinfection Building and the Aeration Tanks. Access to the Administration Building would be controlled. The building would not contain any process equipment; therefore, does not need to be compliant with post-disaster design requirements.

The façade of the building would utilize robust materials and a double volume to reduce the perceived scale. The upper volume would consist of industrial materials such as metal cladding and vertical metal louvers, while the lower volume would consist of masonry elements. The landscaping approach would allow the building to integrate into its natural surroundings by extending the green corridor along the King Street and the adjacent Canal Park, as well as the local watershed of Desjardins Canal and the Cootes Paradise. Landscaping elements would include as evergreen screening along the site’s main frontage and a bermed boulevard.

3.1.13 Centre of Excellence

The Centre of Excellence would be located at the south end of the site. The concept presented in this report assumes this building would be integrated with the Administration Building.

The Centre of Excellence is intended to facilitate community integration and public education on wastewater management services, as well as to provide spaces for training, innovation, and collaboration. The building would include meeting spaces and boardrooms, public presentation and display areas and washrooms.

The Centre of Excellence areas would be isolated from staff areas and access to either the Administration Building or the Centre of Excellence would be controlled.

3.2 Civil Design

3.2.1 Codes, Standards, and Regulations

The Dundas WWTP site works would conform to the following standards, codes and guidelines:

- American Association of State Highway and Transportation Officials (AASHTOM 2011 – Design Vehicle Template Library)
- American Society of Civil Engineers (ASCE) Standard 38-02 – Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data
- City of Hamilton Forms 200 – 1000 for Construction and Material Specifications
- Erosion and Sediment Control Guidelines for Urban Construction by the Greater Golden Horseshoe Area Conservation Authorities
- Ontario Building Code (OBC) 2012
- Ontario Provincial Standards for Roads and Public Works (OPS)
- City of Hamilton Wastewater Outstations Design Manual (Pumping & CSO Tanks)
- Transportation Association of Canada Geometric Design Guide for Canadian Roads (TAC)

3.2.2 Site Grading and Stormwater Management

Site grading would generally follow the existing slope of the land. All ground surfaces adjacent to new buildings and facilities would be graded away from the structures to provide positive drainage to nearby ditches, swales or catchbasins.

Overall, once the new WWTP is constructed and the existing plants are demolished, the site-wide drainage conditions would be maintained such that they are equivalent to existing conditions. Whenever possible, the use of permeable materials would be used to reduce runoff.

Stormwater runoff within the site area is captured by local swales, culverts and catch basins. Stormwater from gutters and drains would be collected in road catch basins and conveyed towards the existing 750 mm storm sewer that runs parallel to the southern site boundary, then conveys stormwater to the 700 mm outfall and Desjardins Canal.

Site drainage swales, storm sewers, catch basins, and culverts would be designed in accordance with City of Hamilton standards where applicable.

3.2.3 Facility Access Roads and Parking

New roads, parking, and walkways would be added to serve the new WWTP facilities and buildings. The existing access driveways from King St E would be maintained; the eastern driveway would provide public access to the Administration Building and Centre of Excellence while the western driveway may used for the future public works yard. An additional access driveway from King St E would be provided between the two existing driveways and would be dedicated to sludge processes.

The existing access road would be extended around the perimeter of the new treatment equipment, providing access to the various buildings and treatment facilities. The access road would also be extended along the north boundary of the site to provide access during construction and operations. The existing parking lot, equipment storage garage, and sludge storage tanks may be demolished to accommodate a new public works yard. The area currently occupied by the existing plant would be reserved for future expansion.

To accommodate construction of the new WWTP and demolition of the existing plant, modifications and temporary closures or lane restrictions may be required to the existing plant access road network. Temporary access roads and staging of road or lane closures would be coordinated to minimize the impact of the construction works on the WWTP access road network.

New roads would be designed to allow for adequate access for operations, deliveries, and emergency vehicles. All connections between new and existing roads would be designed to have the same elevation and new roads would be designed to integrate with the overall site plan. Roads, walkways, and curbs would be designed to meet requirements within current Transportation Association of Canada Geometric Design Guide for road design, City of Hamilton standards, and Ontario Provincial Standard Drawings (OPSD).

3.2.4 Yard Piping and Services

The proposed location of the new facilities, inlet conduits and access roads would result in the relocation of various existing buried utilities and proposed utilities to be installed.

Horizontal and vertical alignment of the proposed utilities would be designed based on the following criteria:

- Satisfy all the City’s technical requirements and meet the City’s Standards;

- Minimize the impact of construction on the existing WWTP operation;
- Provide an economical project that meets all City's requirements;
- Minimize the excavation required by maintaining a minimum cover metres over the utilities, where feasible;
- Optimize the utility alignment by minimizing the number of bends or manholes;
- Minimize the impact on existing utilities and surface features;
- Minimize the relocation of existing utilities and services; and,
- Minimize traffic impacts by preparing Traffic Management Plans and strategies.

3.2.5 Erosion and Sedimentation Control

Construction of the new facilities requires the implementation and maintenance of erosion and sedimentation control (ESC) measures to ensure protection of Desjardins Canal, Cootes Paradise, and ultimately Lake Ontario. All ESC measures and design would be based on the latest ESC Guideline for Urban Construction by the Greater Golden Horseshoe Area Conservation Authorities.

Prior to commencing construction, the Contractor would be required to submit an ESC plan for review and approval by the Engineer. The ESC plan would describe the controls and measures necessary to protect Lake Ontario during construction. The ESC plan would include locations of selected ESC controls and measures, scheduling, operation, modification, maintenance and inspection of all measures installed on site. An ESC drawing would be provided to the Contractor as the basic platform for the ESC planning.

3.3 Architectural Design

3.3.1 Design Overview

The Dundas WWTP would include several buildings:

- Sewage Pumping Station
- Headworks
- Blower Building
- Membrane and UV Disinfection Building
- Administration Building and Centre of Excellence

The proposed buildings would be designed to have a long service life with minimal maintenance requirements. As part of the design process, contextual consideration would be taken for the proposed buildings, ensuring they are contemporary while complimenting the aesthetics of the existing built environment.

3.3.2 Codes, Standards, and Regulations

Building design would comply with the latest editions of codes and industry standards listed below:

- OBC and Ministry of Municipal Affairs and Housing (MMAH) Supplementary Standards SB-1 “Climatic and Seismic Data” as well as SB-10 “Energy Efficiency Requirements”;
- Ontario Fire Code (OFC);
- Masonry Codes;
- Canadian Standards Association (CSA)-S304.1-04(R2010) – Design of Masonry Structures;
- CSA-A371-04(R2009) – Masonry Construction for Buildings; and,
- CSA-A370-04(2009) – Masonry Connectors.

3.3.3 Sustainability

Carbon emissions and waste generated by the construction industry have a significant impact on the environment. Sustainability has therefore become a critical issue in the building industry and can be a challenging aspect of a project. When sustainable strategies are incorporated into a building’s design, it can both increase the building’s longevity and reduce its environmental impacts simultaneously. The following sustainable design strategies would be considered:

- Use of local materials wherever possible, to reduce the significant environmental impacts of transporting materials long distances and to support local economy;
- Use of treated effluent water to mitigate the use of potable water for process uses;
- Use of renewable energy sources to reduce reliance on energy from the grid;
- Use of material containing recycled content wherever possible; and,
- Position and size of windows to maximize passive solar heating as well as better use of natural light to reduce the need for electric light consumption.

3.3.4 Materials

Performance and low maintenance requirements would be considered when selecting materials. A summary of proposed materials is presented in **Table 3-21** below.

Table 3-21: Proposed Building Materials

Building Component	Description
Cladding System	• Light precast concrete panel and/or brick veneer on CMU block. • Prefinished Metal Siding on steel girts. • Vertical metal louvers.
Roofing System	• 2 Ply Modified Bitumen roofing system (cap and base sheet) on concrete deck.
Exterior Doors	• Insulated HM door with thermally broken frame. • Glazed windows.
Exterior Windows	• Prefinished aluminum double glazed window with thermally broken frame. • Double-glazed, tinted, low-e coating, argon filled units.
Overhead Doors	• Insulated Overhead Coiling Doors.
Interior Doors	• HM painted and fire-rated as required. • Glazing lights: Tempered glazing or Fire-rated glazing where required.
Interior Walls	• Painted CMU wall (Fire rated as required) – Process spaces, services rooms, storage room, mechanical/electrical room and any similar areas that require highly durable finish. • Painted dry wall partitions on metal studs. • Ceramic tile on painted CMU wall.
Ceilings	• Unfinished or Painted Concrete - Process spaces, services rooms, and similar areas. • Suspended ACT - Control room. • GWB BD Ceiling (Fire rated as required) - Janitor room and washrooms.
Floor Finishes	• Concrete hardener – Process spaces.

Building Component	Description
	• Epoxy coating – Other rooms. • Polished concrete floors in Administration Building and Centre of Excellence.
Notes: • ACT – Acoustical Ceiling Tile • CMU – Concrete Masonry Unit • GWB BD – Gypsum Wall Board • HM – Hollow Metal	

3.3.5 Life Safety

Fire protection and life safety aspects would be integrated into the design following the Ontario Building Code and the Ontario Fire Code. To comply with the requirements, the following may be present in the design:

- Emergency lighting;
- Fire resistance rating (construction and spaces);
- Fire suppression system, such as Sprinkler system;
- Fire alarm; and,
- Detection systems, such as smoke detectors.

3.4 Structural Design

3.4.1 Design Overview

The structural design scope for the Clarkson WRRF expansion includes the following structures summarized in **Table 3-22** below.

Table 3-22: Structural Design – Dundas WWTP

Facility / Building	Structural Design Concept
Sewage Pumping Station	The new sewage pumping station would be a single storey building with a wet well and valve chamber below-grade. There would be an adjacent aboveground electrical room. The below-grade chamber would be cast-in-place concrete and the electrical room would be load bearing masonry

Facility / Building	Structural Design Concept
	supported on strip footings. The roof construction would be precast hollowcore slabs.
Headworks Building	The new headworks facility would be a single storey building with a basement with several concrete channels. The substructure and superstructure of the Headworks Building would be cast-in-place concrete. Precast concrete roof slabs would be supported by a cast-in-place concrete beam and column framing system. Crane girders would be supported by cast-in-place concrete corbels and columns. Infill concrete masonry blocks would be used around the building to support architectural finishes. Aluminum or stainless steel would be specified for all metal items including checkered plate covers. Lifting mechanisms and bridge crane would be epoxy coated steel. Raft foundation could be used for the design of the building. Raft foundation could be used for the design of the Headworks building.
Aeration Tanks	Three cast-in-place concrete aeration tanks (dimensions 46 m x 12 m x 6 m deep) would be an approximately six meter deep below-grade structures. Rock anchors may be required to resist uplift.
Blower Building	The Blower Building would be a one-storey conventional steel braced frame structure with a cast-in-place concrete floor slab (dimension 46 m x 8 m x 7.7 m high). The Blower Building would consist of the aeration blowers with independent electrical and chemical rooms. The south wall of the substructure would be constructed of cast-in-place concrete as it is common walls with the aeration tanks. Cast-in-place beams and columns would be constructed to support the ground floor slab. The roof of the structure would consist of metal beams and metal decking.
Membrane Cassette Tanks	Four cast-in-place concrete membrane cassette tanks (dimension 16.4 m x 2.44 m x 4.7 m deep) would be an approximately 4-meter deep below grade concrete structure.

Facility / Building	Structural Design Concept
Membrane and UV Building	The new Membrane and UV Building would be a single storey building with a basement. The substructure of the building would be cast-in-place concrete. Precast concrete roof slabs would be supported by cast-in-place concrete beam and column framing system. Crane girders would be supported by cast-in-place concrete corbels and columns. Infill concrete masonry blocks would be used around the building to support architectural finishes. Aluminum or stainless steel would be specified for all metal items including checkered plate covers. Lifting mechanisms and bridge crane would be epoxy coated steel. Raft foundation could be used for the design of the building.
Sludge Storage Facility	The Sludge Pump Building would be a single storey structure to house the sludge mixing and loading equipment. The Sludge Storage Tanks could be glass-fused to steel tanks with a concrete cast-in place foundation.
Administration Building and Centre of Excellence	The building would be a single storey building made of steel frame and bracing.
Conduits, Channels, Tunnels and Chambers	All conduits, channels, tunnels, and chambers would be cast in place concrete.

3.4.2 Geotechnical and Hydrogeological Conditions

There are no available geotechnical reports for the site. It is recommended that a detailed geotechnical and hydrogeological investigation be conducted to support preliminary design.

3.4.3 Design Codes and Standards

The proposed structures would be designed in accordance with the requirements of Ontario Building Code 2024 and National Building Code 2020.

In addition, the following material references are used in the design of the structures:

- CSA - A23.3 – Design of Concrete Structures for Buildings

- CSA – A23.4 - Precast concrete - Materials and construction
- CSA - S16– Limit States Design of Steel Structures
- CISC Handbook of Steel Construction
- CSA - S136 – Cold Formed Steel Structural Members
- CAN3/CSA – S304 – Masonry Design for Buildings
- CSA – S-157 – Strength Design in Aluminum
- ACI 350M-20 – Code Requirements for Environmental Engineering Concrete Structures
- CSA S900.2 - Structural Design of Wastewater Treatment Plants
- Canadian Foundation Engineering Manual

3.4.4 Design Service Life

Design service life is defined as the period of time for which a building, structure, piece of equipment, component, device or system, as applicable, is expected to function at its designated capacity without major repairs or performance of compounding unscheduled maintenance activities. The Dundas WWTP tanks and ancillary buildings would be designed for an operational lifetime of a minimum 80 years.

3.4.5 Structural Material

3.4.5.1 Concrete

Cast-in-place concrete would be used for all below grade and liquid retaining structures. Concrete specifications are summarized in **Table 3-23** below.

Table 3-23: Concrete Specifications

Type	Strength	Exposure Class
Precast concrete	30 MPa @ 28 days	A-1
Cast-in place reinforced	30 MPa @ 28 days 35 MPa @ 56 days	A-1
Concrete Fill	20 MPa	N
Exterior slab on grade, sidewalk, curbs	35 MPa @ 56 days	C-1

3.4.5.2 Metals

Specifications for materials for metal work are included in **Table 3-24.**

Table 3-24: Metal Specifications

Material	Design Basis
Exterior structural steel	CAN/CSA-G40.21, Grade 350W
Carbon reinforcing steel	CAN/CSA G30.18M, 400 MPa
Bolts for exterior structural steel	Stainless Steel 316L
Drilled-in concrete anchors for structural steel	Stainless Steel 316L
Submerged or below covers structural steel	Stainless steel 316L
Drilled-in concrete anchors for submerged steel	Stainless steel 316L
Aluminum	Aluminum alloy 6061-T6

3.4.5.3 Waterproof and Coatings

Dry areas below grade would be waterproofed to ensure that the required watertightness is achieved prior to the commencement of backfilling operations. Chemical containment areas would be coated with appropriate chemical resistant coatings.

3.4.6 Design Considerations

Structures are designed based on climatic design data for Hamilton outlined in the OBC 2024 and typical industry accepted values where specific information from the OBC is not provided. **Table 3-25** and **Table 3-26** summarize the design criteria for climatic conditions, unit self-weights and live loads, respectively.

Table 3-25: Climatic Design Criteria for Hamilton

Load Factor		Value	Unit
Ground snow load (1/50 yrs)	Ss	1.1	kPa
Associated rain load (1/50 yrs)	Sr	0.4	kPa
Snow load importance factor	Is (SLS) Is (ULS)	0.9 1.25	- -

Load Factor		Value	Unit
Reference velocity wind pressure (1/50 yrs)	q	0.46	kPa
Wind load importance factor	Iw (SLS) Iw (ULS)	0.75 1.25	- -
One day rainfall (1/50 yrs.)	-	108	mm
Peak ground acceleration	PGA	0.180	-
Horizontal spectral acceleration values (2% Probability of Exceedance in 50 years)	Sa (0.2) Sa (0.5) Sa (1.0) Sa (2.0)	0.260 0.170 0.064 0.022	- - - -
Seismic importance factor	Ie (SLS) Ie (ULS)	1.5	-
Building classification	Post-Disaster – Process Buildings and Tanks Normal – Administration Building		

Table 3-26: Design Live Loads

Description	Loading (kPa)
All areas unless noted otherwise	4.8
Process equipment areas, truck bays and storage areas	12.0 (or to manufacturer’s specifications)
Mechanical and electrical rooms	15.0
Structural elements below roads	12.0 (or wheel loads as per CSA S6)
Construction	2.0
Construction surcharge on soils	10.0

3.5 Building Mechanical Design

3.5.1 Design Overview

The heating and ventilation of the Clarkson WRRF is based on the requirements of OBC, Ontario Fire Code, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 62.1, and NFPA820.

3.5.2 Ventilation Systems

Areas of the Facility where chemical vapours may be released would be provided with ventilation systems that maintain a negative pressure and an exhaust system would be provided at the roof level or higher via a stack. Depending on the area served, fresh air would be provided by a make-up air package complete with filters, and an intake damper louvre. In appropriate area the louvres would be interlocked with the exhaust system.

Classified areas, where combustible gas may be released, would be provided with push - pull ventilation systems at rates required by NFPA 820. These systems would involve make-up air units with removable filter, and variable speed exhaust fan systems that discharge at roof level or higher via a stack. Combustion gas detectors with visual and audible alarms would be provided in accordance with NFPA 820. Ventilation systems would be fitted with flow detection devices to indicate ventilation system failure.

Unclassified areas without chemical handling would be ventilated to provide operator comfort and control moisture levels, while avoiding excessive heating costs during cold weather. The ventilation systems servicing these areas would have the capability for a range of ventilation rates during different times of the year. A summary of room area classifications according to NFPA 820 and proposed air changes are presented in **Table 3-27.** A technical memorandum should be developed as part of the detailed design to confirm area classifications and ventilation rates.

Table 3-27: Room Area Classifications

Building Name	Room Name	Area Classification	Ventilation (ACH)
Headworks	Bin Area	Class 1, Division 1	3 (low) & 6 (high)
Headworks	Pump Gallery	Class 1, Division 1	3 (low) & 6 (high)

Building Name	Room Name	Area Classification	Ventilation (ACH)
Headworks	Mechanical Room	Unclassified	Varies depending on heat generated by equipment
Headworks	Electrical Room	Unclassified	Varies depending on heat generated by equipment
Headworks	Screen Room	Class 1, Division 1	3 (low) & 6 (high)
Blower Building	Blower Room	Unclassified	Varies depending on heat generated by equipment
Blower Building	Electrical Room	Unclassified	Varies depending on heat generated by equipment
Blower Building	Chemical Room	Unclassified	2 (low) & 6 (high)
Membrane Equipment and UV Building	MBR Tanks	Class 1, Division 2	< 6
Membrane Equipment and UV Building	Pump Room	Unclassified	Varies depending on heat generated by equipment
Membrane Equipment and UV Building	Electrical Room	Unclassified	Varies depending on heat generated by equipment
Membrane Equipment and UV Building	MBR Blower Room	Unclassified	Varies depending on heat generated by equipment
Membrane Equipment and UV Building	Chemical Room	Unclassified	2 (low) & 6 (high)

Building Name	Room Name	Area Classification	Ventilation (ACH)
Membrane Equipment and UV Building	UV Room	Unclassified	Varies depending on heat generated by equipment
Administration Building and COE	-	Unclassified	2 (low) & 6 (high)

3.5.3 Heating Systems

Various heating systems would be utilized at the plant. All classified process areas would be designed to meet NFPA 820 requirements to meet spark-resistant construction requirements per item 9.2.3 of NFPA 820 and would include ventilation monitoring devices. The buildings including exclusively unclassified areas would have HVAC systems consisting of gas fired make up air units (MUA) providing heating and ventilation to the various rooms. Rooftop-mounted exhaust fans would exhaust air from the building. Cooling for the administrative areas, offices, lavatories, locker rooms, laboratory and electrical rooms would be provided by ceiling-mounted split systems.

3.5.4 Energy Optimization Measures

The following energy optimization measures should be considered in the design development of HVAC systems for various areas in this project. These measures would be configured to ensure that the requirements outlined in NFPA 820, as well as all other applicable codes are met.

1. Application of NFPA 820 (Chapter 9) concepts for the reduction of ventilation rates when the supply air temperature is 10°C (50°F) or less, where permitted.
2. Use of variable frequency drives (VFD) in supply and exhaust air handling equipment.
3. Use of heat recovery systems to recover wasted heat from exhaust air and/or treated wastewater effluent, where practical.
4. Redundancy in space heating by handling space ventilation heating loads (by make-up air units) and space transmission loss heating loads (by unit heaters). This would allow ventilation with the minimum acceptable supply air temperature (10 °C adjustable) in unoccupied mode and boost the space temperature whenever the space temperature drops below (10 °C), or the space is in occupied mode.

5. Use of high-end Building Automation System (BAS) control systems to monitor operation and energy saving aspects of the Plant HVAC systems.

3.5.5 HVAC System Monitoring Control

HVAC system monitoring and controls would be provided through a BAS. This system would have its own front end and when required, would alarm to the plant SCADA system, which would be monitored by operations staff.

The proposed monitoring system would aid operations staff in maintaining optimal plant HVAC operation and energy consumption. Equipment would be selected, that provides feedback and diagnostics of operating conditions and energy performance, which would greatly enhance the timely detection of operating anomalies and reduce staffing requirements. Controls would be configured to make sure that HVAC equipment operates in the most effective and energy efficient manner, while still ensuring that the NFPA 820 requirements are met.

3.5.6 Gas Detection

The selection and location of combustible gas detectors would be in accordance with NFPA 820 (both audible and visual alarming devices would be provided inside the space and at all entrances to the space). Continuous ventilation systems would be fitted with flow detection devices connected to an alarm signaling system to indicate system failure. Detection of a high level of gas within a space would initiate high-rate ventilation system via the associated ventilation equipment.

3.5.7 Plumbing Systems

Plumbing systems in each facility may include potable hot and cold-water systems, plant service water systems. Plumbing systems would be designed to meet the requirements of the applicable codes and standards.

Potable water systems feeding the Facility’s service water system would be protected from contamination. Hose valve and hose bibs would be supplied from the plant’s service system for wash down to process areas as required.

Emergency eyewashes and showers stations would be provided for chemical storage areas and other hazardous areas as required. Water supply of emergency eyewashes and showers would be tempered and designed to provide no less than 15 minutes of continuous operation.

3.6 Electrical Design

3.6.1 Existing Conditions

The existing Dundas WWTP is serviced by two independent utility service feeds, provided by the local utility Alectra. Power distribution for the WWTP is segmented based on the following main load centres:

- Treatment Plant
- Sewage Pumping Station (SPS)

The existing treatment plant electrical distribution includes a pad mounted utility transformer that is located at the north end of the site adjacent to Hunter St. The main utility transformer is provided with a primary 27.6 kV aerial feeder located on Hunter St. The pad mounted utility transformer provides 600 V, 3 phase power to the treatment plant distribution system, including the Main MCC located in the Control Building in Plant B. The main MCC services the treatment plant loads associated with inlet works, aeration, primary and secondary treatment. The 600 V distribution system related to the treatment plant is not equipped with a dedicated backup power generation system. The original 600 V distribution for the treatment plant dates to circa 1970’s.

The existing sewage pumping station 600 V distribution is provided by pole mounted utility transformers located on King St. The utility transformers provide 600 V, 3 phase power to the sewage pumping station main 600 V MCC. The SPS MCC includes an automatic transfer switch and 230 kW diesel standby power to provide emergency power during a utility failure. The SPS main MCC provides 600 V power to other process loads at the site including the Filter Building and the sludge storage complex.

3.6.2 Design Overview

The treatment plant expansion would require a new utility service, including a 27.6 kV to 600 V main substation transformer. Based on preliminary calculations, the estimated power requirements to service the new facility are in the order of 1 MW. Primary power can be sourced from the existing utility aerial supply that is located on King St. The new treatment plant main substation would be located at the northeast corner of the site, adjacent to the new Headworks Building. The new transformer substation would be provided with a primary 27.6 kV aerial pole line along the incoming driveway, sourced from the King St. aerial utility supply.

The 600 V utility supply from the transformer substation would terminate in the new MCC service entrance located in the main Blower Building Electrical Room. The main 600V MCC would be equipped with an Automatic Transfer Switch supplied by an outdoor self contained sound attenuated standby generator. Fuel type options for the standby generator should be evaluated and confirmed during the pre-design stage. The standby generator would provide emergency power to high priority loads at the new treatment plant in the event of a power interruption.

The new 600 V Main Service MCC located in the Blower Building Electrical Room would provide 600 V, 3 phase power distribution to the various process load centres including the Headworks, Membrane Equipment and Disinfection Building, Sludge Storage, and Sewage Pumping Station. General 600 V power distribution to the treatment plant load centres would be provided via underground raceways / duct banks.

It should be noted, however, that construction of the new sewage pumping station would likely be staged after the completion of the Treatment Facility. During the pre-design phase the normal and emergency distribution requirements should be evaluated to assess the merits of providing an independent and dedicated utility supply and standby power generation to the new SPS, similar to the configuration of the existing SPS.

3.6.3 Design Codes and Standards

The electrical system would be designed in accordance with the latest editions of the following codes, standards, and references:

- Ontario Electrical Safety Code (OESC)
- OBC
- Electrical Safety Authority (ESA) Bulletins
- NFPA 820
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Illuminating Engineering Society (IES)

Other applicable standards from NFPA, CSA, and Technical Standards and Safety Authority (TSSA) would also be applied as required. Coordination with the local Utility (Alectra) would require coordination with Alectra standards specific to the primary (27.6 kV) distribution.

3.6.4 Power Distribution Upgrades

The existing Dundas WWTP utility supply and power distribution is segmented between the sewage pumping station (feeding the Sludge Storage and Filtration Buildings) and the treatment plant. The implementation of the new treatment plant would be based on a consolidated utility supply to service the new treatment plant loads. The consolidated utility supply would consist of the single substation and 600 V service entrance located in the Blower Building's electrical room. As noted above, the power requirements for the new SPS can be further evaluated during pre-design to confirm the merits of providing a dedicated utility supply for the SPS.

The two existing electrical utility services at the site would be removed once the new plant is commissioned. Existing utility supplies would remain in service until the existing treatment plant and sewage pumping station infrastructure is eliminated.

3.6.5 Utility Service Feed

A new 27.6 kV aerial utility circuit source would be provided from King St. The new aerial supply would be routed to the new transformer substation, located adjacent to the Headworks, via an aerial overhead line. Logistics for sourcing the new circuit for the treatment plant expansion and removal of the existing utility feeders that would become redundant to be confirmed during pre-design.

3.6.6 Standby Power System

Standby power for the new treatment plant expansion would be provided by an outdoor self-contained, sound-attenuated enclosed generator. The generator would be sized to service loads that are defined as priority during emergency conditions. The generator fuel type should be evaluated during the design phase based on logistics of fuel supply and generator performance. During the design phase, it may be determined that a dedicated electrical supply is required for the new SPS. Thus, an additional standby generator dedicated to the sewage pumping station may be required in support of the independent electrical supply for the SPS.

3.6.7 Lighting

LED lighting fixtures would be selected to suit the environment and would be surface mounted as to be accessible by a ladder where possible. In areas where higher mounting heights are required to achieve adequate levels of illumination, high output lighting would be provided. The interior lighting design would be in accordance with the latest lighting standards outlined by the IES. Indoor and outdoor lighting circuits would be rated for 120 V applications and supplied with power from the 120 V panel boards located within each respective building's electrical room.

3.6.7.1 Emergency and Exit Lighting

Emergency lights would be powered via battery units with either integral or remote LED heads, located within all areas required by the OBC. The emergency lighting and exit lights would be explosion-proof in hazardous locations as required.

Exit signs specified would be the illuminated, green “Running Man” type as required by the OBC and would be connected to the nearest battery units. The required lighting levels and battery run-times would meet the requirements of the OBC.

3.6.8 Hazardous Area Classification

The hazard classification of the new facilities included in the expansion would be determined in accordance with the recommendations of NFPA Standard 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

All electrical equipment and methods used would be consistent with the hazardous area classifications defined for the various parts of the plant. They would be compliant with the OESC requirements for hazardous areas and would be in accordance with NFPA 820.

3.7 Instrumentation and Control

3.7.1 General Overview

Any instrumentation and control (I&C) upgrades would be designed utilizing the City of Hamilton Standards as a basis. This includes process and instrumentation diagram (P&ID) development, the design of instrumentation, programming, control narratives, equipment tagging, wire tagging, and approved equipment lists.

3.7.2 SCADA System Software and Hardware

The PLC and SCADA system software would be developed using the City’s SCADA standards as a design basis All SCADA system development would be integrated within the existing plant SCADA system. HMI screens would be developed in accordance with the City’s software platform.

3.7.3 Equipment Tagging

The City’s SCADA Standard would be followed for equipment tagging when developing P&IDs as well as Process Control Narratives. The standard ensures proper identification of equipment function and location for all new equipment.

3.7.4 P&ID Development

The development of P&IDS would be in accordance with the City’s standards. This includes formatting, Input/Output (I/O) assignments, abbreviations and line types.

3.7.5 Process Control Narrative (PCN)

PCN documents describe the operation, automation and control of all process areas and equipment. The PCN describes all equipment and instrumentation involved with a process. The PCN defines and describes are modes of control such as Local Manual, Computer Manual and Computer Auto. The control logic of all equipment is also detailed as well as fault responses of equipment and instrumentation. Control setpoints, alarm setpoints, interlocks, and I/O list are also included.

3.7.6 Instrumentation

Process instrumentation would be provided to accommodate monitoring requirements of each process. It is anticipated that process instrumentation may include the following:

- Flow meters
- Level Instruments
- Pressure Instruments
- Dissolved Oxygen Analyzers
- Temperature Instruments

Gas detection equipment would also be installed within designated classified areas as required by NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities and the OESC. Gas detection would monitor levels of hydrogen sulphide, oxygen deficiency and the lower explosive limit (LEL).

4 Recommended Technical Memoranda for Detailed Design

Table 4-1 summarizes a list of technical memoranda recommended to be prepared during detailed design to refine the preferred design concept for the new Dundas WWTP.

Table 4-1: Technical Memoranda for Detailed Design

Technical Memoranda	Purpose
TM 1 – Screening Technologies	Evaluate fine and band screen technologies based on operation and maintenance and life cycle costs; provide recommendations on procurement strategies.

Technical Memoranda	Purpose
TM 2 – Blower Technologies	Evaluate blower technologies based on operation and maintenance and life cycle costs; provide recommendations on procurement strategies.
TM 3 – MBR Technologies	Evaluate MBR technologies based on operation and maintenance and life cycle costs; provide recommendations on procurement strategies
TM 4 – UV Technologies and Collimated Beam Testing	Evaluate UV technologies based on operation and maintenance and life cycle costs; provide recommendations on procurement strategies. Confirm UVT.
TM 5 – Odour Control Technologies	Evaluate odour control based on operation and maintenance and life cycle costs; provide recommendations on procurement strategies.
TM 6 – Geotechnical and Hydrogeological Conditions Report	Complete and summarize the findings of geotechnical and hydrogeological investigations and provide recommendations for the design of foundation systems of structures as well as construction considerations.
TM 7 – Energy Recovery Opportunities	Review potential heat recovery opportunities from effluent water that could be incorporated.
TM 8 – Area Classification and Ventilation	Review and confirm area classifications and ventilation rates for new facilities.
TM 9 – Fire Routing	Review fire route compliance requirements and provide fire routing plan for the site.
TM 10 – Staffing for Plant Operation, Public Works, and Maintenance	Review and confirm the number of staff anticipated to be on site full-time and

Technical Memoranda	Purpose
	intermittently, and the resources required to support the staff.
TM 11 – Design of Public Works and Maintenance Facility Yard	Confirm design requirements and develop the design of the Public Works and Maintenance Facility and Yard.
TM 12 – Site Security	Confirm security requirements and develop site security design.

5 Capital Phasing and Procurement Plan

5.1 Equipment Procurement

Procurement options for major pieces of equipment would be considered to provide the City with the greatest value while minimizing schedule risks. Some major process equipment systems differ substantially in terms of layouts and requirements while having the same process capacity. Major process equipment delivery times may also significantly affect the overall schedule. In addition, with recent market volatility and supply shortages, issues may arise with increasing costs and supply timelines.

Pre-selection results in a separate equipment supply contract and has the advantage of targeting the preferred equipment, while sole accountability remains with the General Contractor. It can be appropriate based on experience with equipment and/or continuity throughout the facility. However, it can result in sacrificing competitive pricing as the supplier would have no competition.

Pre-purchasing of equipment by the City can be considered in cases where certain equipment has demonstrated long-delivery times that could adversely impact the schedule. However, the City would become responsible for any delay and coordination issues rather than the Contractor with potential cost impacts.

The following major equipment is recommended for pre-selection:

- Screening
- Grit removal
- Process blowers
- Membrane system
- UV disinfection system
- Standby generator

5.2 Capital Phasing

Plant A and Plant B must continue to operate and service the community of Dundas while the new plant is being constructed. Given the magnitude and complexity of the expansion, it is recommended that the work be completed as a program consisting of a single engineering assignment to oversee the following construction contracts:

- Phase 1: Sludge Storage and Immediate Upgrades
- Phase 2: New Plant
    - Contract 1 – New Plant
    - Contract 2 – Existing Plant Demolition
    - Contract 3 – New Public Works, Pilot Plant, & SPS

5.2.1 Phase 1: Sludge Storage and Immediate Upgrades

The first phase would consist of one construction contract to complete immediate upgrades necessary to maintain reliable operation of the existing plant until the new plant can be constructed and commissioned. However, instead of restoring the existing sludge storage, the ultimate sludge storage facility would be constructed to service the existing plant and the new plant in the future.

The anticipated scope of work includes:

- New sludge storage system
    - Interim sludge feed connection to service the existing plant
    - Interim electrical feed either from the existing plant or from a temporary secondary power supply from King St
- Ferric system upgrades
- Other miscellaneous upgrades planned by the City and listed in **Appendix D.**

The existing material stockpiles would need to be relocated to accommodate the new sludge storage system.

Once the new sludge storage system is commissioned, the existing sludge storage tanks can be demolished.

The new sludge handling and storage facility would require a connection to the existing WAS piping to allow for continue operation while the new plant is constructed. Then once the new plant is constructed, the sludge facility would be connected to the new plant.

5.2.2 Phase 2: New Plant

Contract 1 – New Plant

The new WWTP would be located in Martino Park east of the existing WWTP.

The facilities and processes for the new plant can be built as the first contract of Phase 2 without any complex sequencing. Once construction is complete and final tie-ins to the influent and effluent piping occur, the new plant can be brought online, and the existing plant can be decommissioned.

Contract 2 – Demolish Existing Plant

Once the new plant is online, the facilities within the existing site can be demolished under a second contract. This area should be maintained free and clear to provide space for future plant capacity expansions.

Contract 3 – New Public Works, Pilot Plant, & SPS

The third and final contract of Phase 2 would focus on constructing the new Public Works facility and yard, the new pilot plant area, and the new SPS.

5.2.3 High Level Project Schedule

A high-level project schedule is presented below in **Table 5-1.**

Table 5-1: Conceptual Construction Schedule

<table>
<tr><th colspan="4">2025</th><th colspan="4">2026</th><th colspan="4">2027</th><th colspan="4">2028</th><th colspan="4">2029</th><th colspan="4">2030</th><th colspan="4">2031</th><th colspan="4">2032</th><th colspan="4">2033</th><th colspan="4">2034</th><th colspan="4">2035</th></tr>
<tr><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td><td>Q1</td><td>Q2</td><td>Q3</td><td>Q4</td></tr>
<tr><td colspan="12">Relocate Baseball Diamonds</td><td colspan="32"></td></tr>
<tr><td colspan="4">Phase 1 Sludge & Interim Upgrades - Detailed Design</td><td colspan="40"></td></tr>
<tr><td colspan="2"></td><td colspan="10">Phase 2 Contract 1 New WWTP - Detailed Design</td><td colspan="32"></td></tr>
<tr><td colspan="4"></td><td colspan="8">Phase 1 Sludge & Interim Upgrades – Construction and Demolition</td><td colspan="32"></td></tr>
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<tr><td colspan="36"></td><td colspan="8">Phase 2 Contract 3 Public Works, Pilot Facility, & SPS - Construction</td></tr>
</table>

6 Permits and Approvals

The anticipated permits and approvals are summarized in **Table 6-1.**

Table 6-1: Permits and Approvals

Permit / Approval	Agency
Environmental Compliance Approval Amendment (ECA) Sewage	MECP
ECA Amendment Air & Noise	MECP
Site Plan Approval	City of Hamilton
Building Permit	City of Hamilton
Demolition Permit	City of Hamilton
Voltage Report	ESA
Permit to Take Water (PTTW)	MECP
Regulation Permit	Hamilton Conservation

7 Cost Estimate

A Class D conceptual cost estimate is summarized in **Table 7-1.** The cost estimate contingency and cost escalation allowances consistent with the City's standard cost estimation approach, which assumes construction would start in 2028. A more detailed breakdown is provided in **Appendix E.**

Table 7-1: Conceptual Capital Cost Estimate

Description	Amount
General Requirements	$27,200,000
Site Works	$13,000,000
Sewage Pumping Station	$5,000,000
Headworks Building	$14,000,000
Blower Building	$6,500,000
Aeration Tanks	$11,000,000

Description	Amount
MBR & UV Building	$30,000,000
Sludge Storage	$9,300,000
Administration Building	$7,000,000
Center of Excellence	$3,000,000
Soil Anchors	$10,000,000
SUBTOTAL FOR CONSTRUCTION (2024 $CAD)	**$136,000,000**
Construction Contingency (15%)	$20,400,000
Project Contingency & Estimating Allowance (30%)	$40,800,000
Inflation (assuming average of 4 years at 3.5%)	$29,100,000
TOTAL CONSTRUCTION COST	**$226,300,000**
Engineering Design and Contract Administration (15%)	$20,400,000
Project Contingency (25%)	$5,100,000
Inflation	$0
TOTAL CONSULTANT COST	**$25,500,000**
Land Costs	Not included
TOTAL CAPITAL COST ESTIMATE	**$252,000,000**

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A

Appendix A: Technical Memoranda

Engineering
for **people**

A1

Appendix A1: Design Basis Technical Memorandum

Engineering
for **people**

City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Design Basis Technical Memorandum

Tuesday, August 6, 2024

T001744A

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Engineering for **people**

Hamilton

Design Basis Technical Memorandum

Facility Upgrade Plan for Dundas WWTP

T001744A

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List of Appendices

1 Introduction

CIMA+ was retained to complete a review of best available technologies (BAT) to upgrade the Dundas Wastewater Treatment Plant (WWTP). This study will provide the City of Hamilton with a long-term plan and conceptual design to implement upgrades to the treatment process accounting for potential expansion and in consideration of existing site constraints.

This technical memorandum (TM) documents the findings of a review of historical data to establish the operating baseline and establish design basis for the capacity assessment and evaluation of alternatives.

2 Facility Overview

The Dundas WWTP is a conventional activated sludge facility with nitrification and tertiary filtration providing treatment to the community of Dundas. The facility is owned and operated by the City of Hamilton. The plant has a rated capacity of 18,200 m^3/d (MECP, 2001; MECP, 2010). The existing influent diversion chamber is designed to bypass all flows exceeding 42,200 m^3/d as per existing Certificate of Approval Number 3-1040-99-006 (MECP, 1999). The plant discharges to Cootes Paradise, via the Desjardin's Canal.

The plant consists of two treatment trains referred to as Plant A and Plant B constructed in 1962 and 1977, respectively. Plant A has a rated capacity of 6,100 m^3/d, while Plant B has a capacity of 12,100 m^3/d (MECP, 2010). Peak flows exceeding the capacity of the plant are diverted to the Dundas Equalization Tank (HC060) to the catchment of the Woodward Avenue WWTP.

The plant operation is subject to the Ministry of Environment, Conservation, and Parks (MECP) Amended Environmental Certificate of Approval (ECA) Number 3101-89PNRC issued October 6, 2010 (MECP, 2010). It is expected that the facility will be subject to the effluent loading targets outlined in the Hamilton Harbour Remedial Action Plan (HHRAP) for Cootes Paradise. However, the ECA has not been updated to reflect these targets.

An overview of the Dundas WWTP site is shown in **Figure 2-1** below. A general overview of the wastewater collection system in the area surrounding Dundas WWTP is shown in **Figure 2-2** below. The red lines depict the gravity sewers and manholes while the blue depicts the pumping stations and forcemains.

Flows to the plant enter through an influent diversion chamber. Flows are conveyed to the influent diversion chamber via a 600 mm by 400 mm rectangular sewer from the west; by an existing 375 mm diameter sewer inletting to the influent pumping station (known as the King Street Pumping Station) and pumping via a 300 mm diameter forcemain; and by another existing 375 mm diameter sewer which conveys flows from the east Dundas and from Waterdown. Flows from Waterdown are currently all conveyed to the Dundas Equalization (EQ) Tank via a manhole chamber (known as Manhole Chamber No. 1) located directly south of the Dundas EQ Tank.

The influent diversion chamber connects to the plant via a 730 mm by 1150 mm elliptical concrete pipe. The chamber also allows bypassing some or all flows via a 900 mm diameter bypass sewer which leads to the Dundas Equalization Tank.

From the influent diversion chamber flows enter the inlet works which consist of a mechanical bar screen followed by an aerated grit removal chamber.

The screened and degritted raw wastewater then splits via weir assemblies into a 600 mm channel discharging to Plant A and a 900 mm channel discharging to Plant B. Both Plants are conventional activated sludge facilities with rectangular primary clarifiers, aeration tanks and secondary clarifiers.

Both plants are equipped with chlorine contact tanks where secondary effluent is disinfected using sodium hypochlorite and dechlorinated with sodium bisulphite seasonally from May 1 to October 31.

The disinfected effluent from Plant A and Plant B flows by gravity via a 750 mm and 600 mm diameter pipe, respectively, and is combined in a manhole prior to flowing to entering the sand filtration facility via a 750 mm diameter pipe. The filtered effluent flows to a wet well by gravity and from there, it is pumped to the Desjardins Canal by two (duty/standby) high lift pumps via a 750 mm diameter sewer.

The waste activated sludge (WAS) from the secondary clarifiers is wasted to the influent of the primary clarifiers in each plant for co-thickening. The raw sludge and scum co-thickened with WAS is pumped to on-site covered holding tanks prior to being transported to Woodward Avenue WWTP for further treatment.

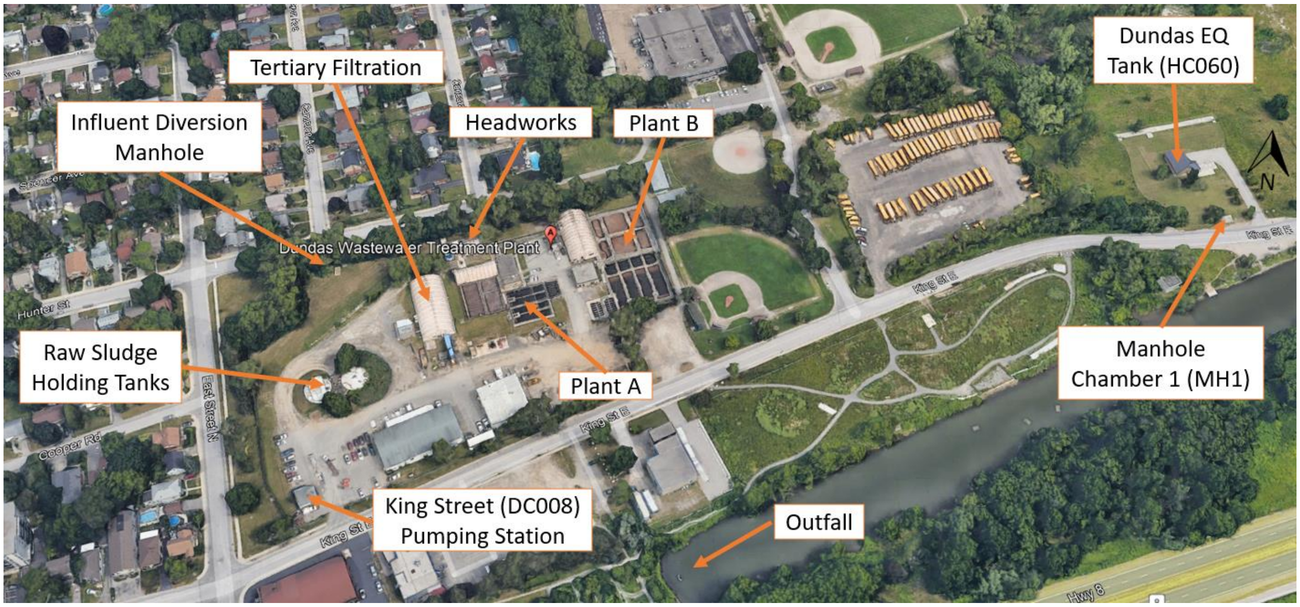

Figure 2-1: Existing Location and Site Plan of Dundas WWTP

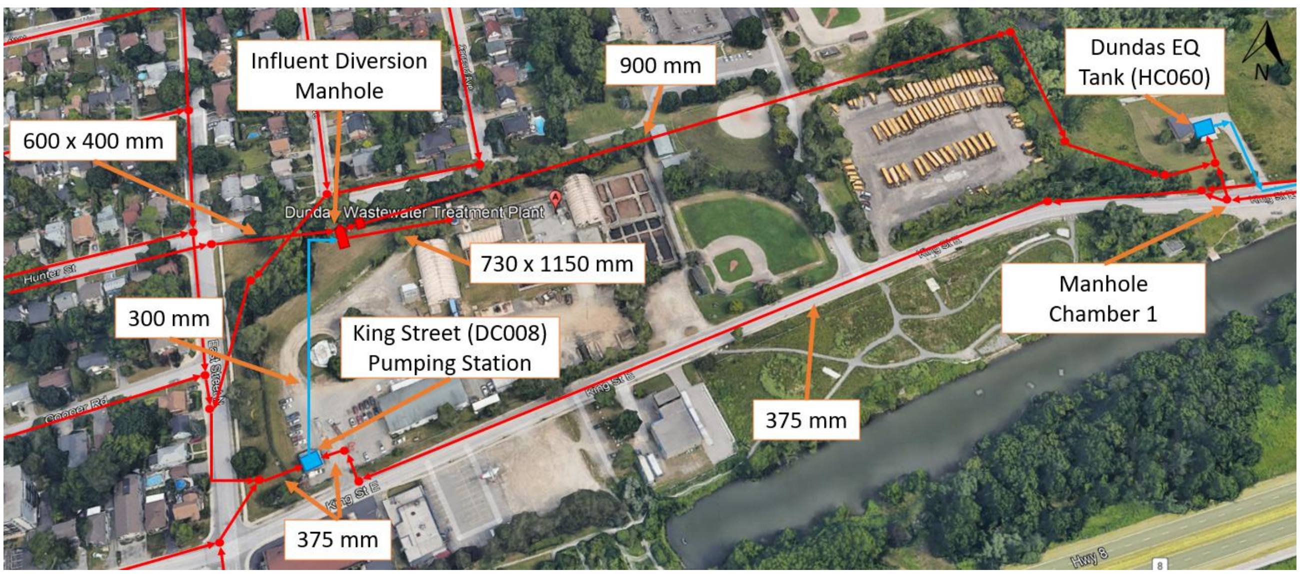

Figure 2-2: Overview of Dundas Wastewater Collection System

2.1 Existing Treatment Requirements

2.1.1 Hamilton Harbour Remediation Action Plan

Due to pollution concerns, the International Joint Commission (IJC) formed by Canada and the United States identified Hamilton Harbour as one of the 43 Areas of Concern in the Great Lakes Water Quality Agreement (HHRAP, 2003).

The Hamilton Harbour Remedial Action Plan (HHRAP) was developed to restore and protect environmental quality and beneficial uses in the Harbour. The goals of the HHRAP include control of Combined Sewer Overflows (CSOs), improved efficacy of WWTPs, erosion control and habitat restoration (HHRAP, 1992). To achieve these goals, the HHRAP provided 50 recommendations including the establishment of net loading targets for the WWTPs that discharge to the Hamilton Harbour. Both short-term and long-term targets were outlined within HHRAP, with the initial targets to be met by 2003 and final targets to be met by 2015.

Initially, in the 1992 HHRAP report, the goal for Dundas WWTP was to reduce the TP to less than 0.1 ppm (equivalent to 0.1 mg/L) based on the HHRAP Recommendation #1 c) iv) (HHRAP, 1992). The HHRAP established the requirement to use the Best Available Technology Economically Achievable (BATEA) for trace metals and trace organics such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (HHRAP, 1992). The HHRAP did not require the implementation of BATEA for TP. However, it should be noted that when HHRAP was developed, the 0.1 ppm was considered the minimum achievable TP concentration using the best available technology at the time. During the Stage 2 Update Report (HHRAP, 2003), Recommendation 1 was updated and the initial targets for Dundas WWTP were set to those identified in **Table 2-1** below.

The HHRAP Cootes-Grindstone Water Quality Targets Sub-Committee was responsible for developing the final targets in **Table 2-1** below (HHRAP, 2018). Primary members of this subcommittee include the Royal Botanical Gardens, City of Hamilton, MECP, Environment Canada, Fisheries & Oceans Canada, as well the Hamilton Conservation Authority and Conservation Halton (Oakes & Stone, 2021).

Although the Dundas WWTP only contributes approximately 10% of the total phosphorus (TP) loading to Cootes Paradise, it is one of the only manageable sources (Kim, et al., 2016). The City provided the effluent targets proposed for Dundas WWTP as per their latest communications with the HHRAP Cootes-Grindstone Water Quality Targets Sub-Committee. Supporting documentation regarding how these targets were selected were outlined in three documents provided by the Sub-Committee to the City. An effluent target of 0.05 mg/L for TP was proposed. Achieving such low effluent concentration at the plant would result in less than a 10% decrease in TP to Cootes Paradise (Yang, Kim, Bowman, Theysmeyer, & Arhonditsis, 2020). However, this decrease was considered critical in achieving a tipping point to where the environment switches to a more desirable state (Yang, Kim, Bowman, Theysmeyer, & Arhonditsis, 2020).

It should be noted that the TP limit adopted would have a significant impact on the process selection for future upgrades at the Dundas WWTP and would significantly impact the capital and operation and maintenance costs for the facility. Furthermore, the TP concentration limit (mass per unit volume) would imply a maximum TP loading limit (in terms of mass per unit time). Thus, any future increases to the current rated flow capacity would require corresponding reductions to the TP effluent concentration. If a limit near or at the limit of available technology is selected, it would make future capacity expansions, if required, very difficult.

Within the documents provided to the City by the Cootes-Grindstone Water Quality Targets Sub-Committee, effluent targets for total suspended solids (TSS) and total ammonia nitrogen (TAN) were also proposed. The initial targets outlined in **Table 2-1** below are those set in the 2003 Stage 2 Update Report (HHRAP, 2003) and the final targets are those proposed in the latest communications with the HHRAP Cootes-Grindstone Water Quality Targets Sub-Committee.

Table 2-1: Existing Dundas WWTP HHRAP Targets

Effluent Parameter	Initial HHRAP Target (3)	Final HHRAP Target (4)
TSS, mg/L	1.54	1.20 (1)
TP, mg/L	0.27	0.05 (2)
TAN, mg/L May 1 – October 31 November 1 – April 30	1.22	 0.07 (1) 0.28 (1)

Notes:

1. Compliance based on monthly average basis.
2. Compliance based on six-month average basis (May to October inclusive and November to April inclusive).
3. Initial HHRAP targets do not specify compliance basis.
4. Proposed effluent targets from latest communications with the Cootes-Grindstone Water Quality Targets Sub-Committee.

Further consultation is required to confirm the effluent limits to be adopted. The limits at Woodward Avenue WWTP were negotiated with the HHRAP committee, so the targets for Dundas WWTP may be further discussed. However, this may be more challenging at Dundas WWTP since Cootes Paradise is a sensitive receiver.

2.1.2 Existing Effluent Parameter Summary

The existing regulatory effluent objectives and compliance limits are summarized in **Table 2-2** below, adapted from the current Amended ECA No. 3101-89PNRC, issued October 2010.

Table 2-2: Current Effluent Parameters

Effluent Parameter	Effluent Objective (1),(2)	Effluent Compliance Limit (1),(2)
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), mg/L	5.0	5.0
Total Suspended Solids (TSS), mg/L	5.0	5.0
TP, mg/L	0.5	0.5
TAN, mg/L May 1 – October 31 November 1 – April 30	 2.0 10.0	 2.0 10.0
Total Residual Chlorine, mg/L (May 1 to October 31)	0.02	0.02
E. coli (May 1 to October 31) (3)	100 organisms per 100 mL	200 organisms per 100 mL
pH	6.0 to 9.5	6.0 to 9.5

Notes:

1. Adapted from Amended ECA No. 3101-89PNRC issued October 2010.
2. Compliance based on monthly average basis.
3. Compliance based on monthly geometric mean density.

3 Historical Data Review

3.1 Service Population

The City is undergoing a Water and Wastewater Master Servicing Plan to determine infrastructure needs to 2051 and beyond. The 2021 service population for Dundas was reported as 30,219 assuming no Urban Boundary Expansion (UBE) (GMBP, 2021).

3.2 Influent Flows

The plant is not equipped with an influent flow meter. Plant A and Plant B are each equipped with a Parshall flume to measure the secondary effluent flows. These measurements are used for reporting daily plant effluent flow by adding the two flows together. According to the process control narrative, the hourly flows and daily totals are recorded. CIMA+ was only provided daily flow data from the Parshall flumes.

Flows diverted to the Dundas EQ tank at the influent manhole chamber are measured using a weir-based ultrasonic flow transmitter. Daily flow data was provided to CIMA+ for analysis.

There is also a flow monitoring device at a manhole on the 900 mm bypass sewer upstream of the Dundas EQ tank. This flow monitor was installed in September 2021 as part of a flow monitoring study of the sanitary sewers in the City (AECOM, 2021). Flow data is collected every 5 minutes.

Bypass flow data was totalized to obtain daily flows and then added to the secondary effluent flow values to estimate the total influent flow to the Dundas WWTP.

Figure 3-1 below plots the secondary effluent flows against the bypass flows diverted to the Dundas EQ Tank for the 2020 to 2021 data. This chart shows that most of the influent flow is treated at Dundas WWTP, but there are periods where a large portion of the flow bypasses to the EQ tank.

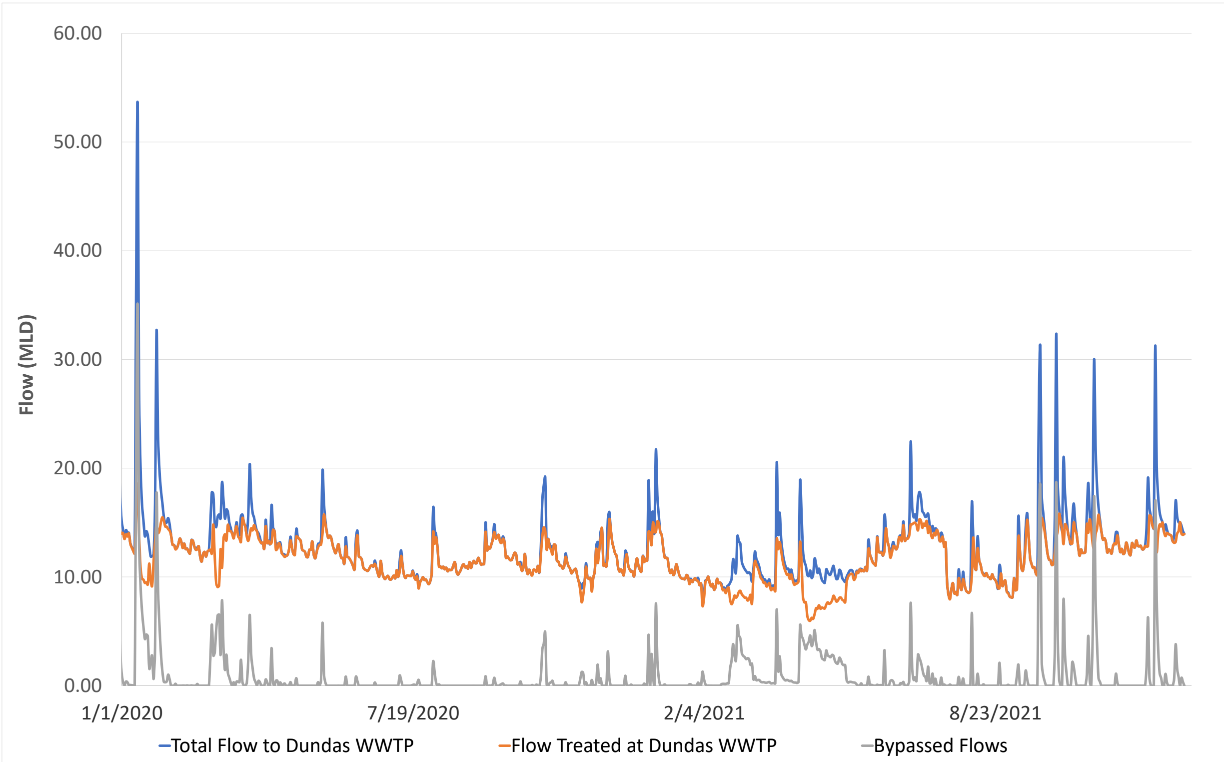

Figure 3-1: Historical Dundas WWTP Effluent Flows and Bypass Flows (2020 to 2021)

A summary of the calculated historical influent flow to Dundas WWTP from 2017 to 2021 is presented below in **Table 3-1**. Historical data analysis is available in **Appendix A**.

Table 3-1: Historical Flow Data Summary (2017 to 2021)

Parameter	Flow, m^3/day	Peaking Factor
Average Day Flow (ADF)	14,115	-
Peak Day Flow – 99th Percentile (PDF) (1)	35,207	2.5
PDF – Maximum Day (2)	67,261	4.8

Notes:

1. Based on 99th percentile from historical average day flow data.
2. Maximum daily flow on May 1, 2017 from historical average day flow data.

Figure 3-2 plots the calculated daily average flows to Dundas WWTP against the plant's rated capacity for the period 2017 to 2021. As noted above, daily flows are estimated as the sum of secondary effluent flows and flows measured at the influent manhole (corresponding to flows diverted to the Dundas EQ tank). Flows to the Dundas WWTP have been steadily decreasing over the past several years with less occurrences of flows exceeding the rated capacity of the facility. The existing Water and Wastewater Plan projected a per capita flow of 653 L/cap/day for Dundas WWTP in 2021 (KMK Consultants Ltd., 2006). However, using the latest flow and population data, the per capita flow was determined to be 467 L/cap/day for Dundas WWTP.

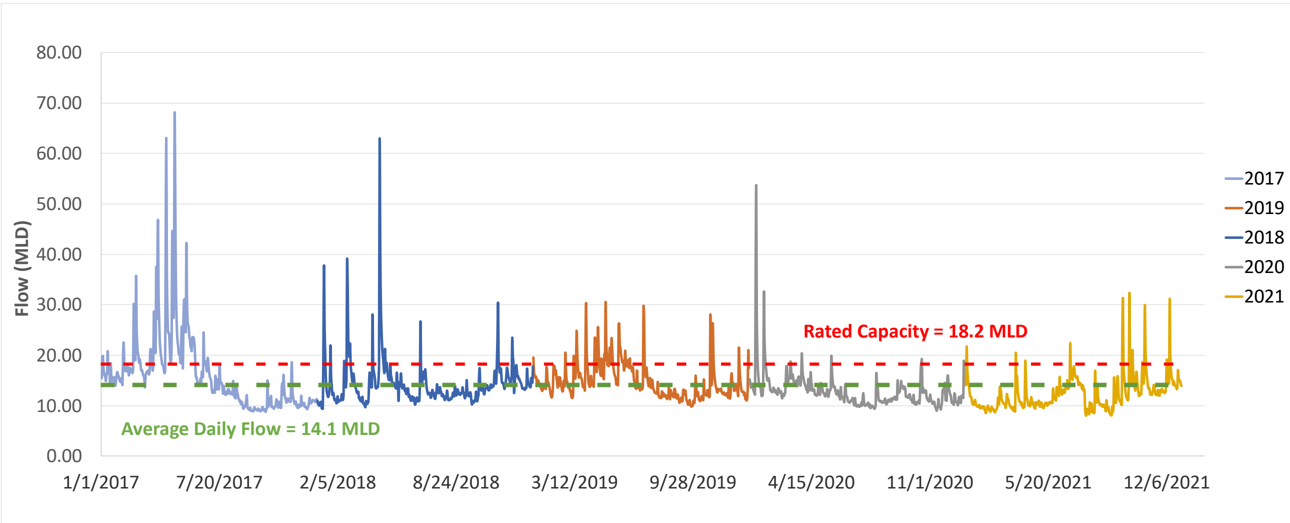

Figure 3-2: Historical Flows to Dundas WWTP (2017 to 2021)

Since only daily flow data is available for the treated flow, an accurate analysis of diurnal flow patterns could not be completed. Thus, a full analysis to determine peak hourly and peak instantaneous flow could also not be completed.

For the purposes of this study, it will be assumed that future upgrades would be designed such that flows over 42,200 m^3/day would be diverted to the Dundas EQ Tank.

3.3 Raw Wastewater Characteristics and Loadings

The influent concentration characteristics are sampled weekly at the plant using an automatic sampler in the influent chamber. No data was available on influent alkalinity. Average concentrations of 74 mg/L and 75 mg/L for $cBOD_5$ and TSS, respectively, were observed during the period 2017 to 2021. Average concentrations of 1.5 mg/L and 26 mg/L for TP and TKN, respectively, were observed during the period of 2017 to 2021. Given that the influent concentrations of $cBOD_5$,TSS and TP are significantly lower than those for typical domestic wastewater sources, CIMA+ suspected that there might be an issue with the data. Monthly concentration data obtained from manual samples from

2017 to 2021 were reviewed and were found to be significantly higher in concentration and more representative of typical domestic raw wastewater.

Therefore, for the purposes of this technical memorandum, the manual monthly samples were used to establish the design basis. The City has confirmed through additional sampling that the data from these monthly grab samples are reliable.

A summary of the historical raw wastewater characteristics from 2017 to 2021 are presented below in **Table 3-2**.

Table 3-2: Historical Raw Wastewater Characteristics Summary (2017 to 2021)

Parameter	Average Concentration, mg/L	Max Month Concentration, mg/L	Max Month Peaking Factor
$cBOD_5$	158	228	1.4
TSS	224	377	1.7
TP	5.0	8.0	1.6
Total Kjeldahl Nitrogen (TKN)	33.8	53.0	1.6

A comparison of the historical per capita loadings to typical per capita loadings is presented in **Table 3-3** below. The historical per capita loadings are within the typical range provided in MECP guidelines (MECP, 2008) and Metcalf and Eddy (Metcalf & Eddy, 2014) for domestic sewage.

The historical average concentrations will be utilized for evaluating existing process capacity and alternative BAT treatment technologies.

Table 3-3: Comparison of Historical and Typical Per Capita Loadings (2017 to 2021)

Parameter	Historical Per Capita Loading, g/cap/d (1)	Typical Per Capita Loadings (Range), g/cap/d (2)
$cBOD_5$	74	75 (3) (70-110)
TSS	105	90 (3) (60-115)

Parameter	Historical Per Capita Loading, g/cap/d (1)	Typical Per Capita Loadings (Range), g/cap/d (2)
TP	2.3	2.1 (2-5)
Total Kjeldahl Nitrogen (TKN)	16	13.2 (9-14)

Notes:

1. Based on 2021 service population estimate of 30,219 (GMBP, 2021).
2. Typical per capita loading rates of TP and TKN for domestic sewage (Metcalf & Eddy, 2014).
3. Typical per capita loading rates of $cBOD_5$ and TSS for domestic sewage (MECP, 2008).

3.4 Effluent Quality and Treatment Performance

The Dundas WWTP has generally been operating in compliance with the ECA limits and objectives during the period 2017 to 2021. A summary of the effluent performance from 2017 to 2021 is presented below in **Table 3-4**.

Table 3-4: Final Effluent Quality Summary (2017 to 2021)

Effluent Parameter	Monthly Average Conc., mg/L	Max Month Conc., mg/L	Effluent Limit/ Obj., mg/L (1),(2),(3)
$cBOD_5$	1.4	4.8	5.0
TSS	1.2	4.8	5.0
TP	0.09	0.2	0.5
TAN			
May 1 – October 31	0.09	0.60	2.0
November 1 – April 30	0.31	3.15	10.0

Notes:

1. Adapted from Amended ECA No. 3101-89PNRC issued October 2010.

Effluent Parameter	Monthly Average Conc., mg/L	Max Month Conc., mg/L	Effluent Limit/ Obj., mg/L (1),(2),(3)

2. Compliance based on monthly average basis.
3. ECA objectives and limits are the same.

4 Design Criteria

4.1 Population Growth

The plant was serving a population of 30,219 in 2021, which is projected to increase to 31,920 in 2051 (GMBP, 2021).

4.2 Design Flows

As noted above, the historical five-year ADF to the plant is 14,115 m^3/day prior to any diversions within the influent manhole. However, the plant has been historically operating at 12,436 m^3/day, with the remaining flows bypassed to the Dundas EQ Tank. The influent flows treated at the plant correspond to 68% of its rated capacity.

Based on a flow of 467 L/cap/d, the projected ultimate flow to the Dundas WWTP would be 14,910 m^3/d. Thus, the rated capacity of Dundas should be sufficient to service the projected population to 2051 and beyond.

For the purposes of the evaluation of BAT options, a design flow equal to the current rated capacity of 18,200 m^3/day will be adopted.

Per the ECA (MECP, 1999), the diversion manhole is designed to bypass all flows exceeding 42,200 m^3/day. This value was thus adopted as the design peak flow. It is expected that existing deficiencies would be corrected to allow flows up to this peak value to be treated at the plant.

The proposed design flows and corresponding peaking factors for Dundas WWTP are summarized below in **Table 4-1**.

Table 4-1: Proposed Peak Flow Factors for Dundas WWTP

Parameter	Flow, m^3/day	Peaking Factor
ADF	18,200	-
Peak Flow	42,400	2.3

4.3 Design Influent Wastewater Characteristics

The design raw wastewater characteristics are summarized in **Table 4-2** below. The maximum month peaking factors are used to assess the capacity of the existing aeration system and for the conceptual design of the upgrades to the aeration system.

Table 4-2: Design Raw Wastewater Characteristics

Parameter	Design Average Day Conc., mg/L (1)	Design Maximum Month Conc., mg/L (2)	Maximum Month Peaking Factor
$cBOD_5$	158	228	1.4
TSS	224	377	1.7
TP	5	8	1.6
TKN	34	53	1.6
Alkalinity (as $CaCO_3$)	200	-	-

Notes:

1. Design concentration at rated capacity of 18,200 m^3/day.
2. Maximum month concentrations based on design average concentrations with maximum month peaking factors determined from historical data applied.
3. No historical data was available on influent alkalinity. It is recommended that alkalinity be confirmed during the design phase.

4.4 Proposed Effluent Limits and Objectives

The proposed effluent design objectives are summarized below in **Table 4-3** below.

Further consultation with the MECP is required to confirm the effluent limits to be adopted.

Table 4-3: Proposed Design Effluent Criteria

Effluent Parameter	Proposed Effluent Objective
$cBOD_5$, mg/L (1)	3.0
TSS, mg/L (1)	2.0
TP, mg/L (2)	0.05 (0.91 kg/d)
TAN, mg/L (1) May 1 – October 31 November 1 – April 30	 0.3 0.5
Total Residual Chlorine, mg/L (May 1 to October 31) (1)	0
E. coli (May 1 to October 31) (3)	100 organisms per 100 mL
pH	6.0 to 9.5

Notes:

1. Compliance based on monthly average basis.
2. Compliance based on six-month average basis (May to October inclusive and November to April inclusive).
3. Compliance based on monthly geometric mean density.

4.5 Design Basis Summary

The historical Dundas WWTP flow and concentration data from 2017 to 2021 was reviewed and analyzed to develop a design basis for the evaluation of BAT treatment alternatives and conceptual design of proposed process upgrades at the facility. The recommended design basis is summarized in **Table 4-4** below.

Table 4-4: Design Basis Summary

Parameter	Design Value
Design Flows	
Average Day Flow, m^3/d	18,200
Peak Flow, m^3/d (1)	42,400
Wastewater Characteristics	
$cBOD_5$, mg/L	158
TSS, mg/L	224
TP, mg/L	5
TKN, mg/L	34
Proposed Effluent Objectives (2)	
$cBOD_5$, mg/L	3.0
TSS, mg/L	2.0
TP, mg/L (3)	0.05
TAN, mg/L May 1 – October 31 November 1 – April 30	 0.3 0.5
Total Residual Chlorine, mg/L (May 1 to October 31)	0.00
E. coli (4) (May 1 to October 31)	100 organisms per 100 mL
pH	6.0 to 9.5

Parameter	Design Value
Notes: 1. Flows greater than this value will be bypassed to the Dundas EQ tank. 2. Compliance based on monthly average basis. 3. Compliance based on six-month average basis (May to October inclusive and November to April inclusive). Compliance basis to be confirmed in consultation with the MECP and Cootes-Grindstone Water Quality Targets Sub-Committee. 4. Compliance based on monthly geometric mean density.	

5 Capacity Assessment

A capacity assessment was completed for the major unit processes at the Dundas WWTP to evaluate the available capacity of the existing facility. The assessment was based on traditional desktop analytical methods, using historical plant data including raw wastewater concentrations and primary clarifier removal efficiencies, plant design criteria, process train capacities as stated in the ECA, and MECP design guidelines. Details of the capacity assessment are included in **Appendix B.**

The equivalent ADF capacity of each unit process in Plant A and Plant B relative to each plant's rated capacity is shown in **Figure 5-1** and **Figure 5-2** for Plant A and Plant B, respectively. The equivalent ADF capacity of each plant unit process at Dundas WWTP as a whole relative to the facility's rated capacity is shown in **Figure 5-3**. The graphs are colour coded based on the capacity limiting condition for each unit process as follows:

- Unit processes limited by average day flow are shown in blue.
- Unit processes limited by peak daily flows are shown in green.
- Unit processes limited by peak hourly flows are shown in orange.
- Unit processes limited by peak instantaneous flows are shown in yellow.

As shown, most of the unit processes have theoretical capacities well below their rated capacities as stated in the ECA. During average flows and peak flows, both Plant A and B are limited hydraulically by the primary clarifiers. A summary of the actual capacity at average day flow at Dundas WWTP is presented below in **Table 5-1**.

Table 5-1: Capacity Assessment Summary

Parameter	Rated Average Day Capacity, m^3/day	Actual Average Day Capacity, m^3/day
Plant A	6,100	4,240

Parameter	Rated Average Day Capacity, m³/day	Actual Average Day Capacity, m³/day
Plant B	12,100	9,490
Total	18,200	13,730

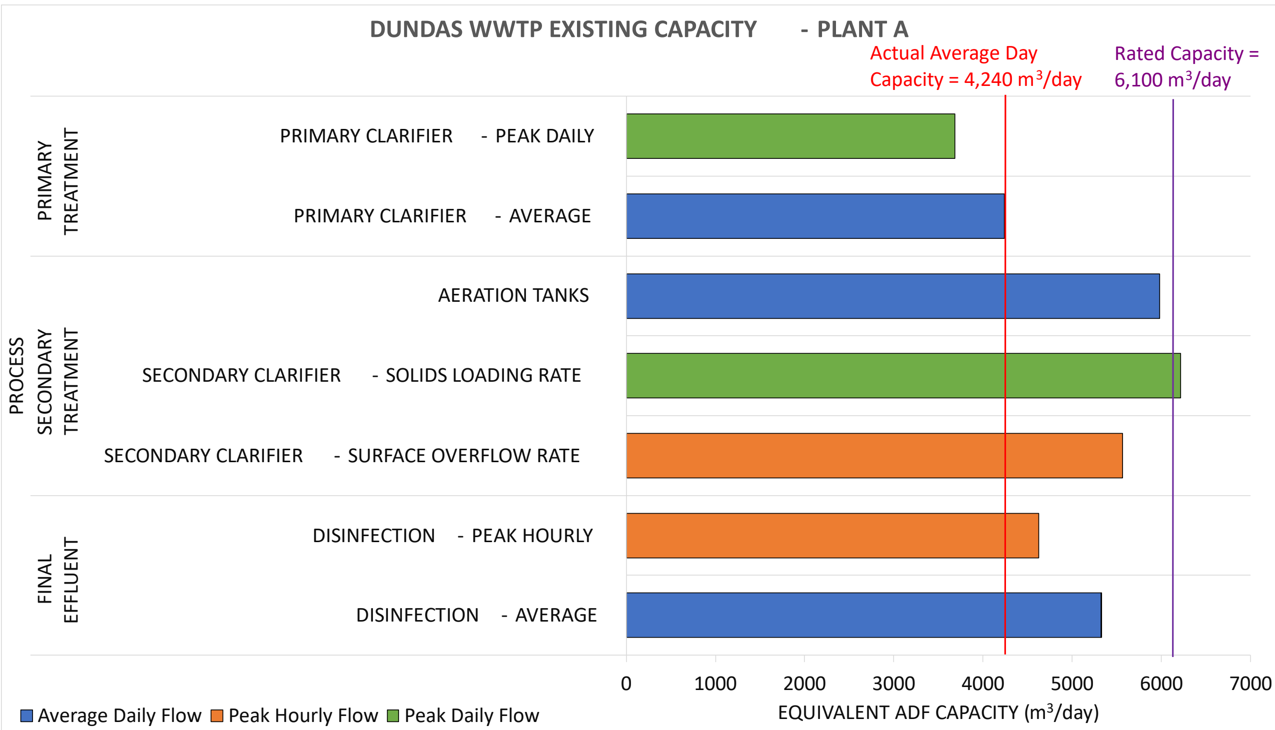

Figure 5-1: Plant A Existing Capacity

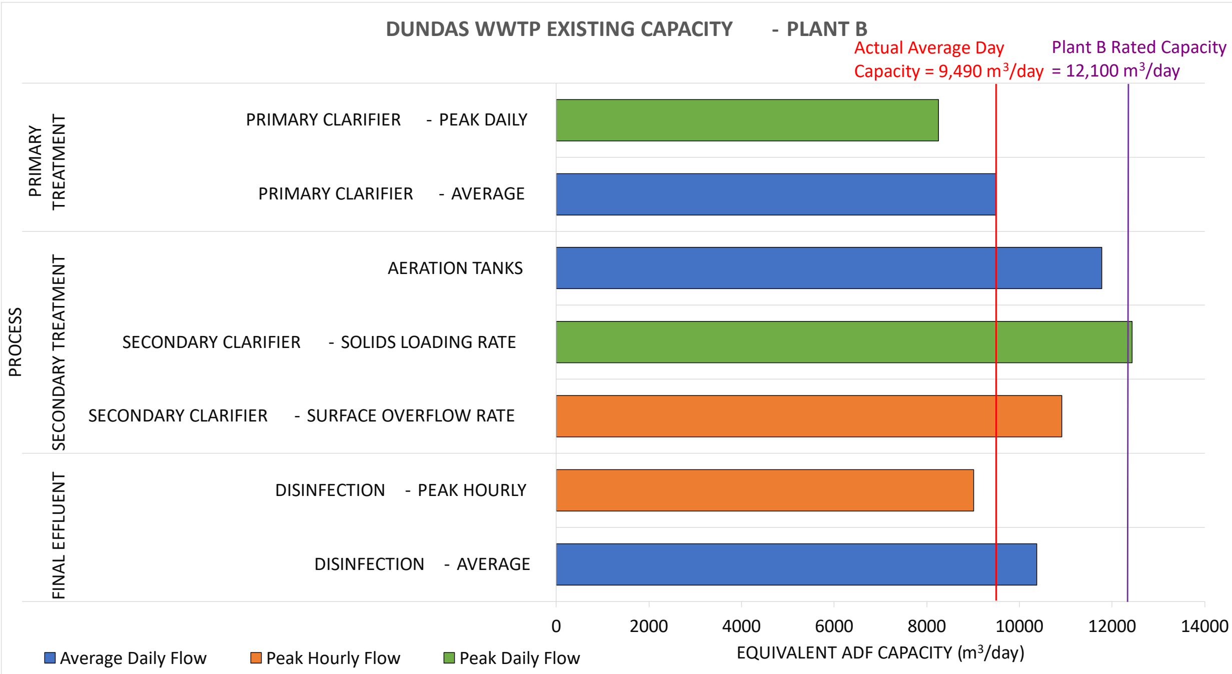

Figure 5-2: Plant B Existing Capacity

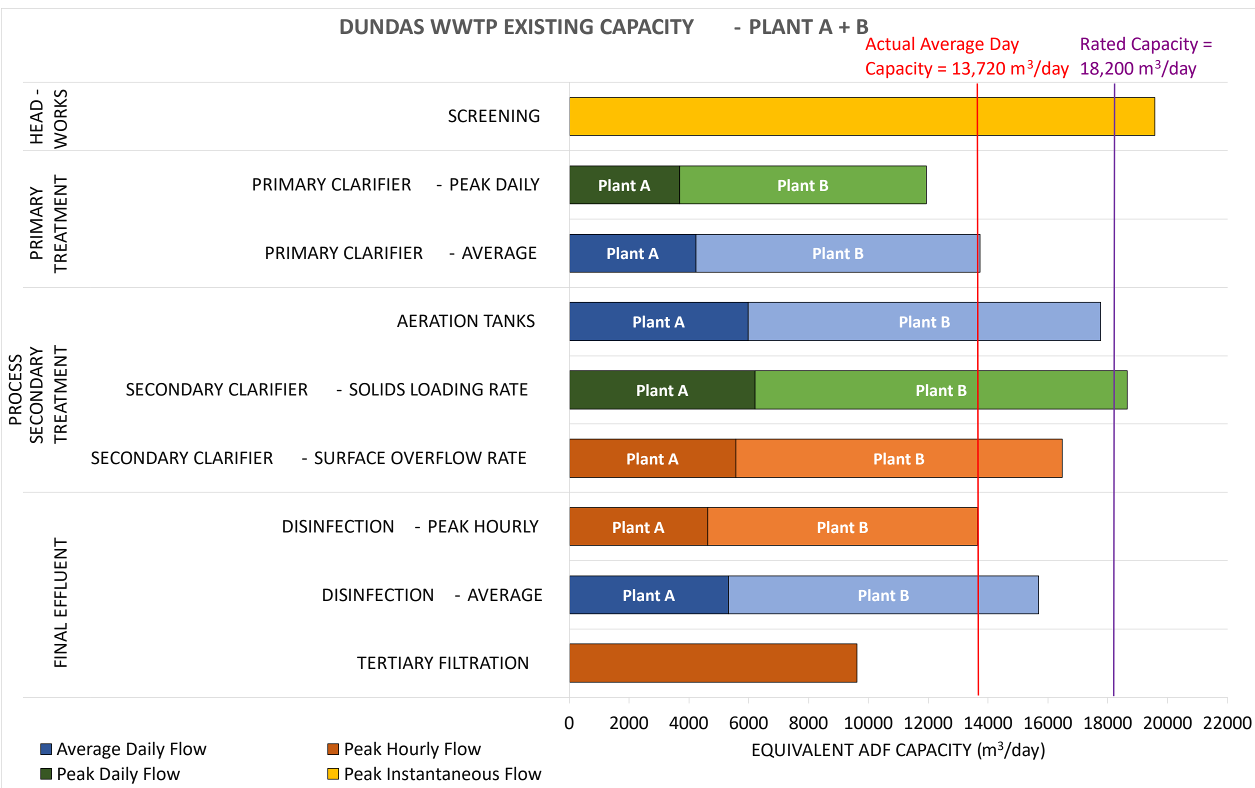

Figure 5-3: Dundas WWTP Existing Capacity - Plant A and B Combined

6 Potential Challenges and Opportunities

Table 6-1 below summarizes project challenges, facility issues and opportunities identified during a site visit with operations conducted by CIMA+ on August 31, 2022.

Table 6-1: Project Challenges and Opportunities

Process	Challenges/Issues	Opportunities
Manhole Chamber No. 1 (Upstream of Dundas EQ Tank – Along King St.)	• The actuated gate within MH Chamber No. 1 is not operational so it is kept closed and all flows from Waterdown are diverted to the Dundas EQ tank.	• Replace/repair actuated gate to provide the flexibility to direct flows from Waterdown/East Dundas to Dundas WWTP as capacity allows, specifically during low flow periods, such as overnight. This would provide increased operational flexibility.
Influent Diversion Manhole Chamber	• Actuation of influent manhole bypass gate is based on secondary effluent flow measurement delaying the reaction time of the gate operation.	• Operation of gate and reaction time would be improved if a flow meter providing instantaneous data was installed upstream to the influent diversion manhole chamber. • Dosage of ferric sulphate could be improved with an influent flow meter. • The feasibility of installing a flow meter(s) upstream of the diversion chamber should be investigated.
Grit Removal	• The aerated grit lift in the grit chambers is not functional.	• Review grit chamber functionality and potentially replace/repair aeration to grit chamber to improve grit removal performance.
Automatic Sampling	• There seems to be an issue with the automatic sampling of $cBOD_5$, TSS and TP. The concentration data is generally significantly low. • Alkalinity has not been measured in the influent.	• The accuracy of the automatic sampler should be investigated. • Full wastewater characterization, including alkalinity, to be completed for Detailed Design phase.

Process	Challenges/Issues	Opportunities
Chemical Storage	• The design of the chemical storage and feed is such that there are hydraulic limitations to the allow the full volume of the storage tank to be used.	• Review of the chemical storage and feed system should be conducted.
Raw Sludge Holding Tanks	• One of the holding tanks has been fully taken out of service due its poor structural condition. • Both holding tanks are in poor condition structurally. • Sludge hauling required frequently due to insufficient storage capacity available. • The existing tank design does not provide any opportunities for decanting/thickening.	• Rehabilitate/replace the sludge tanks. • Review option to pump solids to Woodward Avenue WWTP using the bypass channel to reduce truck visits and optimize storage.
King St. PS	• There are no means of isolating the wet well. • Equipment is reaching end of its expected service life. • The station is not equipped with a flow meter.	• Review the configuration of the wet well. • Carry out equipment replacement as required. • Evaluate the feasibility of installing a flow meter.
Requirement to meet HHRAP Targets	• The current facility would not be capable to reliably meet more stringent targets.	• Upgrade facility to incorporate BAT.
Existing Plant Condition and Performance	• As discussed above, the existing facility is not able to treat flows up to its rated capacity.	• Upgrade facility to address capacity deficiencies.
Space Constraints within the Plant	• Limited space within the plant available for construction.	• Review siting options for the construction of the new plant. • Consider feasibility of expanding site boundaries to the east.

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A

Appendix A: Design Basis Summary

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Appendix B: Capacity Assessment

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Appendix A2: Effluent Criteria Long List of Alternatives Technical Memorandum

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City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Effluent Criteria Technical Memorandum

Tuesday, August 6, 2024

T001744A

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Hamilton

Effluent Criteria Technical Memorandum

Facility Upgrade Plan for Dundas WWTP

T001744A

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1 Introduction

CIMA+ was retained by the City of Hamilton to complete a review of best available technologies (BAT) to upgrade the Dundas Wastewater Treatment Plant (WWTP). This study will provide the City with a long-term plan and conceptual design to implement upgrades to the treatment process in consideration of existing site constraints, effluent criteria updates and life cycle costs.

This technical memorandum (TM) documents the proposed effluent objectives to be used as the design basis for upgrades to the Dundas WWTP. This document was developed to support consultation with the Hamilton Harbour Remedial Action Plan (HHRAP) Cootes-Grindstone Water Quality Targets Sub-Committee, to obtain general feedback on the proposed effluent objectives. The regulatory effluent compliance limits would be confirmed with the Ministry of Environment, Conservation and Parks (MECP) at a future date.

2 Facility Overview

2.1 Existing Facility

The Dundas WWTP is a conventional activated sludge facility with nitrification and tertiary filtration providing treatment to the community of Dundas. The facility is owned and operated by the City of Hamilton. The plant has a rated capacity of 18,200 m^3/day (MECP, 2010). The plant discharges to Cootes Paradise, via the Desjardin's Canal.

The plant consists of two treatment trains referred to as Plant A and Plant B constructed in 1962 and 1977, respectively. Plant A has a rated capacity of 6,100 m^3/d, while Plant B has a capacity of 12,100 m^3/d. Peak flows exceeding the capacity of the plant are diverted to the Dundas Equalization Tank (HC060) to the catchment of the Woodward Avenue WWTP.

The plant operation is subject to the MECP Amended Environmental Certificate of Approval (ECA) Number 3101-89PNRC issued October 6, 2010 (MECP, 2010). The ECA has not been updated to reflect any of the targets set by the HHRAP.

An overview of the Dundas WWTP site is shown in **Figure 2-1** below. A general overview of the wastewater collection system in the area surrounding Dundas WWTP is shown in **Figure 2-2** below. The red lines depict the gravity sewers and manholes while the blue depicts the pumping stations and forcemains.

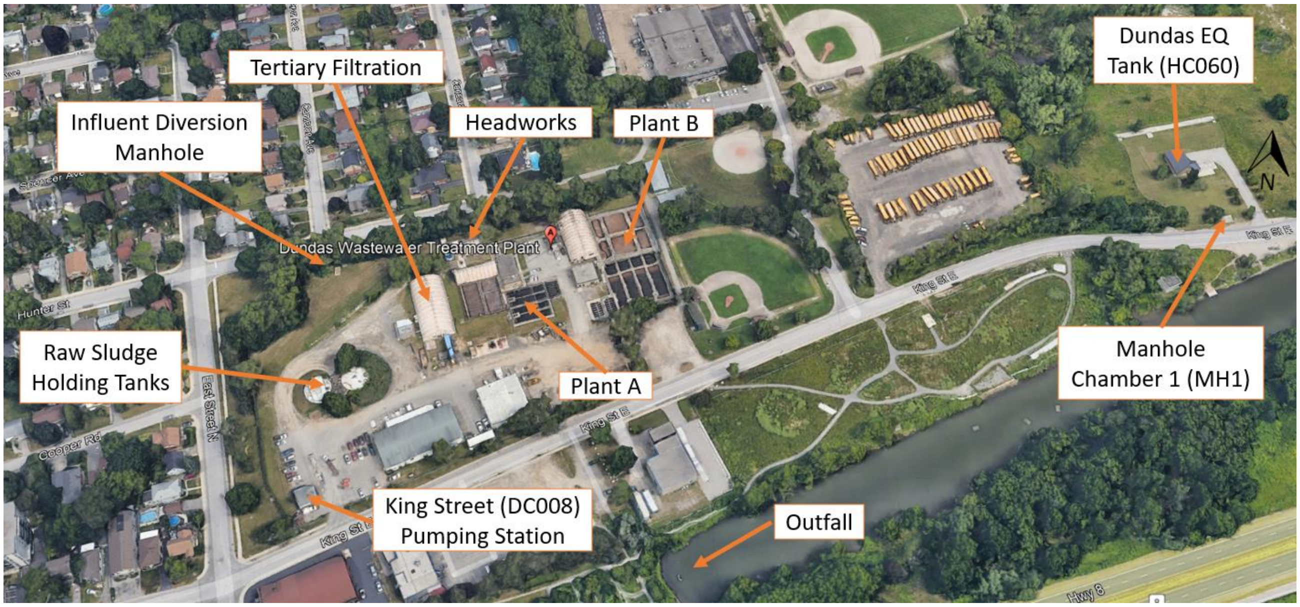

Figure 2-1: Existing Location and Site Plan of Dundas WWTP

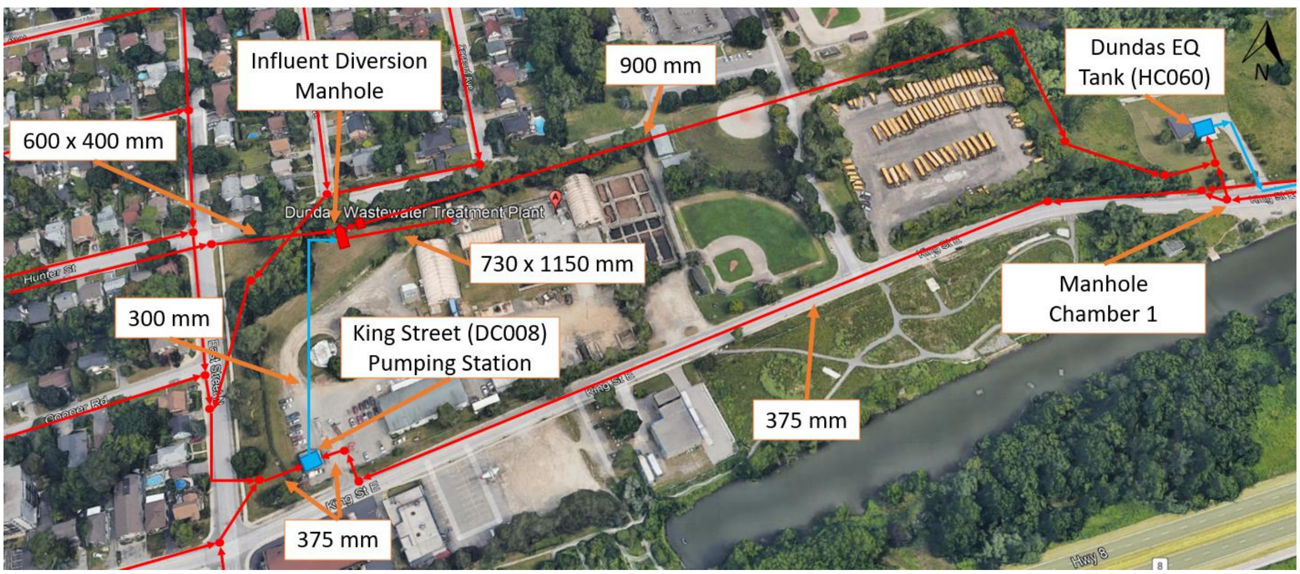

Figure 2-2: Overview of Dundas Wastewater Collection System

Flows to the plant enter through an influent diversion chamber. Flows are conveyed to the influent diversion chamber via a 600 mm by 400 mm rectangular sewer from the west; by an existing 375 mm diameter sewer inletting to the influent pumping station (known as the King Street Pumping Station) and pumping via a 300 mm diameter forcemain; and by another existing 375 mm diameter sewer which conveys flows from the east Dundas and from Waterdown. Flows from Waterdown are currently all conveyed to the Dundas Equalization (EQ) Tank via a manhole chamber (known as Manhole Chamber No. 1) located directly south of the Dundas EQ Tank.

The influent diversion chamber connects to the plant via a 730 mm by 1150 mm elliptical concrete pipe. The chamber also allows bypassing some or all flows via a 900 mm diameter bypass sewer which leads to the Dundas Equalization Tank.

From the influent diversion chamber flows enter the inlet works which consist of a mechanical bar screen followed by an aerated grit removal chamber.

The screened and degritted raw wastewater then splits via weir assemblies into a 600 mm channel discharging to Plant A and a 900 mm channel discharging to Plant B. Both Plants are conventional activated sludge facilities with rectangular primary clarifiers, aeration tanks and secondary clarifiers.

Both plants are equipped with chlorine contact tanks where secondary effluent is disinfected using sodium hypochlorite and dechlorinated with sodium bisulphite seasonally from May 1 to October 31.

The disinfected effluent from Plant A and Plant B flows by gravity via a 750 mm and 600 mm diameter pipe, respectively, and is combined in a manhole prior to flowing to the sand filtration facility via a 750 mm diameter pipe. The filtered effluent flows to a wet well by gravity and lifted by two (duty/standby) pumps to the 750 mm diameter outfall sewer, from there, it flows by gravity to the Desjardins Canal.

The waste activated sludge (WAS) from the secondary clarifiers is wasted to the influent of the primary clarifiers in each plant for co-thickening. The raw sludge and scum co-thickened with WAS is pumped to on-site covered holding tanks prior to being transported to Woodward Avenue WWTP for further treatment.

2.2 Project Background

The infrastructure at the Dundas WWTP is reaching its end of life and requires significant upgrades. Furthermore, the HHRAP Cootes-Grindstone Water Quality Targets Sub-Committee has proposed revising the effluent criteria at Dundas WWTP to incorporate more stringent targets to protect and restore Cootes Paradise (further described in **Section 2.2.1** and **Section 2.3.2** below).

2.2.1 Hamilton Harbour Remediation Action Plan

Due to pollution concerns, the International Joint Commission (IJC) formed by Canada and the United States identified Hamilton Harbour as one of the 43 Areas of Concern in the Great Lakes Water Quality Agreement (HHRAP, 2003).

The HHRAP was developed to restore and protect environmental quality and beneficial uses in the Harbour. The goals of the HHRAP include control of Combined Sewer Overflows (CSOs), improved efficacy of WWTPs, erosion control and habitat restoration

(HHRAP, 1992). To achieve these goals, the HHRAP provided 50 recommendations including the establishment of net loading targets for the WWTPs that discharge to the Hamilton Harbour. Both short-term and long-term targets were outlined within HHRAP, with the initial targets to be met by 2003 and final targets to be met by 2015.

The HHRAP Cootes-Grindstone Water Quality Targets Sub-Committee (herein referred to as the “HHRAP Cootes-Grindstone Sub-Committee”) was responsible for developing the initial and final targets for Dundas WWTP (HHRAP, 2018). Primary members of this subcommittee include the Royal Botanical Gardens, City of Hamilton, MECP, Environment Canada, Fisheries & Oceans Canada, as well the Hamilton Conservation Authority and Conservation Halton (Oakes & Stone, 2021).

Initially in the 2006 Master Plan, multiple options were considered as potential future treatment solutions for wastewater collected in Dundas including (KMK Consultants Ltd., 2006):

1. Upgrade Dundas WWTP to repair and/or replace aging infrastructure and to meet updated effluent criteria.
2. Take Dundas WWTP offline and convey all wastewater to Woodward Ave. WWTP.

Although the flow from Dundas would be a small portion of the flow treated at Woodward Ave. WWTP, the collection system in the Woodward Ave. WWTP catchment cannot hydraulically support a permanent, full diversion of Dundas flows without significant upgrades (KMK Consultants Ltd., 2006). Diverting the full volume of flow would result in an increased number of overflows during wet weather events.

Significant modelling was conducted by the HHRAP Cootes-Grindstone Sub-Committee to support the recommended effluent total phosphorus (TP) target. It was found that removing Dundas WWTP in its entirety would not result in significant environmental benefit to Cootes Paradise. During wet weather events, the marsh has a short residence time and functions more like a river, while during dry weather, the marsh functions more like a pond (Cootes-Grindstone Water Quality Targets Subcommittee, 2017). It was found that by reducing the effluent TP concentration to 0.05 mg/L, Dundas WWTP would contribute a negligible load of TP during wet weather flows (Cootes-Grindstone Water Quality Targets Subcommittee, 2017). During dry weather flows, the effluent from Dundas WWTP helps maintain a base flow to Cootes Paradise when water levels are low.

Due to hydraulic limitations of the collection system and flushing functions within Cootes Paradise, it was decided that Dundas WWTP would be maintained and the infrastructure would be upgraded or replaced as required. Historically the facility has been operating at 68% of its rated capacity on average with minimal population growth expected within the Dundas catchment. Thus, for the purposes of evaluating BAT options an average day design flow equal to the current rated capacity of 18,200 m^3/day was adopted.

2.3 Existing Treatment Requirements

2.3.1 Existing Effluent Parameter Summary

The existing regulatory effluent objectives and compliance limits are summarized in **Table 2-1** below, as defined in the current Amended ECA No. 3101-89PNRC, issued October 2010.

Table 2-1: Current Effluent Parameters

Effluent Parameter	Effluent Objective (1,2)	Effluent Compliance Limit (1,2)
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), mg/L (kg/d)	5.0	5.0 (91)
Total Suspended Solids (TSS), mg/L (kg/d)	5.0	5.0 (91)
TP, mg/L (kg/d)	0.5	0.5 (9.1)
Total Kjeldahl Nitrogen (TKN), mg/L (kg/d) May 1 – October 31 November 1 – April 30	 2.0 10.0	 2.0 (36.4) 10.0 (182)
Total Residual Chlorine, mg/L (May 1 to October 31)	0.02	0.02
E. coli (May 1 to October 31) (3)	100 organisms per 100 mL	200 organisms per 100 mL
pH	6.0 to 9.5	6.0 to 9.5

Effluent Parameter	Effluent Objective (1,2)	Effluent Compliance Limit (1,2)

Notes:

1. From Amended ECA No. 3101-89PNRC issued October 2010.
2. Compliance based on monthly average basis.
3. Compliance based on monthly geometric mean density.

2.3.2 Hamilton Harbour Remediation Action Plan Targets

Initially, in the 1992 HHRAP report, the goal for Dundas WWTP was to reduce the effluent TP to less than 0.1 ppm (equivalent to 0.1 mg/L) based on the HHRAP Recommendation #1 c) iv) (HHRAP, 1992). The HHRAP established the requirement to use the Best Available Technology Economically Achievable (BATEA) for trace metals and trace organics such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (HHRAP, 1992). The HHRAP did not require the implementation of BATEA for TP. However, it should be noted that when HHRAP was developed, the 0.1 ppm was considered the minimum achievable TP concentration using the best available technology at the time. During the Stage 2 Update Report (HHRAP, 2003), Recommendation 1 was updated and the initial targets for Dundas WWTP were set to those identified in **Table 2-2** below.

The HHRAP Cootes-Grindstone Sub-Committee is responsible for developing the final targets in **Table 2-2** below (HHRAP, 2018). The City provided the effluent targets proposed for Dundas WWTP as per their latest communications with the HHRAP Cootes-Grindstone Sub-Committee. Supporting documentation regarding how these targets were selected were outlined in three white paper documents provided by the HHRAP Cootes-Grindstone Sub-Committee to the City. An effluent target of 0.05 mg/L for TP was proposed (Cootes-Grindstone Water Quality Targets Sub-Committee, n.d.c).

Within the documents provided to the City by the HHRAP Cootes-Grindstone Sub-Committee, effluent targets for total suspended solids (TSS) and total ammonia nitrogen (TAN) were also provided. The initial targets outlined in **Table 2-2** below are those set in the 2003 Stage 2 Update Report (HHRAP, 2003) and the final targets are those suggested in the latest communications with the HHRAP Cootes-Grindstone Sub-Committee.

Table 2-2: Existing Dundas WWTP HHRAP Targets

Effluent Parameter	Initial HHRAP Target [3]	Final HHRAP Target [4]
TSS, mg/L	1.54	1.20 [1]
TP, mg/L	0.27	0.05 [2]
TAN, mg/L May 1 – October 31 November 1 – April 30	1.22	 0.07 [1] 0.28 [1]

Notes:

1. Compliance based on monthly average basis.
2. Compliance based on six-month average basis (May to October inclusive and November to April inclusive).
3. Initial HHRAP targets do not specify compliance basis.
4. Proposed effluent targets from latest communications with the HHRAP Cootes-Grindstone Sub-Committee.

TP target was the main focus of the HHRAP and is critical to restoring Cootes Paradise. Thus, the HHRAP Cootes-Grindstone Sub-committee has committed to this target and it is considered set. The other targets suggested above (TSS and TAN) are considered potential targets and are open to further discussion.

3 Effluent Objectives

3.1 Total Phosphorus

As mentioned above, the TP target was the main focus of the HHRAP and is critical to restoring Cootes Paradise. Significant modelling has been completed to support the implementation of a 0.05 mg/L TP objective (Cootes-Grindstone Water Quality Targets Subcommittee, 2017). Although Dundas WWTP only contributes approximately 10% of the TP loading to Cootes Paradise, it is one of the only manageable sources (Kim, et al., 2016). Achieving this low effluent TP concentration at the plant would result in less than a 10% decrease in TP to Cootes Paradise (Yang, Kim, Bowman, Theysmeyer, & Arhonditsis, 2020). This decrease is considered critical in achieving a tipping point to where the environment switches to a more desirable state (Yang, Kim, Bowman, Theysmeyer, & Arhonditsis, 2020).

Overall, an effluent objective of 0.05 mg/L TP is recommended for implementation at Dundas WWTP in line with the HHRAP Cootes-Grindstone Sub-Committee's commitments. This objective will aid in the protection and restoration of Cootes Paradise and can be achieved through best available technologies. It is consistent with the objectives set at other similar facilities in Ontario discharging to sensitive receivers such as Keswick WPCP and Innisfil WPCP.

The proposed effluent design objective for TP is shown in **Table 3-1** below.

Table 3-1: Proposed Design Effluent Criteria

Effluent Parameter	Final HHRAP Target [1,2]	Proposed Effluent Design Objective [2]
TP, mg/L	0.05	0.05 (0.91 kg/d)

Notes:

1. Proposed effluent target from latest communications with the HHRAP Cootes-Grindstone Sub-Committee.
2. Based on six-month averaging period (May to October inclusive and November to April inclusive).

It should be noted that the TP objective adopted would impact the process selection for future upgrades at the Dundas WWTP and the capital and operation and maintenance costs for the facility. Furthermore, the TP concentration target (mass per unit volume) would imply a maximum TP loading target (in terms of mass per unit time) as noted in brackets in **Table 3-1** above (0.91 kg/d). Thus, any future increases to the current rated flow capacity would require corresponding reductions to the TP effluent concentration.

3.2 Other Parameters

The targets presented by the HHRAP Cootes-Grindstone Subcommittee for other pollutants were preliminary and were subject to additional review as the TP target was the main focus of modelling and studies. The recommended effluent objectives for other pollutants are shown in **Table 3-2** below. The TSS and TAN objective recommendations are based on best available technologies in the industry at this time and what is reasonable to achieve without creating undue risk to the operation of the facility during abnormal conditions. The justification behind these recommendations are detailed in the following sections. The other parameters listed ($cBOD_5$, Total Chlorine Residual, E. coli and pH) were not specifically discussed by the HHRAP Cootes-Grindstone Sub-Committee, so typical values were recommended based on standard effluent objectives specified by the MECP and are consistent with other similar facilities across Ontario with highly sensitive receivers.

Table 3-2: Potential Design Effluent Criteria

Effluent Parameter	Final HHRAP Target (1,2)	Potential Effluent Design Objective (2)
$cBOD_5$, mg/L	-	3.0
TSS, mg/L	1.20	2.0
TAN, mg/L May 1 – October 31 November 1 – April 30	 0.07 0.28	 0.30 0.50
Total Residual Chlorine, mg/L (May 1 to October 31)	-	0.0
E. coli (May 1 to October 31) (3)	-	100 organisms per 100 mL
pH	-	6.0 to 9.5

Notes:

1. Proposed effluent targets from latest communications with the HHRAP Cootes-Grindstone Sub-Committee.
2. Based on monthly averaging periods.
3. Based on monthly geometric mean density.

3.2.1 Effluent TSS Objective

There is no ecosystem requirement to reduce TSS loadings from existing conditions and the dominant process affecting TSS in Cootes Paradise are other factors such as wind and wave action, sediment loads from the watershed and storm events (Cootes-Grindstone Water Quality Targets Sub-Committee, n.d.a). The HHRAP effluent target recommendation for TSS was developed from historical effluent concentrations of TSS achieved at Dundas WWTP.

The filtration technology required to reduce effluent TP to 0.05 mg/L would inherently achieve effluent TSS concentrations less than 2 mg/L and the facility has already been producing concentrations of this magnitude with existing technologies. However, setting an objective lower than 2 mg/L would be restricting operationally and in terms of technology selection. This low limit also increases the risk of the facility being out of compliance due to sampling errors or lab testing results (near reliable detection limit) rather than true process performance. It would be difficult to have vendors guarantee an effluent TSS concentration below 2.0 mg/L for their technologies. It should be noted that other similar facilities in Ontario with stringent TP objectives, do not have stringent TSS objectives. For example, Keswick WPCP has a TP objective of 0.07 mg/L but has a TSS objective of 10 mg/L (MECP, 2015).

Thus, an effluent objective of 2.0 mg/L TSS is recommended for implementation at Dundas WWTP. This objective would provide flexibility in selecting a vendor for the treatment process equipment and would allow operations staff to manage variations in flow and quality conditions without compromising the ability to meet the objective. It should be noted that originally a TSS design objective of 3.0 mg/L was suggested. However, after consultation with the HHRAP, it was agreed to reduce this target to 2.0 mg/L of TSS.

Appendix A includes meeting minutes with HHRAP, additional correspondence to HHRAP and a detailed justification of the proposed effluent objective for TSS. Supporting data is provided in **Appendix B**.

3.2.2 Effluent TAN Objective

The effluent TAN objectives must meet the chronic toxicity threshold Provincial Water Quality Objective (PWQO) of less than 0.02 mg/L unionized ammonia (UIA) within the receiving water body (MECP, 1994a). UIA concentrations are determined using the 75th percentile effluent temperature and pH to account for background concentrations in the receiving water body (MECP, 1994b). This UIA concentration is typically measured at the edge of an approved initial mixing zone. The initial mixing zone is the area of water where the effluent is discharged where the water quality may not meet one or more of the PWQOs prior to mixing with the receiving water. However, conditions within the mixing zone, must not be acutely lethal to aquatic life. Thus, the effluent must also typically meet an end-of-pipe acute toxicity threshold. This has generally been accepted by the MECP as 0.1 mg/L UIA at the end-of-pipe using the 75th percentile effluent pH and temperature in recent projects such as the South Niagara Falls WWTP Environmental Assessment (EA) and the Clarkson and G.E. Booth Water Resource Recovery Facilities (WRRFs) EAs. Terms and conditions for the boundaries of the initial mixing zone are typically designated on a case-by-case basis. The boundaries of the mixing zone for Dundas WWTP would need to be confirmed with the MECP.

The HHRAP effluent targets recommended for TAN (0.07 mg/L for summer and 0.28 mg/L for winter) were developed based on existing plant performance and are expected to meet the PWQO for UIA (Cootes-Grindstone Water Quality Targets Sub-Committee, n.d.b). However, guaranteeing the consistent and reliable achievement of such low targets would be difficult to do in practice as any variations in influent characteristics may cause the effluent quality to exceed this target. In addition, these targets have not been consistently met every month in the historical data. Other similar facilities in Ontario discharging to sensitive water bodies have effluent TAN objectives greater than those suggested by HHRAP. For example, Keswick WPCP has an effluent TAN objective of 0.8 mg/L in the summer months and 2.0 mg/L in the winter months (MECP, 2015).

Considering the HHRAP recommendations, environmental protection, minimizing risk to the City and allowing operational flexibility, a summer effluent TAN objective of 0.3 mg/L is recommended. To allow for cold weather impacts on the biological treatment process in the winter months, it is recommended that the winter effluent TAN objective be set to 0.5 mg/L. Unionized ammonia fractions are also reduced at low temperatures mitigating the impact of the slightly higher effluent TAN objective. These objectives are consistent with Methods 1 and 2 in the Total Ammonia Nitrogen Loading Target provided by the Cootes-Grindstone Water Quality Targets Sub-Committee, provided in **Appendix A**, as well as the standard approach that the MECP has accepted in recently completed projects. Additionally, these objectives are more protective than those established for other similar facilities in Ontario discharging to sensitive water bodies.

Based on 75^{th} percentile values determined from historical effluent temperature and pH data (2017 to 2023 inclusive), the potential effluent TAN objectives are expected to meet both the acute (0.1 mg/L) and chronic (0.02 mg/L) toxicity thresholds. **Table 3-3** below summarizes the potential TAN objectives for Dundas WWTP and the corresponding 75^{th} percentile UIA concentrations.

Table 3-3: 75th Percentile UIA Concentrations at Potential TAN Objectives

Period	75th Percentile Effluent Temperature (˚C) (1)	75th Percentile Effluent pH (1)	Potential TAN Objective (mg/L)	75th Percentile UIA at TAN Objective (mg/L) (2)
Winter (Nov. 1 to April 30)	13.7	7.58	0.5	0.006
Summer (May 1 to Oct. 31)	20.5	7.58	0.3	0.006

Notes:

1. Based on historical data from 2017 to 2023 (inclusive).
2. Presented in terms of total ammonia.

Appendix B includes meeting minutes with HHRAP, additional correspondence to HHRAP and a detailed justification of the proposed effluent objective for TAN. Supporting data is provided in **Appendix C.**

3.3 Consideration for Future Total Nitrogen

The technology selection for the Dundas WWTP upgrades will consider the potential future need to reduce the total nitrogen concentration in the effluent. Treatment processes with the flexibility to achieve denitrification will be considered.

4 Summary and Next Steps

An effluent TP objective has been proposed for Dundas WWTP as presented in **Table 3-1** and potential effluent objectives for other parameters were recommended as presented in **Table 3-2**. The proposed TP objective is consistent with the target established by the HHRAP Cootes-Grindstone Sub-Committee. This TP objective will aid in the protection and restoration of Cootes Paradise and is achievable through the use of currently best available technologies. The effluent TAN and TSS objectives recommended were defined based on providing environmental protection while also minimizing risk to the City and maintaining operational flexibility. The other parameters ($cBOD_5$, TCR, E.coli and pH) were recommended based on standard values used by similar facilities across Ontario.

The short list of alternative design concepts to meet the effluent treatment targets will be evaluated based on the following criteria:

- Ease of Implementation
- Ease of Operation
- Energy Use
- Environmental Impacts (greenhouse gas emissions)
- Long-Term Sustainability
- Costs (Capital, Operating and Lifecycle)
- Permits and Approvals

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A

Appendix A: Contaminant Loadings and Concentration to Hamilton Harbour: 2008-2016 Update

B

Appendix B: Correspondence with HHRAP

C

Appendix C: Supporting Data to Determine 75th Percentile UIA Concentrations at Potential TAN Objectives

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Appendix A3: Long List of Alternatives Technical Memorandum

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City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Long List of Alternatives Technical Memorandum

Tuesday, July 30, 2024

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Hamilton

Long List of Alternatives Technical Memorandum

Facility Upgrade Plan for Dundas WWTP

T001744A

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1 Introduction

CIMA+ was retained to complete a review of best available technologies (BAT) to upgrade the Dundas Wastewater Treatment Plant (WWTP). This study will provide the City of Hamilton with a long-term plan and conceptual design to implement upgrades to the treatment process accounting for potential expansion and in consideration of existing site constraints.

This technical memorandum (TM) documents the evaluation of a long list of BAT. The short-listed BATs will be further developed into alternative concepts in a subsequent TM.

2 Design Basis

2.1 Design Basis Summary

The historical Dundas WWTP flow and raw wastewater concentration data from 2017 to 2021 was reviewed and analyzed to develop a design basis for the evaluation of BAT treatment alternatives and conceptual design of proposed process upgrades at the facility. The design parameters were defined in the *Design Basis TM* (CIMA+, 2022). The recommended design basis is summarized in **Table 2-1** below. The facility will be designed to have a rated capacity of 18,200 m^3/day.

The effluent objectives and limits are subject to approval by the Ministry of Environment, Conservation and Parks (MECP) and Hamilton Harbour Remedial Action Plan (HHRAP) Cootes-Grindstone Water Quality Targets Sub-Committee. However, it is expected that the upgraded facility will have stringent ammonia and total phosphorus limits. Total nitrogen (TN) removal is not required at this time. However, technologies capable of TN removal are being considered to provide additional levels of treatment given that Cootes Paradise is a sensitive receiver. This is in line with the City’s goals of environmental stewardship and implementing advanced technologies at their facilities.

Table 2-1: Design Basis Summary

Parameter	Design Value
Design Flows	
Average Day Flow, m^3/d	18,200
Maximum Month Flow, m^3/d	22,750

Parameter	Design Value
Maximum Day Flow, m^3/d (1)	31,850
Peak Hourly Flow, m^3/d (1)	36,400
Peak Instantaneous Flow, m^3/d (2)	42,200
Wastewater Characteristics	
Carbonaceous Biological Oxygen Demand ($cBOD_5$), mg/L	158
Total Suspended Solids (TSS), mg/L	224
Total Phosphorus (TP), mg/L	5
Total Kjeldahl Nitrogen (TKN), mg/L	34
Temperature, °C	15
Alkalinity, mg/L as $CaCO_3$	200
Proposed Effluent Objectives (3)	
$cBOD_5$, mg/L	3.0
TSS, mg/L	3.0
TP, mg/L	0.05
TAN, mg/L May 1 – October 31 November 1 – April 30	 0.3 0.5
Total Residual Chlorine, mg/L (May 1 to October 31)	0

Parameter	Design Value
E. coli [(4)] (May 1 to October 31)	100 organisms per 100 mL
pH	6.0 to 9.5

Notes:

1. Design peak flows based on historical peak flows treated at Dundas WWTP. To be confirmed with the City.
2. Existing diversion manhole is designed to bypass all flows exceeding 42,200 m^3/day as per existing Certificate of Approval Number 3-1040-99-006 (MECP, 1999).
3. Compliance based on monthly average basis. Compliance basis to be confirmed in consultation with the MECP.
4. Compliance based on monthly geometric mean density.

The design basis for the sizing of each unit process varies as per the *Design Guidelines for Sewage Works* as shown in **Table 2-2**.

Table 2-2: Unit Process Design Basis (MECP, 2008)

Unit Process/Operations	Design Basis
Screening	Peak instantaneous flow One Screen Off-line
Grit Removal	Peak hourly flow
Primary Clarification	Average daily flow Peak daily flow
Aeration	Average daily BOD_5 loading Peak daily TKN loading
Secondary Clarification	Peak hourly flow Peak daily solids loading
Filtration	Peak hourly flow
Disinfection	Peak hourly flow

Unit Process/Operations	Design Basis
Outfall	Peak instantaneous flow

2.2 Capacity Assessment

The existing Dundas WWTP consists of two parallel conventional activated sludge (CAS) facilities known as Plant A and Plant B. Plant A has a rated capacity of 6,100 m^3/day and Plant B has a rated capacity of 12,100 m^3/day, for a combined rated capacity of 18,200 m^3/day (MECP, 2010).

A capacity assessment was completed for the major unit processes at the Dundas WWTP to evaluate the available capacity of the existing facility. The assessment was based on traditional desktop analytical methods, using historical plant data including raw wastewater concentrations and primary clarifier removal efficiencies, plant design criteria, process train capacities as stated in the ECA, and MECP design guidelines. Details of the capacity assessment are included in the *Design Basis TM* (CIMA+, 2022)**.**

The equivalent ADF capacity of each unit process in Plant A and Plant B relative to each plant's rated capacity is shown in **Figure 2-1** and **Figure 2-2** for Plant A and Plant B, respectively. The equivalent ADF capacity of each plant unit process at Dundas WWTP as a whole relative to the facility's rated capacity is shown in **Figure 2-3**. The graphs are colour coded based on the capacity limiting condition for each unit process as follows:

- Unit processes limited by average day flow are shown in blue.
- Unit processes limited by peak daily flows are shown in green.
- Unit processes limited by peak hourly flows are shown in orange.
- Unit processes limited by peak instantaneous flows are shown in yellow.

As shown, most of the unit processes have theoretical capacities well below their rated capacities as stated in the ECA. During average flows and peak flows, both Plant A and B are limited hydraulically by the primary clarifiers. The estimated actual capacity at average day flow and ECA rated capacity are shown below in **Table 2-3**.

Table 2-3: Capacity Assessment Summary

Parameter	Rated Average Day Capacity, m^3/day	Estimated Actual Average Day Capacity, m^3/day
Plant A	6,100	4,240
Plant B	12,100	9,490
Total	18,200	13,730

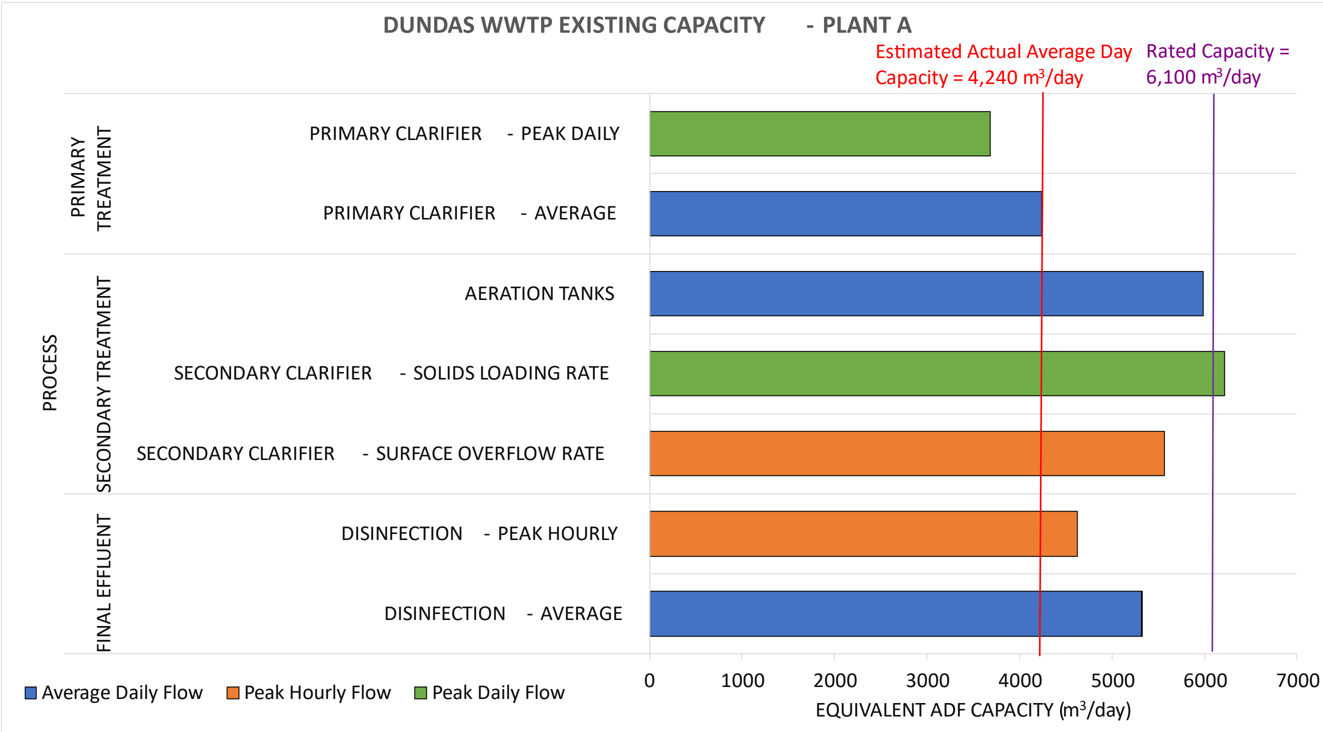

Figure 2-1: Plant A Existing Capacity

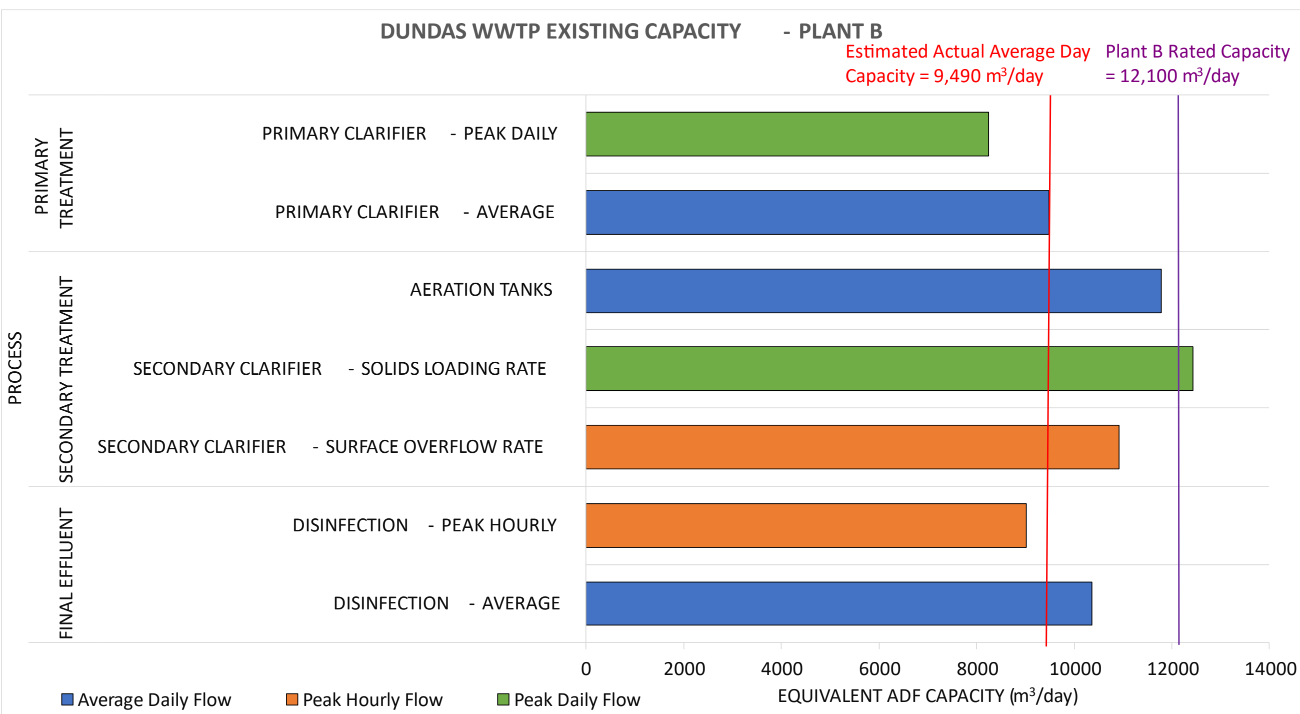

Figure 2-2: Plant B Existing Capacity

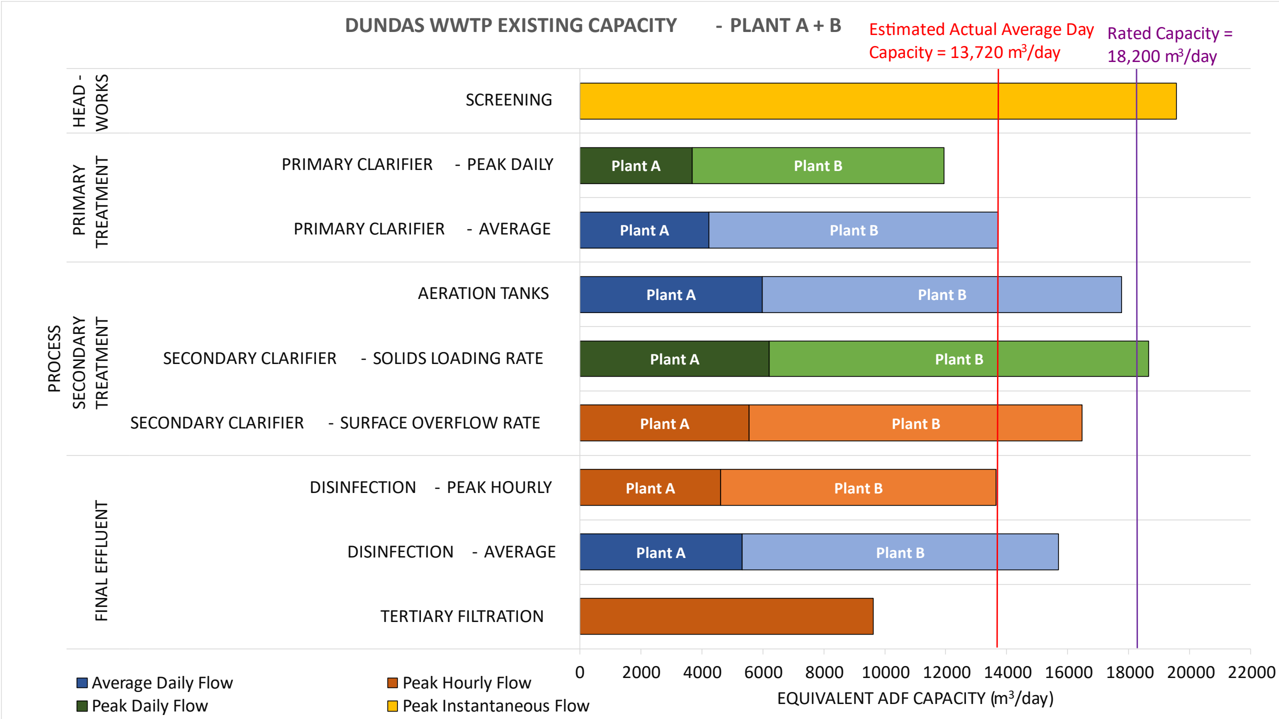

Figure 2-3: Dundas WWTP Existing Capacity - Plant A and B Combined

In recognition of capacity constraints, plant operations set the overflow weir at the bypass chamber to bypass flows exceeding 18,200 m^3/d. Therefore, the five-year average day flow treated at the plant has been roughly 12,436 m^3/d.

3 Screening Criteria and Methodology

A long list of alternative technologies was assessed and screened to develop a short list to be evaluated further for implementation at Dundas WWTP. The short list of technologies is considered for implementation in a new treatment train.

Table 3-1 below lists the factors/ “must have” descriptors or criteria that will be used for screening of the long list of alternative technologies. The technologies that successfully meet the criteria will be recommended for further consideration.

Table 3-1: Screening Criteria

Screening Criteria	Description
Performance Reliability	The technology must be able to reliably achieve the required effluent concentration objectives.

Screening Criteria	Description
Footprint and Compatibility with Site	The technology must be able to fit within the available footprint of the existing site boundary while considering constructability and the need to maintain the facility in operation during construction.
Ability to Expand within Required Implementation Schedule	The technology must not extend the required implementation schedule. The existing facility is in poor condition and is reaching the end of its service life. Operational staff have expressed concerns regarding delaying the upgrades to the facility. Preference is to be given to technologies that would not require pilot testing that may extend the approvals process.

4 Best Available Technology Review

4.1 Overview

Technologies evaluated are grouped in three categories:

1. Biological treatment processes for organic carbon, ammonia and nitrogen removal
2. Filtration technologies for suspended solids and phosphorus removal
3. Disinfection technologies

The preferred design concept will require a combination of processes from the three categories to achieve the effluent objectives.

Other plant process areas (e.g., raw sewage pumping, preliminary treatment) and integration with the existing facility will be considered during the development of alternative design concepts based on the short-listed technologies.

4.2 Long List of Biological Treatment Technologies

Biological treatment removes soluble BOD and ammonia and can be designed to achieve nitrogen and phosphorus removal.

The long list of biological treatment technologies considered for the Dundas WWTP includes:

- Activated Sludge (AS) with Biological Nutrient Removal (BNR) Modification
- Denitrifying moving bed bioreactor (MBBR)
- Membrane aerated biofilm reactor (MABR)
- Aerobic granular sludge (AGS)
- Membrane bioreactor (MBR)
- Biologically Active Filter (BAF)

These technologies will be screened using the criteria in **Table 3-1**.

4.2.1 Activated Sludge with BNR

4.2.1.1 General Process Description

The Activated Sludge (AS) process is the most common secondary treatment process, and it is the process currently used at Dundas WWTP. BNR processes are variations of the AS process designed to encourage nitrification and denitrification and/or proliferation of phosphorus accumulating organisms which remove phosphorus. BNR processes include bioreactors with a combination of selector zones (anaerobic, anoxic and aerobic) and additional recycle streams. Different configurations of the BNR process are listed below (Metcalf & Eddy, 2014):

1. Anaerobic-anoxic-aerobic (A^2O) process.
2. Westbank process (anoxic-anaerobic-anoxic-aerobic)
3. Modified Bardenpho process (anaerobic-anoxic-aerobic-anoxic-aerobic).
4. Enhanced Biological Phosphorus Removal (EBPR) with Primary Sludge Fermentation
5. Modified Ludzack-Ettinger (MLE) (anoxic-aerobic with internal recycle stream)
6. 4-Stage Bardenpho (anoxic-aerobic-anoxic-aerobic with internal recycle stream)
7. Step-Feed BNR (several alternating anoxic and aerobic zones with influent fed to each of the anoxic zones)

Processes involving enhanced biological phosphorus removal (such as process 1, 2, 3, 4) require a larger footprint and are not able to meet the low effluent TP requirements at Dundas WWTP without a tertiary TP removal process. Therefore, they are not considered further.

For the purposes of this evaluation, the AS process modified to operate as an MLE process or a step feed process will be considered. These processes can achieve full nitrification and can be operated to achieve denitrification in the future.

Figure 4-1 shows a schematic of a typical MLE process.

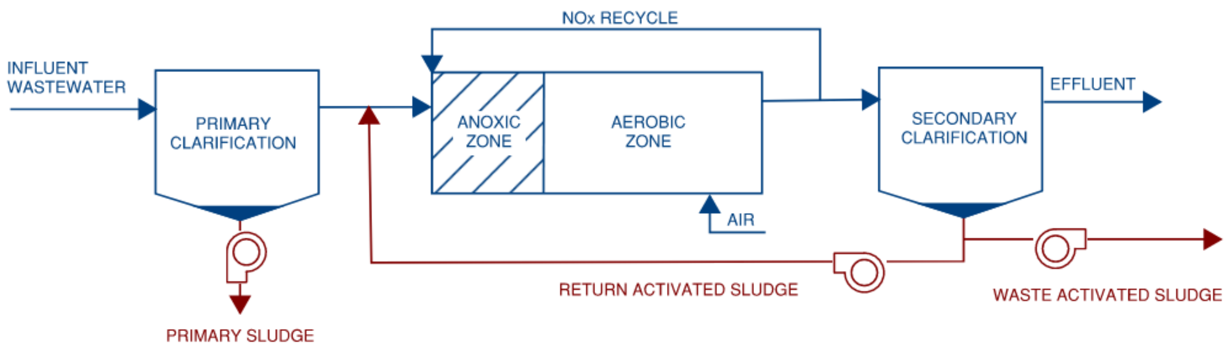

Figure 4-1: Typical MLE Process Schematic

4.2.1.2 Performance Reliability

Processes such as the MLE process have been proven to easily meet effluent objectives of 2.0 mg/L for TAN and 10 mg/L or less for TN (Metcalf & Eddy, 2014). With the addition of a carbon source, these processes can achieve concentrations lower than 3 mg/L TN (Metcalf & Eddy, 2014).

4.2.1.3 Footprint and Compatibility with Site

The footprint requirements for this technology are larger than those required for an AS process as it requires the addition of tankage for several selector zones. The MLE process would be approximately 10 to 30% larger than an AS process.

4.2.1.4 Ability to Expand within the Required Implementation Schedule

Sample applications of the MLE process in plants with capacities similar to the Dundas WWTP are listed below in **Table 4-1**. There are other BNR configurations in operation in Ontario including the step-feed variation which is utilized at large facilities such as Clarkson and G.E. Booth WRRF. The Midhurst WWTP near Barrie, Ontario planned for construction this year will be a 12 MLD BNR plant with step-feed (Tylin, 2023). Overall, this technology is mature and would have a simplified MECP approvals process.

Table 4-1: Installations of the MLE Process

Facility	Location	Rated Capacity (MLD)
Freedom District WWTP[1]	Sykesville, Maryland	13
Cambridge WWTP[1]	Cambridge, Maryland	31

Facility	Location	Rated Capacity (MLD)
Cox Creek WWTP[1]	Anne Arundel County, Maryland	57
Notes: 1. (US EPA, 2007)		

4.2.2 Integrated Fixed Film Activated Sludge/ Moving Bed Bioreactor

4.2.2.1 General Process Description

The Integrated Fixed Film Activated Sludge (IFAS) and Moving Bed Bioreactor (MBBR) processes are types of attached growth aerobic processes. IFAS is a variation of the AS process in which inert plastic media (free floating or fixed to a grid) within the aeration tanks provides a large surface area per unit volume for biomass to attach and grow within the bioreactor (Metcalf & Eddy, 2014). This allows a higher inventory of biomass to be maintained per unit tank volume than AS.

The MBBR process is a submerged attached growth process similar to IFAS with mixed, suspended media, except there is no RAS (Metcalf & Eddy, 2014). Many of the characteristics of IFAS are applicable including the biofilm carrier media, aeration and mixing, and substrate flux into the biofilm (Metcalf & Eddy, 2014). In this process, the biofilm formed on the media allows the removal of BOD in addition to the development of nitrifier microorganisms that oxidize ammonia compounds.

The MBBR system can be used in a post-anoxic zone to achieve denitrification with the addition of an external carbon source (Metcalf & Eddy, 2014). Denitrification can also be achieved in a tertiary MBBR reactor with the addition of an external carbon source (Metcalf & Eddy, 2014).

Both the IFAS and MBBR processes can be used to improve the performance of existing WWTP or to increase treatment capacity when the area on site is limited. The process requires the installation of a higher capacity aeration system to meet the oxygen requirements associated with the larger amount of biomass generated in the reactor. Containment grills or screens are also required to prevent the media from escaping from the aeration tank.

This technology allows the gradual expansion of capacity in the plant by adding more media to an existing aeration tank and increasing the amount of air sent to the aeration tank.

A typical IFAS process with floating biofilm carrier media is illustrated in **Figure 4-2.** below. As noted above, MBBR is similar but it does not require a return stream.

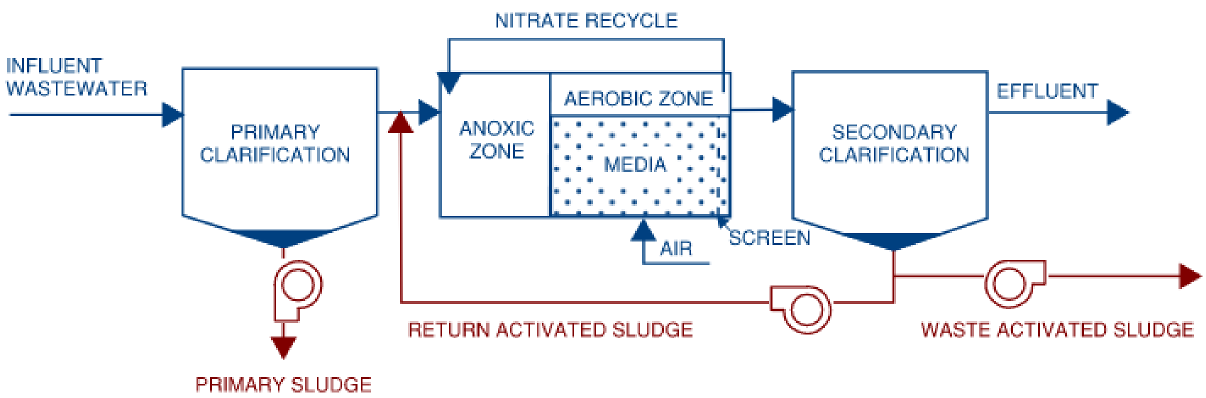

Figure 4-2: Typical IFAS Process Schematic

4.2.2.2 Performance Reliability

In both the post-anoxic zone and tertiary application with an external carbon source added, effluent TN of less than 3 mg/L can be achieved (Metcalf & Eddy, 2014).

4.2.2.3 Footprint and Compatibility with Site

This technology requires a smaller footprint than AS since the floating media provides a larger surface area per unit volume for biomass to attach to and grow within a reactor. However, the media retention sieves can cause bunching of media during high flows and will introduce headlosses into the system.

Special care is required when emptying tanks for maintenance to prevent the weight of the media from causing damage to the air distribution system. In addition, there have been instances in which fragments of the media are broken and thus carried in the secondary effluent. Thus, if combined with membrane filtration, an additional screening system would need to be installed downstream to prevent damage to the membranes.

4.2.2.4 Ability to Expand within the Required Implementation Schedule

Sample applications of this technology in plants with a similar capacity to the Dundas WWTP are listed below in **Table 4-2**. This technology was piloted at GE Booth WRRF in Plant 1B. During the pilot, it was found that the high flow velocities into the aeration tank led to bunching of the media at the retention screens, causing excessive headloss and media loss from the tanks. This process is well established internationally with several installations in Canada, so it would likely not require pilot testing.

Table 4-2: Installations of IFAS/Denitrifying MBBRs

Facility	Location	Process	Rated Capacity (MLD)
Hawkesbury WWTP [1]	Hawkesbury, Ontario	IFAS	13.8
Ladysmith WWTP [2]	Ladysmith, British Columbia	MBBR	14.4
Crow Creek WRF [3]	Cheyenne Wyoming	MBBR	15
Sundets WWTP [4]	Växjö, Sweden	MBBR	23.8
Williams Monaco WWTP [5]	South Adams County, Colorado	MBBR	26
Dry Creek WRF [3]	Cheyenne, Wyoming	IFAS	40
Massillon WWTP [6]	Massillon, Ohio	IFAS	64

Notes:

1. (ASCO Construction, 2014)
2. (Green, 2021)
3. (Johnson & Thesing, 2009)
4. External carbon source is added (Taljemark, et al., 2004)
5. (Phillips, et al., 2008)
6. (Wastewater Digest, 2022)

4.2.3 Membrane Aerated Biofilm Reactor

4.2.3.1 General Process Description

MABR is an attached growth process in which membranes are located within a bioreactor tank, providing a large-fixed surface area for biomass growth. The membranes in the reactor diffuse oxygen at a molecular level in an inside-out fashion.

Unlike other attached growth processes, in the membrane supported biofilm, oxygen and substrate (ammonia and organics) approach the biofilm from opposite sides (**Figure 4-3**). The oxygen is delivered directly to the biofilm by diffusion from the inside of the membrane and ammonia diffuses into the biofilm from the bulk liquid. Since ammonia is a small molecule, it diffuses into the biofilm much faster than organic carbon molecules. Therefore, the establishment of nitrifying bacteria is favoured over heterotrophic bacteria even in the presence of significant readily biodegradable organics (Veolia Water Technologies & Solutions, 2018). As a result, nitrification occurs within the inner portion of the biofilm and denitrification in the outer portion of the biofilm, utilizing influent BOD to reduce the nitrate/nitrite.

This system provides a more efficient delivery of oxygen to the biomass when compared to a traditional fine bubble diffuser system. MABR also achieves denitrification which further reduces aeration requirements.

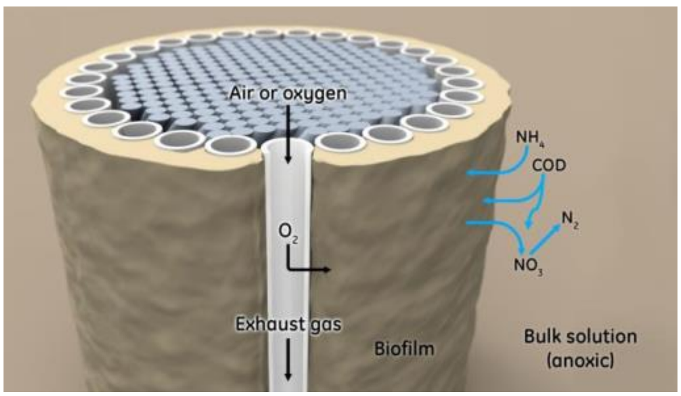

Figure 4-3: MABR Operation Principle (Veolia Water Technologies & Solutions, 2018)

The MABR process can be installed in an anoxic tank to increase the secondary treatment capacity by:

- Operating at a lower suspended growth SRT (i.e., lower MLSS concentration) due to the biofilm nitrifier population attached to the membranes.
- Increasing secondary clarifier capacity for plants that are limited by solids loading rate.

An example of the MABR configuration can be seen in **Figure 4-4.**

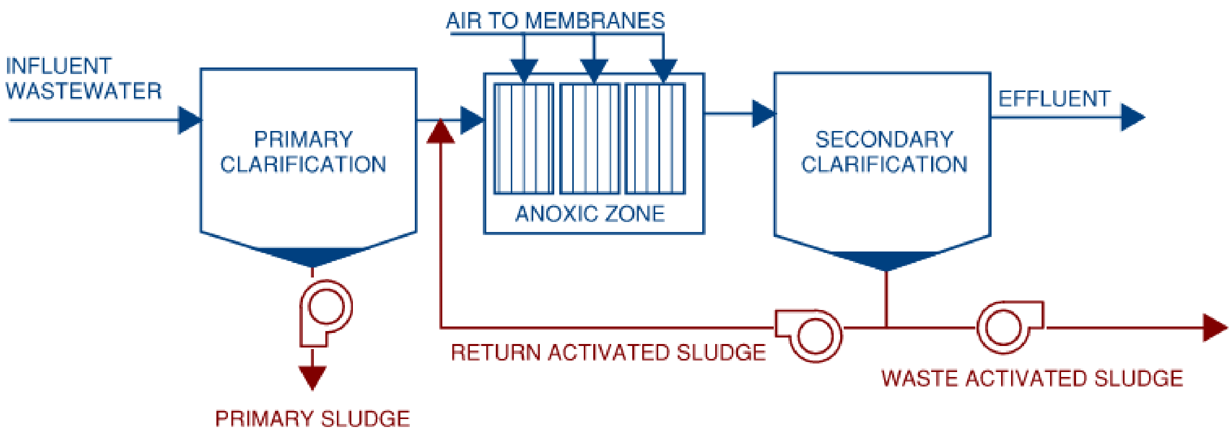

Figure 4-4: Typical MABR Process Schematic

4.2.3.2 Performance Reliability

A pilot study has demonstrated ammonia removal of 95% and total inorganic nitrogen removal of 66% (Cote, et al., 2015). OxyMem claims that total nitrogen concentrations of less than 5 mg/L are possible with MABR (OxyMem, 2019).

4.2.3.3 Footprint and Compatibility with Site

This technology would have a similar footprint to MBBR/IFAS and similar processes.

4.2.3.4 Ability to Expand within the Required Implementation Schedule

There are currently no full-scale installations in Ontario. However, upgrades utilizing MABR at the Hespeler WWTP (9.34 MLD) in the Region of Waterloo and the North Toronto Treatment Plant (45 MLD) have been approved by the MECP and are under construction. There is also a 13.7 MLD full scale MABR plant operating since 2017 in Yorkville-Bristol, IL in the USA. A list of the approved or operating full-scale applications of the MABR process are shown in **Table 4-3** below. Due to the recent successful pilot studies and approvals by the MECP, this technology may not require extensive pilot testing.

Table 4-3: Approved or Operating Full-Scale Applications of the MABR Process in North America

Name	Location	Status	Capacity (MLD)
Hespeler WWTP[1]	Cambridge, Ontario	Approved	9.34
Yorkville-Bristol[2] Sanitary District	Yorkville, Illinois	Operating	13.7

Name	Location	Status	Capacity (MLD)
North Toronto TP[3]	East York, Ontario	Approved	45

Notes:

1. (WaterWorld, 2020)
2. (WaterWorld, 2016)
3. MABR will be installed in 2 of 8 aeration tanks for side-by-side comparison to CAS (City of Toronto, 2020)

4.2.4 Aerobic Granular Sludge

4.2.4.1 General Process Description

The AGS system is an advanced technology for biological wastewater treatment based on the sequencing batch reactor (SBR) process which fosters the formation of aerobic granular biomass. These granules include layers of ordinary heterotrophs, nitrifying and denitrifying bacteria which can simultaneously remove carbon, nitrogen and phosphorus from the wastewater (Nancharaiah & Reddy, 2018). The granules also exhibit better settleability characteristics.

To develop the granules, the SBR is operated to achieve anaerobic, anoxic and aerobic conditions (Aqua-Aerobic Systems Inc., 2017). Granules can be considered as a special case of biofilm growth without carrier material (Weber, Ludwig, Schleifer, & Fried, 2007). Therefore, the AGS process is considered an attached growth process with floating media instead of a suspended growth process such as the SBR process (Metcalf & Eddy, 2014). A magnified granule is shown in **Figure 4-5**.

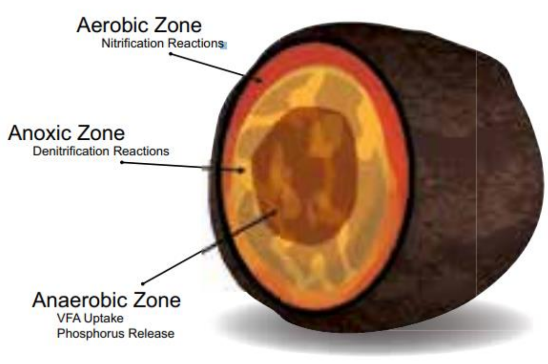

Figure 4-5: Magnified Granule in the AquaNereda® Cycle Process (Aqua-Aerobic Systems Inc., 2017)

AquaNereda® is a commercially available system which utilizes the aerobic granular sludge process. A granular sludge reactor can be operated at higher biomass concentrations, allowing higher loading rates while maintaining a longer solids retention time (SRT). A longer SRT is necessary for stable nitrification and providing anoxic and anaerobic micro-environments in the sludge granules for nutrient removal. To achieve granulation under aerobic process conditions, short settling times are used to introduce a strong selective advantage for well-settling sludge granules. Poor-settling biomass is washed out under these conditions (Pronk, et al., 2015).

There is significant on-going research to integrate aerobic granular sludge into continuous flow activated sludge systems. In most cases, studies involve modifying aeration tank operating conditions and using hydrocyclones on the sludge stream to preferentially retain a denser biomass in the aeration tanks.

A typical AGS process schematic is shown below in **Figure 4-6.**

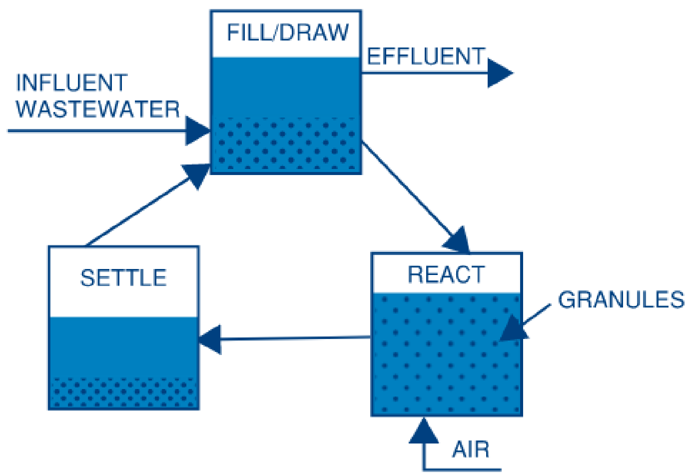

Figure 4-6: Typical AGS Process Schematic

4.2.4.2 Performance Reliability

The AGS installation at Riviera Utilities WWTP in Foley, Alabama met a TN limit of 5 mg/L and TP limit of 1.5 mg/L (Schachle, et al., 2021). To achieve the low TP effluent requirements at Dundas WWTP, a tertiary TP removal process would be required.

4.2.4.3 Footprint and Compatibility with Site

The AGS process would eliminate the requirement for secondary clarifiers, so the secondary treatment footprint would be reduced. Although, AGS does remove some phosphorus, a tertiary treatment process would be required to meet the effluent objectives. The AGS process operates as a SBR process which is a complex automatic control system and a different operating philosophy than the existing CAS process on site. AGS would also introduce high headloss in secondary treatment, likely requiring intermediate pumping.

4.2.4.4 Ability to Expand within the Required Implementation Schedule

By mid-2021, there were approximately 88 full-scale installations reported worldwide by both Nereda® and S::Select®, in the Netherlands, the United Kingdom, Brazil and the United States (Hamza, et al., 2022). Sample applications of this technology in plants capacities similar to the Dundas WWTP are listed in **Table 4-4** below. Since there are multiple installations internationally and this technology is in the process of being approved at Napanee WPCP, this technology may not require pilot testing.

Table 4-4: Installations of Aerobic Granular Sludge

Facility	Location	Rated Capacity (MLD)
Wolcott WWTP [1]	Wolcott, Kansas	7.6
Epe WWTP [2]	Epe, the Netherlands	8
Riviera Utilities WWTP [3]	Foley, Alabama	13
Alpnach WWTP [4]	Alpnach, Switzerland	14
Cork Lower Harbour WWTP [4]	Cork Lower Harbour, Ireland	15
Kendal WWTP [4]	Kendal, United Kingdom	19

Notes:

1. (HDR Inc., 2023)
2. (RoyalHaskoningDHV, 2013)
3. (Schachle, et al., 2021)
4. (Hamza, et al., 2022)

4.2.5 Membrane Bioreactor

4.2.5.1 General Process Description

The MBR process is a suspended growth activated sludge wastewater treatment process in which physical separation of solids utilizes an ultrafiltration (UF) membrane system. Membranes are commonly installed as modules submerged dedicated tanks.

Mixed liquor from the biological reactor is fed to the membrane tanks and clean effluent is drawn through membrane filters by permeate pumps.

MBRs include air scour, back pulse and clean-in-place systems to maintain membrane permeability (EPA, 2019). During the clean-in-place cycles, membrane tanks are emptied of wastewater and then filled with a cleaning solution. Therefore, implementation of MBRs requires chemical use and additional process redundancy.

The MBR process is not affected by the requirement to produce sludge with good settling characteristics as with other suspended growth technologies. Therefore, an MBR can be operated at considerably higher MLSS concentrations than the AS process. By operating at a high MLSS (up to 10,000 mg/L) and eliminating the need for secondary clarifiers and tertiary filters, the system footprint is significantly reduced compared to a conventional system. Oxygen requirements are satisfied by a combination of diffused air and an air scouring system.

The biological reactor can incorporate anoxic zones and internal recycle streams, such that the MBR could provide total nitrogen removal and advanced phosphorus removal in a single process.

A typical MBR process is shown in **Figure 4-7** below.

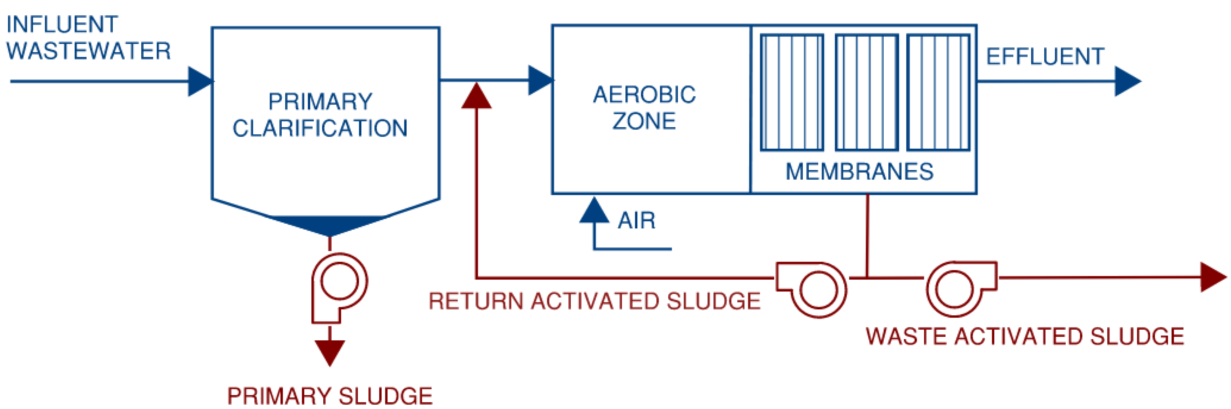

Figure 4-7: Typical MBR Process Schematic

4.2.5.2 Performance Reliability

A typical MBR process is capable of reliably achieving very low effluent TP concentrations (<0.1 mg/L) as the ultrafiltration system can remove particles greater than 0.01 µm (Fleischer, et al., 2006). UF has been proven to reliably achieve effluent TP levels below 0.1 mg/L and as low as 0.03 mg/L (Fundneider, Alejo, & Lackner, 2020).

4.2.5.3 Footprint and Compatibility with Site

The MBR system has a small footprint compared to the other alternatives since it eliminates the requirement for secondary clarifiers and tertiary treatment. However, fine screens would be required upstream to prevent damage to the membranes.

4.2.5.4 Ability to Expand within the Required Implementation Schedule

With increasingly stringent effluent requirements, MBR has become more widely used across Canada and North America. However, given its operational complexity and high capital and operating costs, MBRs have generally been limited to plants with footprint constraints and/or with total phosphorus effluent limits lower than 0.1 mg/L.

MBRs have been successfully implemented in small municipalities including facilities in Ontario such as those listed below in **Table 4-5**. Barrie WWTP will also be implementing an MBR retrofit to the 76 MLD facility (WaterWorld, 2018). This is a mature technology and thus it would have a simplified MECP approvals process.

Table 4-5: Installations of Membrane Bioreactors

Facility	Location	TP Limit (mg/L)	Rated Capacity (MLD)
Port Carling WWTP [1]	Port Carling, Ontario	0.3	0.9
Port McNicoll WWTP [2]	Tay, Ontario	0.25	1.9
Oxford WPCP [3]	London, Ontario	0.5	13

Notes:

1. (District Municipality of Muskoka, 2021)
2. (Tay Township, 2020)
3. (Stantec, 2011)

4.2.6 Biologically Active Filter

4.2.6.1 General Process Description

BAF is another type of attached growth process in which media such as expanded clay or shale or other inert plastic media are used as a medium for microorganism growth.

Wastewater is pumped into the BAF and flows through the filter medium. Air is added to the bioreactor by means of diffusers at the bottom of the tank. Microorganisms attach to the filter media and use up the organic matter contained in the wastewater. As in other attached growth processes, BAF can be operated to maintain anaerobic, anoxic and aerobic conditions to achieve biological nutrient removal.

Fine screening is required upstream of the BAF process to minimize the risk of damage to distribution and media retention nozzles.

The process requires intermittent backwashing to maintain hydraulic performance and to remove excess solids from the bioreactor. This process is fully automated and operator input is minimal requiring only setting the frequency of backwash cycles. Backwash solids from the BAF have a very low solids concentration, so thickening systems are typically required.

There are upflow or downflow configurations of the BAF process.

The BAF process is patented and in Ontario systems have been provided by Veolia: Biostyr™ and BioFOR™.

A typical BAF process is shown in **Figure 4-8** below.

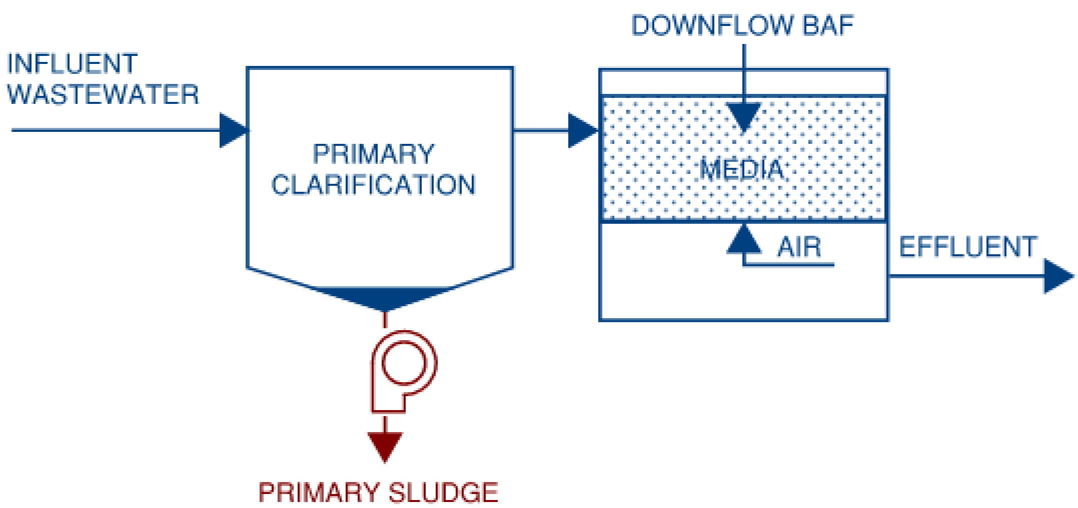

Figure 4-8: Typical BAF Process Schematic

4.2.6.2 Performance Reliability

The BAF process can be operated to maintain anaerobic, anoxic and aerobic conditions to achieve TN and TP removal. However, to achieve the low TP effluent requirements at Dundas WWTP, an additional tertiary TP removal process would be required.

4.2.6.3 Footprint and Compatibility with Site

This process combines biological substrate removal and physical separation of solids into a single structure. Therefore, BAF does not require the use of secondary clarifiers and takes up less space than the AS process. However, BAF introduces high headloss and would require intermediate pumping as well as fine screening.

Maintenance of the diffuser system and BAF underdrains requires careful consideration as this would require emptying the tank and discarding the media to access the bottom of the BAF tank.

4.2.6.4 Ability to Expand within the Required Implementation Schedule

Some proven applications of this technology are listed below in **Table 4-6.** This technology is mature and would have a simplified MECP approvals process.

Table 4-6: Installations of the BAF Process

Facility	Location	Rated Capacity (MLD)
Owen Sound WWTP [1]	Owen Sound, Ontario	10
Cataraqui Bay WWTP [2]	Kingston, Ontario	55
Thunder Bay WPCP [3]	Thunder Bay, Ontario	84.5

Notes:

1. (Municipality of Owen Sound)
2. (Utilities Kingston, 2020)
3. (City of Thunder Bay, 2019)

4.2.7 Evaluation of Long List of Biological Treatment Technologies

A summary of the evaluation of the long list of biological treatment technologies is presented in **Table 4-7**. Green shading indicates a “pass” for that criteria, while red shading indicates a “fail”.

Table 4-7: Evaluation Summary of the Long List of Biological Treatment Technologies

Technology	Performance Reliability	Footprint and Compatibility with Site	Ability to Expand within Required Implementation Schedule	Consider for Evaluation
AS with BNR	Effluent criteria for BOD and TAN can be achieved reliably.	The footprint of this process would not fit on site.	This is a mature technology that would have a simplified MECP approvals process.	**No**, this process would not fit on site.
IFAS/MBBR	Effluent criteria for BOD and TAN can be achieved reliably.	The footprint of this process would fit on site. However, the media in this process introduces maintenance complexities when taking tanks offline for maintenance. The reduction in footprint associated with this process would not result in significant benefits at Dundas WWTP.	Many installations internationally, with two in Canada. May not require pilot testing.	**No,** due to maintenance complexities and potential for media loss and bunching.
MABR	Effluent criteria for BOD and TAN can be achieved reliably.	The footprint of this process would not fit on site.	Installations approved at both Hespeler WWTP and North Toronto TP by MECP. May not require pilot testing at Dundas WWTP	**No**, this process would not fit on site.
AGS	Effluent criteria for BOD and TAN can be achieved reliably.	This process eliminates the requirement for secondary clarifiers. The footprint could fit on site. However, this process introduces headlosses and may require additional intermediate pumping.	Multiple installations internationally and it is in the process of being approved at Napanee WPCP in Ontario. May not require pilot testing at Dundas WWTP.	**Yes**
MBR	Effluent criteria for BOD and TAN can be achieved reliably. Effluent TP of 0.05 mg/L can also be achieved reliably with ultrafiltration membranes.	This process eliminates the requirement for secondary clarifiers and tertiary treatment. The overall footprint of this process is small and could fit on site.	This is a mature technology that would have a simplified MECP approvals process.	**Yes**
BAF	Effluent criteria for BOD and TAN can be achieved reliably.	This process eliminates the requirement for secondary clarifiers. The footprint of this process could fit on site. This process significant	This is a mature technology that would have a simplified MECP approvals process.	**No,** this process is typically not utilized at facilities less than 30 MLD. This

Technology	Performance Reliability	Footprint and Compatibility with Site	Ability to Expand within Required Implementation Schedule	Consider for Evaluation
		headlosses and will require additional intermediate pumping. The media in this process introduces complexities when trying to gain access to the aeration and underdrain system. This process is typically not utilized at facilities less than 30 MLD due to cost effectiveness.		technology also introduces complexities with maintenance.

4.3 Long List of Filtration Technologies

The long list of filtration technologies for TP removal considered for the Dundas WWTP includes:

- Two-stage solid separation
- Membrane filtration
- Cloth media disk filtration

These technologies will be screened using the criteria in **Table 3-1**.

The selection of a TP removal technology will have an impact on the design of upstream processes (e.g., membrane filtration technologies require fine screening of the flows before they enter the membrane tanks). Descriptions of these technology alternatives as applied to the Dundas WWTP are presented below.

4.3.1 Two-Stage Solids Separation

4.3.1.1 General Process Description

Two-stage solid removal processes employ two solids removal processes in series, with the addition of coagulant before the first or both stages, to maximize removal of soluble phosphorus.

Examples of two stage tertiary treatment plants include:

- Two sand filters in series (e.g., Dynasand® D2)
- High-rate clarifiers or ballasted flocculation (e.g., Veolia Actiflo®) processes followed by granular media filtration

In two-stage filtration processes, a filter with large size diameter media is used followed by a filter with a small size diameter media to remove the residual particles from the first stage. Backwash water is typically recycled to the first filter providing residual coagulant to further aid in floc formation (Metcalf & Eddy, 2014).

The other option involves a high-rate clarification process followed by granular media filtration. Ballasted clarification is a coagulation and flocculation process which utilizes a coagulant such as alum or ferric chloride with a microsand flocculent aid (ballast) to form denser, heavier floc for rapid sludge settling. Clarification performance is further improved by the use of lamellae plate settlers. The microsand is separated from the settled sludge slurry by centrifugal force in a hydrocyclone and reused (Veolia Water Technologies, 2020). The clarified effluent is then conveyed to a granular media filter to filter out any residual particles and floc.

The selection of technologies to be used in the first and second stage depends on factors such as:

- Potential to reuse (i.e., add on to) an existing tertiary process

- Plant hydraulics
- Available land area
- Complexity (e.g., operating two different technologies or the same technology)
- Capital cost

A typical two-stage solids separation process schematic is shown in **Figure 4-9** below.

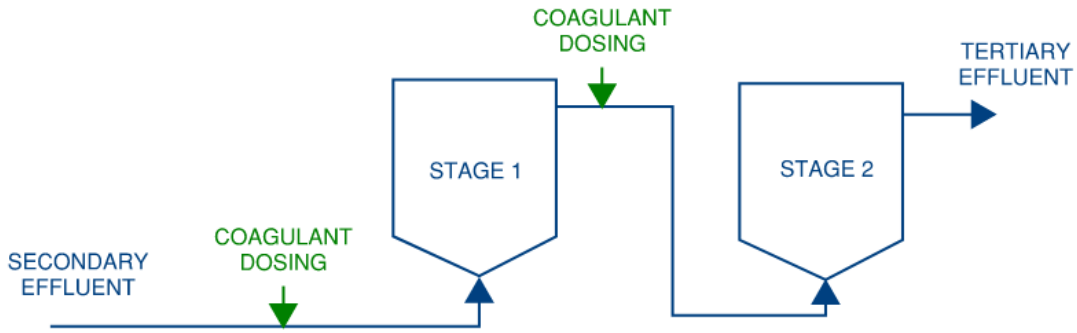

Figure 4-9: Typical Two-Stage Solids Separation Process Schematic

4.3.1.2 Performance Reliability

Phosphorus levels equal to or less than 0.02 mg/L have been achieved in the final filter effluent of a two-stage upflow filtration process (Metcalf & Eddy, 2014). Upflow sand filtration systems such as Dynasand® D2 are reported have achieved filtrate TP concentrations of 0.01 to 0.05 mg/L (Parkson). According to its manufacturer, Actiflo®, a ballasted flocculation system, has achieved seasonal average effluent TP concentrations of 0.06 mg/L (Veolia Water Technologies, 2022). Therefore, followed by granular media filtration supported by the coagulant aid, it is expected that the 0.05 mg/L TP limit can be reliably achieved. Performance of both types of two-stage tertiary treatment will depend on the coagulant dosing and the characteristics of the raw wastewater.

4.3.1.3 Footprint and Compatibility with Site

Filters would need to be housed within a building to prevent freezing in the winter. This alternative would require a larger footprint than the other phosphorus removal technology options as it requires two stages. If the existing tertiary filters are used to provide the second solids removal stage, then only one new tertiary treatment system would need to be constructed.

4.3.1.4 Ability to Expand within the Required Implementation Schedule

There are several proven installations of two-stage solid removal systems at facilities of varying sizes. Some of the installations are listed below in **Table 4-8**. Although this technology is mature, pilot testing would likely be required to confirm that the low effluent criteria at Dundas WWTP can be achieved reliably.

Table 4-8: Applications of Two-Stage Tertiary Treatment Technologies

Facility	Location	Technology	TP Limit (mg/L)	Reported Average Performance (mg/L)	Rated Capacity (MLD)
Stamford WWTP [1]	Stamford, New York	Two-stage filtration	0.2	0.01	1.9
Walton WWTP [1]	Walton, New York	Two-stage filtration	0.2	0.01	5.9
Pinery WRRF [1]	Parker, Colorado	Two-stage filtration	0.05	0.029	7.6
Noman Cole WWTP [1]	Fairfax County, Virginia	Tertiary clarification and filtration	0.18	0.061	253

Notes:

1. (US EPA, 2007)

4.3.2 Membrane Filtration

4.3.2.1 General Process Description

Membrane filtration technology involves the physical separation of particulate and colloidal matter from the feed water stream using membranes to produce a polished effluent stream. Membranes serve as selective barriers that remove substances or particles that have a diameter bigger than the membrane pores from the filtered water (Metcalf & Eddy, 2014).

Depending on their pore size, membrane filters can be divided into four principal categories ranging from the coarsest, microfiltration (MF), followed by ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) (Metcalf & Eddy, 2014). Thus, pore size is a key factor is the selection of the type of membrane filtration. The rate at which is permeate (the filtered effluent) is transferred through a membrane is known as the rate of flux and determines the footprint of the filtration unit (Metcalf & Eddy, 2014).

Membrane systems are typically associated with greater equipment complexity and intermittent cleaning to address membrane fouling (which results in a reduction in the rate of flux) and an increase in feed pressure. The rate of fouling and the frequency of cleaning are affected by water temperature with more frequent cleaning required during cold weather months. Membrane cleaning requires the use of sodium hydroxide, sodium bisulphite, citric acid or sodium hypochlorite. Membrane modules have a life of approximately 87,600 run time hours, requiring replacement approximately every 10 years (EPA, 2019).

There are several proprietary membrane configurations, including those using hollow fibres and plate and frame type equipment (EPA, 2019).

A typical schematic using membrane filters is shown in **Figure 4-10** below.

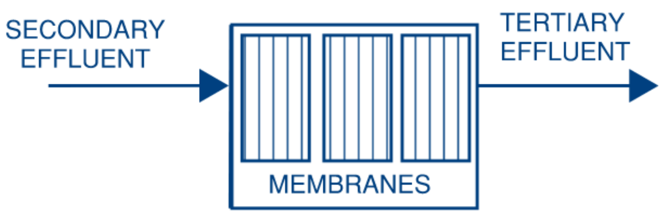

Figure 4-10: Typical Membrane Filtration Process Schematic

4.3.2.2 Performance Reliability

To reliably achieve tertiary phosphorus levels less than 0.05 mg/L, UF membranes would be required. UF has been proven to reliably achieve effluent TP levels as low as 0.03 mg/L (Fundneider, Alejo, & Lackner, 2020).

4.3.2.3 Footprint and Compatibility with Site

The tertiary membrane filter system technology would require a building to house the filters and associated equipment. Additional space to house the cleaning chemicals would be required as well.

4.3.2.4 Ability to Expand within the Required Implementation Schedule

Some proven applications of this technology are listed below in **Table 4-9**. In Innisfil, Ontario, the Lakeshore WWTP is planned to expand to 25 MLD upgrading their facility using tertiary membrane filtration (Hatch, 2021). The new 12 MLD Midhurst WWTP in Midhurst, Ontario to be constructed in 2024 is also implementing tertiary membrane filters (Ainley Group, 2020). The Midhurst WWTP will be required to meet an ultimate effluent TP objective of 0.03 mg/L. Overall, this technology is mature and would have a simplified MECP approvals process.

Table 4-9: Installations of Membrane Filtration

Facility	Location	TP Limit (mg/L)	Rated Capacity (MLD)
Wuxi New City Plant [1]	Wuxi, Jiangsu province, China	Unknown	15
Keswick WPCP [2]	Keswick, Ontario	0.1	18
Clark Country Water Reclamation Facility (WRF) [3]	Las Vegas, Nevada	0.25	114
F. Wayne Hill WRF [3]	Gwinnett County, Georgia	0.08	189

Notes:

1. (Veolia Water Technologies, 2018)
2. (Hatch Mott MacDonald, 2015)
3. (GE, 2007)

4.3.3 Cloth Media Disk Filtration

4.3.3.1 General Process Description

Cloth media disk filtration is a common tertiary treatment process which provides a large filtration area in a small footprint. There are two types of disk filter technologies classified by their flow direction:

- Inside-Out (e.g., Veolia Hydrotech)
- Outside-In (e.g., Aqua-Aerobic AquaDisk®)

In inside-out flow pattern disk filters, a woven cloth media is used in the disk panels. The influent enters through the central drum and flows from the drum out into the filter panels (Veolia, 2020). The woven cloth media traps solids on the surface and allows filtered water to flow through the system from the inside out. The cloth media needs to be cleaned periodically using a high-pressure spray in an automated backwashing sequence initiated based on the measured headloss through the filters (Veolia, 2020).

In outside-in flow pattern disk filters, a pile cloth media is used on the disk panels. The disks are stationary and completely submerged in the influent (Aqua-Aerobic Systems

Inc., 2019). The influent flows from the tank into the disk panels through the pile cloth media. The heavier solids settle to the tank bottom, preventing them from building up on the cloth media. This filter system utilizes an automatic backwash system with backwash shoes that make direct contact with the cloth media to vacuum solids and particulates (Aqua-Aerobic Systems Inc., 2019).

All disk filters will require chemical cleaning periodically due to fouling over time. This can be achieved using dilute sodium hypochlorite for biological growth removal and dilute hydrochloric acid or citric acid for calcium carbonate scale removal (Veolia, 2020).

A coagulant aid can be dosed upstream of both types of disk filters to improve phosphorus removal.

A typical cloth disk filter configuration with an outside-in flow pattern is shown in **Figure 4-11**.

Figure 4-11: Typical Cloth Disk Filter Process Schematic with an Outside-In Flow Pattern

4.3.3.2 Performance Reliability

Studies report that cloth media filtration has achieved effluent TP concentrations of 0.04 to 0.06 mg/L (Fundneider, Alejo, & Lackner, 2020). The Veolia Hydrotech filters report phosphorus removal to less than 0.1 mg/L (Veolia, 2022).

In 2021, CIMA+ conducted a review of disk filter technologies for the Lake Simcoe WPCP in Durham Region. The Lake Simcoe WPCP has an effluent TP objective of 0.15 mg/L (CIMA+, 2020). Vendors could not guarantee meeting this objective with disk filters alone and recommended an additional upstream TP removal process with coagulant addition (Veolia, 2020), (Aqua-Aerobic Systems Inc., 2020). Thus, it is unlikely disk filter manufacturers would guarantee a TP objective of 0.05 mg/L without an upstream tertiary treatment stage.

4.3.3.3 Footprint and Compatibility with Site

The disk filter technology would require a building to house the filters to minimize the impact on plant operations during winter months. Additional space to house the cleaning chemicals would be required.

4.3.3.4 Ability to Expand within the Required Implementation Schedule

Some installations of cloth media disk filtration are listed below in **Table 4-10**. The literature reviewed did not indicate whether the disk filters were downstream of a tertiary treatment process. As noted above, manufacturers consulted could not guarantee meeting a TP limit of less than 0.15 mg/L without an additional pre-treatment process. Within a two-stage configuration, this technology would likely require pilot testing to confirm that the low effluent criteria at Dundas WWTP can be achieved reliably.

Table 4-10: Installations of Cloth Media Disk Filtration

Facility	Location	Technology	TP Limit (mg/L)	Rated Capacity (MLD)
Riverview WWTP [1]	Birmingham, Alabama	AquaDisk®	0.2	5.7
Bartlett Bay WWTP [1]	South Burlington, Vermont	AquaDisk®	0.1	7.9
Rainbow City WWTP [1]	Rainbow City, Alabama	AquaDisk®	0.043	11
Brockton WWTP [1]	Brockton, Massachusetts	AquaDiamond®	0.1	78

4.3.4 Evaluation of Long List of Filtration Technologies

A summary of the evaluation of the long list of filtration technologies is presented in **Table 4-11**. Green shading indicates a “pass” for that criterion, while red shading indicates a “fail”.

Table 4-11: Evaluation Summary of the Long List of Filtration Technologies

Technology	Performance Reliability	Footprint and Compatibility with Site	Ability to Expand within Required Implementation Schedule	Consider for Evaluation
Two-Stage Solids Separation	Depending on the technology used in each stage, the effluent TP and TSS could be achieved. Confirmation through pilot testing would be required. Performance is dependent on coagulant dosing.	A secondary treatment process is required. Depending on the technology used in each stage, the footprint of this process may fit on site.	This is a mature technology. However, the required effluent TP and TSS criteria at Dundas WWTP would require pilot testing to confirm the process can achieve the low effluent concentrations reliably.	**No**, will require pilot testing to confirm effluent performance.
Membrane Filtration	The effluent TP and TSS limits can be achieved reliably using ultrafiltration membranes.	Compatible with any secondary treatment process. However, fine screening required to protect the membranes.	This is a mature technology that would have a simplified MECP approvals process.	**Yes**
Cloth Media Disk Filtration	Effluent TP concentrations below 0.1 using disk filters alone would not be guaranteed by vendors. Two stages of tertiary treatment are recommended subject to pilot testing.	A secondary treatment process is required. The footprint of this process could fit on site.	This technology would require pilot testing to confirm the required effluent criteria could be achieved reliably.	**No,** unlikely to achieve stringent limits on its own. Cloth Disk Filtration could be considered as one of the stages in two-stage tertiary treatment.

4.4 Long List of Disinfection Technologies

A long list of disinfection process alternatives is presented below in **Table 4-12**. These technologies will be screened using the criteria in **Table 3-1**.

Table 4-12: Long List of BAT Technologies

Category	Potential BAT Technology
Disinfection	• Chlorination/Dechlorination • Ultraviolet (UV) Disinfection • Peracetic Acid (PAA) • Ozone

Descriptions of these technology alternatives as applied to the Dundas WWTP are presented below.

4.4.1 Chlorination/Dechlorination

4.4.1.1 General Process Description

Chlorine is a strong oxidant that breaks down the cellular component of microorganisms to inactivate both bacteria and viruses (EPA, 1999).

Chlorination involves adding chlorine to the final effluent, then allowing for a sufficient contact time for disinfection. After sufficient contact time is achieved, a dechlorination chemical is injected to ensure chlorine concentrations are below 0.02 mg/L (the threshold for non-toxicity in Canada). Sodium hypochlorite is used for chlorination and sodium bisulphite is used for dechlorination.

Chemical disinfection can be expressed in terms of a first order differential equation commonly known as the Chick-Watson model. The model expresses the concentration of pathogenic microorganisms in the water as a function of the reaction time and the disinfectant chemical concentration (Metcalf & Eddy, 2014). As the product of concentration and time (CT) increases, the concentration of microorganisms decreases.

MECP recommends a minimum chlorine residual of 0.5 mg/L at average flow conditions after a 30-minute contact time to meet disinfection requirements. In addition, a contact time of 15 minutes is recommended at the design peak hourly flow (MECP, 2008).

Any facility using chlorination must dechlorinate the effluent before the effluent is discharged to the environment. Dechlorination agents react with the chlorine in solution to produce chloride ions that do not have a toxic impact on aquatic organisms. The dechlorination reaction is very quick and a contact time of less than a few minutes is normally sufficient to reduce a chlorine residual to below the acceptable level (EPA, 2000).

4.4.1.2 Footprint and Compatibility with Site

Chlorination and dechlorination is the current disinfection process used at the Dundas WWTP. The footprint of this process is a function of the flow capacity and the required contact time. Therefore, this process requires a larger footprint than the other alternatives considered.

4.4.1.3 Ability to Expand within the Required Implementation Schedule

Chlorination/dechlorination is widely used across North America and the rest of the world. Most facilities in Ontario utilize chlorination/dechlorination. This process would have a simplified MECP approvals process.

A list of some of the full-scale applications similar or greater in size to Dundas WWTP are shown in **Table 4-13.**

Table 4-13: Full-Scale Applications of Chlorination/Dechlorination

Facility	Location	Rated Capacity (MLD)
Baker Road WWTP	Grimsby, Ontario	31
North Toronto TP	East York, Ontario	45
Guelph WWTP	Guelph, Ontario	64

Notes:

1. (Procon Constructors Inc., 2010)
2. (City of Toronto, 2021)
3. (MECP, 2014)

4.4.2 UV Disinfection

4.4.2.1 General Process Description

UV disinfection involves irradiating water with radiation waves in the range of 250-270 nm (ideally around 254 nm) to inactivate pathogenic microorganisms and viruses (EPA, 1999). UV irradiation cuts through the genetic components of microorganism preventing them from reproducing (EPA, 1999). UV light is generated by a mercury (vapour) lamp much like a normal fluorescent light, which ionizes (excites) mercury inside the lamp when charged by striking an electric arc (EPA, 1999). UV light is emitted as a result of the energy generated by the excitation of the mercury vapour in the lamp. UV disinfection does not require any chemical addition and effluent is non-toxic to aquatic life.

UV dose is a measurement of the UV energy input to the wastewater effluent. To be effective, the dose must exceed a threshold value dependent on the target microorganisms to be inactivated. UV dose is defined as the product of the UV intensity and the UV exposure/contact time. A reactor contact time of only a few seconds is normally adequate to achieve the desired effluent quality.

The effectiveness of UV disinfection depends on the characteristics of the wastewater specifically iron and suspended solids which affects UV transmittance and thus the UV dosage required to treat the wastewater. For the Dundas WWTP, the treated effluent will have low concentrations of solids due to the higher level of treatment required for TP removal resulting in lower UV doses and energy costs required to achieve disinfection requirements. Similarly, treatment of bypasses would not be an issue since peak flows are diverted to the Dundas EQ tank.

4.4.2.2 Footprint and Compatibility with Site

Since UV disinfection systems require significantly less contact time (20-30 seconds) than chlorine, the footprint required for UV disinfection is much smaller than that for a chlorine contact tank. UV disinfection systems require flow control weirs or other flow control structures to maintain a near constant submergence level of the UV lamps. This increases headloss in the system. However, this is not a concern at the Dundas WWTP since the filtration system requires effluent pumping.

4.4.2.3 Ability to Expand within the Required Implementation Schedule

UV disinfection has been proven at full-scale applications with many installations in Canada. For example, the Region of Waterloo predominately uses UV disinfection at their wastewater treatment facilities and UV disinfection is being implemented at the Ashbridges Bay Treatment Plant in the City of Toronto (replacing chlorination/ dechlorination). Some examples at plants of similar capacity to the Dundas WWTP are listed in **Table 4-14.** Overall, this technology is mature and would have a simplified MECP approvals process.

Table 4-14: Full-Scale Applications of UV Disinfection

Name	Location	Rated Capacity (MLD)
Preston WWTP [1]	Cambridge, Ontario	16.8
Keswick WPCP [2]	Keswick, Ontario	18

Name	Location	Rated Capacity (MLD)
Galt WWTP [1]	Cambridge, Ontario	56.8
Waterloo WWTP [1]	Waterloo, Ontario	57.5
Thunder Bay WPCP [3]	Thunder Bay, Ontario	84.5
Pine Creek WWTP [4]	Calgary, Alberta	100
South End WPCC [5]	Winnipeg, Manitoba	100
Notes: 1. (CIMA+, 2019) 2. (Hatch Mott MacDonald, 2015) 3. (Utilities Kingston, 2020) 4. (City of Calgary, n.d.) 5. (City of Winnipeg, 2020)		

4.4.3 Ozone

4.4.3.1 General Process Description

Ozone (O_3) is an unstable gas that is a strong oxidizer used to disinfect water. When dissolved in water, ozone forms hydrogen peroxyl (HO_2) and hydroxyl radicals (OH-) which are stronger oxidizing agents. Inactivation of viruses, bacteria and cysts by ozone is attributed to the oxidation or destruction of the cell wall (EPA, 1999). The overall system design is similar to chlorine gas disinfection; however, ozone is a stronger disinfectant than chlorine. Therefore, it requires lower concentrations and less contact time (i.e., as little as five minutes, compared to 30 minutes for chlorine).

Ozone is reactive and unstable, so it must be generated on site (EPA, 1999). For large systems, liquid oxygen is commonly supplied to the site and is then evaporated to a gas and fed into an ozone generator. An electrical current is then applied to the oxygen gas to convert it to ozone (EPA, 1999). The gas is then injected into the water to be disinfected. Any off-gas remaining in the headspace of the contact tank is then passed through a catalytic converter to destroy any residual ozone.

Ozone reacts with organics in the water which leads to the formation of organic peroxides, aldehydes, and halogenic compounds (Metcalf & Eddy, 2014).

4.4.3.2 Footprint and Compatibility with Site

Although, the footprint required for the contact tank for ozonation is smaller than for chlorine disinfection, ozonation would require a larger space for liquid oxygen storage, space for truck delivery of liquid oxygen, evaporators, ozone generators, catalytic converters and electrical equipment.

4.4.3.3 Ability to Expand within the Required Implementation Schedule

Ozone has been used for disinfection of potable water for many years. It is also used in some facilities to disinfect raw lake water and in advanced oxidation processes (e.g., the Arthur P. Kennedy WTP and Lorne Park WTP in the Region of Peel). However, there are relatively few wastewater treatment plants that utilize ozone for disinfection. It gained acceptance for use in municipal wastewater disinfection in the United States in the 1970s and many systems were installed in the 1980s (Loeb, Thompson, Drago, & Takahara, 2012). However, many discontinued the use of ozone from 2005 to 2010 and it was reported that less than 10 facilities still utilize ozone in the United States (Loeb, Thompson, Drago, & Takahara, 2012). Montreal's Jean R. Marcotte (JRM) WWTP is one of the only facilities in Canada to use ozone for disinfection. It is important to note that this plant only provides primary treatment rather than secondary/tertiary treatment like Dundas WWTP. Due to the poorer wastewater effluent quality produced at the JRM WWTP, the strong oxidizing potential of ozone can offer advantages.

Cobourg WWTP 1 replaced chlorination with ozone following a full-scale pilot study (Aclarus Ozone, 2023) and ozone is in operation at the Wellington WWTP, a small facility in Prince Edward County (Smith, 2020). Ozone was previously used at two Indianapolis plants – Belmont WWTP and Southport WWTP (both at 473 MLD) but it has since been replaced with chlorination/dechlorination.

This technology has not been widely used for wastewater applications. However, since recent installations have been completed in Ontario, it may not require pilot testing.

North American facilities with ozonation are listed in **Table 4-15** below.

Table 4-15: Full-Scale Applications of Ozone Disinfection

Name	Location	Status	Rated Capacity (MLD)
Wellington WWTP[1]	Prince Edward County, Ontario	Operating	1.5
Cobourg WWTP 1 [2]	Cobourg, Ontario	Operating	16
Jean-R. Marcotte WWTP[3]	Montreal, Quebec	Operating (primary treatment only)	2,780
Notes:			

Name	Location	Status	Rated Capacity (MLD)
1. (Smith, 2020) 2. (Aclarus Ozone, 2023) 3. (Stevenson, 2019)			

4.4.4 Peracetic Acid

4.4.4.1 General Process Description

Peracetic Acid (PAA) is a strong oxidant and virucide. The free radicals formed when PAA decomposes in water (hydrogen peroxyl and hydroxyl) disinfect the water by oxidizing or destructing the cell wall of pathogenic organisms (EPA, 2012). PAA decomposes into acetic acid, hydrogen peroxide, and water relatively quickly, so the contact time requirements are less than those for chlorine (EPA, 2012).

Studies completed with PAA used for disinfection show very low residuals eliminating the need for neutralization before release. In addition, PAA did not produce any disinfection by-products that are harmful to the environment and human health (Bettenhausen, 2020). Based on experience with a recent pilot study using PAA for disinfection at Hespeler WWTP in Cambridge, Ontario (Region of Waterloo), the MECP will require quenching with sodium bisulphite for PAA.

However, the decomposition of PAA to acetic acid can generate BOD within the treated effluent, contributing to the biological uptake of oxygen in the receiving water (PeroxyChem, 2016).

The storage and chemical feed system required for PAA would be similar to those for sodium hypochlorite. Capital costs for implementation of a PAA system have been found to be similar to those using sodium hypochlorite (EPA, 2012). However, the operating costs for PAA are currently higher than chlorination/dechlorination as the of PAA is approximately $1.40 - $1.70 USD per liter ($5.30 - $6.81 USD per gallon) (Bettenhausen, 2020). A comparison of the unit cost of purchasing PAA and sodium bisulphite to purchasing sodium hypochlorite and sodium bisulphite is shown below in **Table 4-16**. Please note these costs are from 2019.

Table 4-16:Chemical Cost Comparison of PAA to Chlorination/Dechlorination

Chemical	Unit Cost (USD)
Sodium Hypochlorite[1]	$0.86 per gallon
Sodium Bisulphite[1]	$2.03 per gallon

Chemical	Unit Cost (USD)
Peracetic Acid[2]	$5.30 - $6.81 per gallon
Total Chlorination & Dechlorination	**$2.89 per gallon**
Total Peracetic Acid & Quenching	**$7.33 - $8.84 per gallon**
Notes: 1. (City of Lawrence, 2019) 2. (Bettenhausen, 2020)	

4.4.4.2 Footprint and Compatibility with Site

PAA disinfection involves a system of chemical storage and dosage similar to that in place at the Dundas WWTP. The existing chemical storage systems could be repurposed to accommodate PAA. Contact time requirements are less than those for chlorine so the required footprint would be smaller.

4.4.4.3 Ability to Expand within the Required Implementation Schedule

The use of PAA for disinfection has been approved at the Region of Waterloo Hespeler WWTP following a year-long pilot study using PAA (CIMA+, 2020). The new PAA disinfection is anticipated to be commissioned in 2023.

Since PAA is not a well-established method for disinfection, the MECP requires a year-long side-stream pilot study to be completed to verify disinfection effectiveness and equivalency to other proven disinfection methods (CIMA+, 2020). Some facilities with proven installations are listed below in **Table 4-17.**

Table 4-17: Large Full-Scale Application of PAA

Name	Location	Rated Capacity (MLD)
Berkeley Heights STP [1]	Berkeley Heights, New Jersey	7.5
Mount Holly WPCP [1]	Mount Holly, New Jersey	11
Maxon WWTP [1]	Memphis, Tennessee	265
Notes: 1. (Bettenhausen, 2020)		

4.4.5 Evaluation of Long List of Disinfection Technologies

A summary of the evaluation of the long list of disinfection technologies is presented in **Table 4-18.** Green shading indicates a “pass” for that criteria, while red shading indicates a “fail”.

Table 4-18: Evaluation Summary of the Long List of Disinfection Technologies

Technology	Performance Reliability	Footprint and Compatibility with Site	Ability to Expand within Required Implementation Schedule	Consider for Evaluation
Chlorination/Dechlorination	This process would be able to reliably disinfect wastewater.	Current technology used on site. Sufficient space to accommodate within existing site.	This is a mature technology that would have a simplified MECP approvals process.	**Yes**
UV Disinfection	This process would be able to reliably disinfect wastewater.	Footprint is small and will fit within existing site.	This is a mature technology that would have a simplified MECP approvals process.	**Yes**
Ozone	This process would be able to reliably disinfect wastewater.	Ozonation would require greater space for contact tanks, liquid oxygen storage, space for truck delivery of liquid oxygen, evaporators, ozone generators, catalytic converters, and electrical equipment.	Installations at Cobourg WWTP 1 and Wellington WWTP have been approved by the MECP and are operating in Ontario. May not require extensive pilot testing.	**No,** this process requires additional space.
Peracetic Acid	This process would be able to reliably disinfect wastewater.	Footprint would be smaller than chlorination/dechlorination due to contact time.	Not a well-established technology for use in wastewater disinfection. Few operating installations internationally. Will require year long side stream pilot study	**No**, will require a year of pilot testing.

5 Short List of Technologies

The technology review focused on three separate categories: biological treatment processes, filtration technologies, and disinfection technologies.

The preferred design concept will require a combination of processes from the three categories to achieve the effluent objectives.

Other plant process areas (e.g., raw sewage pumping, preliminary treatment) and integration with the existing facility will be considered during the development of alternative design concepts based on the below short-listed technologies.

5.1 Biological Treatment Technologies

Based on the assessment presented in **Table 4-11**, the biological treatment process alternatives short listed for further evaluation are listed in **Table 5-1** below:

Table 5-1: Short List of Biological Treatment Technologies

Technology Alternative	Description
Aerobic Granular Sludge	This alternative utilizes an SBR process to granular biomass which fosters aerobic, anoxic and anaerobic conditions. This technology should be implemented in combination with one of the preferred filtration technologies in **Table 5-2** below.
Membrane Bioreactor	This alternative utilizes ultrafiltration membrane filters within a bioreactor to provide biological treatment and separate particulates to achieve low level effluent phosphorus and TSS. This option would eliminate the need for tertiary filtration.

5.2 Filtration Technologies

Based on the assessment presented in **Table 4-11**, the filtration technology alternative for TP removal short listed for further evaluation are listed in **Table 5-2** below:

Table 5-2: Short List of Filtration Technologies

Technology Alternative	Description
Membrane Filtration	This alternative utilizes ultrafiltration membrane filters to separate particulates to achieve low levels of effluent phosphorus and TSS concentrations.

5.3 Disinfection Technologies

Based on the assessment presented in **Table 4-18**, the disinfection technology alternatives short listed for further evaluation are listed in **Table 5-3** below:

Table 5-3: Short List of Disinfection Technologies

Technology Alternative	Description
Chlorination/dechlorination	The new process train would utilize chlorination and dechlorination. This disinfection approach is already used at the existing facility for Plants A and B.
UV Disinfection	This technology involves using UV disinfection to treat tertiary effluent produced by the new process train before discharging to the outfall.

5.4 Design Concepts

The above short-listed technologies will be combined to create design concepts that will be further detailed and evaluated in the following TM. Each design concept will involve a new headworks with screening and grit removal to handle flows to the entire facility. Primary treatment would be optional. The short-listed technologies will be combined to achieve the BOD, TSS, TAN and TP objectives. Each design concept considered will be a variation of the process illustrated in **Figure 5-1** below.

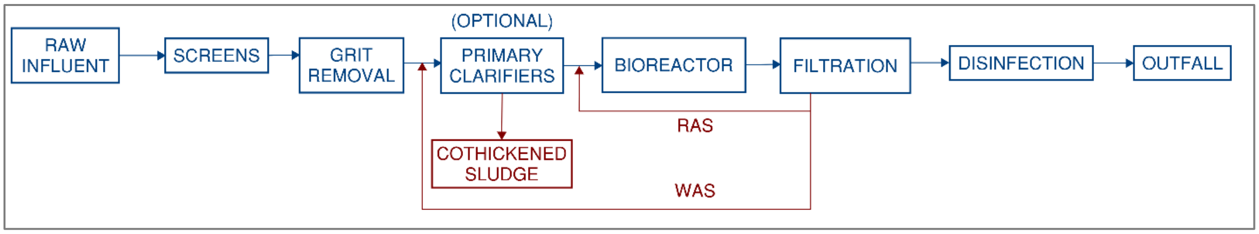

Figure 5-1: Design Concept Combination 1

6 Summary and Next Steps

This TM presented a review and evaluation of a long list of treatment technologies to upgrade the Dundas WWTP. A short list of technology alternatives was developed for more detailed evaluation. The technologies will be combined (whenever applicable) to develop alternative design concepts. Each design concept will involve a combination of shortlisted processes from the three process areas: biological treatment, filtration and disinfection.

The biological treatment process short list consists of:

- Aerobic granular sludge
- Membrane bioreactor

The filtration technology short list consists of:

- Membrane filtration

The disinfection technology short list consists of:

- Chlorination/Dechlorination.
- UV Disinfection

The alternative design concepts will be evaluated in detail to select the preferred wastewater design concept to upgrade the Dundas WWTP.

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A4

Appendix A4: Evaluation of Alternative Design Concepts Technical Memorandum

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City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Evaluation of Alternative Design Concepts Technical Memorandum

Tuesday, August 6, 2024

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Hamilton

Evaluation of Alternative Design Concepts Technical Memorandum

Facility Upgrade Plan for Dundas WWTP

T001744A

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Appendices

1 Introduction

CIMA+ was retained to complete a review of best available technologies (BAT) to upgrade the Dundas Wastewater Treatment Plant (WWTP). This study will provide the City of Hamilton with a long-term plan and conceptual design to implement upgrades to the treatment process in consideration of existing site constraints.

In a previous technical memorandum (TM), a long list of BAT were screened into a short list of technologies, which are combined to form alternative design concepts. This TM documents the evaluation of alternative design concepts and the selection of a preferred design concept to upgrade Dundas WWTP. A conceptual design will be developed for the preferred design concept in a subsequent report.

2 Design Basis

Historical data plant flow and raw wastewater concentration data from 2017 to 2021 was reviewed and analyzed to develop a design basis for the evaluation of BAT treatment alternatives and conceptual design of proposed process upgrades at the facility. The design parameters were defined in the *Design Basis Technical Memorandum (TM)* (CIMA+, 2022) and confirmed in consultation with the HHRAP as documented in in the *Effluent Criteria TM* (CIMA+, 2023). The recommended design basis is summarized in **Table 2-1** below. The facility will be designed to maintain its current rated capacity of 18,200 m^3/day.

The effluent objectives and limits are subject to approval by the Ministry of Environment, Conservation and Parks (MECP). However, the proposed effluent criteria have been accepted in principle by the Hamilton Harbour Remedial Action Plan (HHRAP) Cootes Paradise Subcommittee and the Royal Botanical Gardens (RBG). The proposed effluent criteria include stringent ammonia and total phosphorus treatment objectives. Total nitrogen (TN) removal is not required at this time. However, technologies capable of TN removal were short-listed to provide additional levels of treatment given that Cootes Paradise is a sensitive receiver. This is in line with the City's goals of environmental stewardship and implementing advanced technologies at their facilities.

Table 2-1: Design Basis Summary

Parameter	Design Value
Design Flows	
Average Day Flow, m^3/d	18,200
Maximum Month Flow, m^3/d	22,750
Maximum Day Flow, m^3/d (1)	31,850
Peak Hourly Flow, m^3/d (1)	36,400
Peak Instantaneous Flow, m^3/d (2)	42,200
Wastewater Characteristics	
Carbonaceous Biological Oxygen Demand ($cBOD_5$), mg/L	158
Total Suspended Solids (TSS), mg/L	224
Total Phosphorus (TP), mg/L	5
Total Kjeldahl Nitrogen (TKN), mg/L	34
Temperature, °C	15
Alkalinity, mg/L as $CaCO_3$	200
Potential Effluent Objectives	
$cBOD_5$, mg/L	3.0
TSS, mg/L	2.0
TP, mg/L	0.05

Parameter	Design Value
TAN, mg/L May 1 – October 31 November 1 – April 30	 0.3 0.5
Total Residual Chlorine, mg/L (May 1 to October 31)	0.00
E. coli (4) (May 1 to October 31)	100 organisms per 100 mL
pH	6.0 to 9.5

Notes:

1. Design peak flows based on historical peak flows treated at Dundas WWTP. To be confirmed with the City.
2. Existing diversion manhole is designed to bypass all flows exceeding 42,200 m^3/day as per existing Certificate of Approval Number 3-1040-99-006 (MECP, 1999).
3. Compliance based on monthly average basis.
4. Compliance based on monthly geometric mean density.

The design basis for the sizing of each unit process per the *Design Guidelines for Sewage Works* is shown in **Table 2-2**.

Table 2-2: Unit Process Design Basis (MECP, 2008)

Unit Process/Operations	Design Basis
Screening	Peak instantaneous flow One Screen Off-line
Grit Removal	Peak hourly flow
Primary Clarification	Average daily flow Peak daily flow
Aeration	Average daily BOD_5 loading

Unit Process/Operations	Design Basis
	Peak daily TKN loading
Secondary Clarification	Peak hourly flow Peak daily solids loading
Filtration	Peak hourly flow
Disinfection	Peak hourly flow
Outfall	Peak instantaneous flow

The existing Dundas WWTP consists of two parallel conventional activated sludge (CAS) facilities known as Plant A and Plant B. Plant A has a rated capacity of 6,100 m^3/day and Plant B has a rated capacity of 12,100 m^3/day, for a combined rated capacity of 18,200 m^3/day (MECP, 2010).

A capacity assessment was completed for the major unit processes at the Dundas WWTP as part of the *Design Basis TM* (CIMA+, 2022)**.** Most of the unit processes have theoretical capacities well below their rated capacities as stated in the ECA. During average flows and peak flows, both Plant A and B are limited hydraulically by the primary clarifiers. Therefore, given the capacity limitations, and the age and condition of the facility, the design concepts considered are based on constructing new process tanks and installing new equipment. The existing Plant A and Plant B would be ultimately decommissioned.

3 Evaluation Methodology and Criteria

The criteria to be used in the evaluation of the alternative design concepts are presented in **Table 3-1** below. Each alternative is evaluated against each criterion qualitatively and quantitatively using the rating scale shown in **Table 3-2** below.

Table 3-1: Evaluation Criteria

Criteria	Description
Environmental Considerations	
Terrestrial Environment	The potential for this alternative to impact terrestrial habitats or systems including terrestrial feature, unique vegetation

Criteria	Description
	species, mature trees, existing park/open spaces or wildlife.
Aquatic Environment	The potential of the alternative to impact aquatic habitats, systems or species.
Surface Water Quality and Source Water Protection	The potential for this alternative to impact surface water quality and protect source water.
Groundwater Quality and Quantity	The potential for this alternative to impact the quality and quantity of groundwater.
Air Quality	The potential for this alternative to impact air quality.
Greenhouse Gas (GHG) Emissions	The ability of this alternative to minimize GHG emissions.
Social-Cultural Considerations	
Odour	The potential for this alternative to produce odour post-construction.
Noise/Vibrations	The potential for this alternative to produce noise/vibrations post-construction.
Visual Aesthetics	The potential of this alternative to impact the scenic attributes of the community and surrounding areas.
Truck Traffic	The potential for this alternative to increase truck traffic and demands on the transportation system.
Disruption During Construction	The potential of this alternative to impact surrounding landowners and users including disruption to traffic, parking,

Criteria	Description
	noise and odour generation, and park/greenspace use.
Property Acquisition and Easement	The potential requirement to purchase additional land for facilities.
Recreational Use and Users	The potential for this alternative to impact surrounding recreational uses including both land and water uses.
Agricultural Use and Users	The potential for this alternative to impact agricultural productivity.
Human Health and Well Being	The potential for this alternative to impact human health and well being.
Existing and Future Land Use Compatibility	The extent to which the alternative fits in with the existing and future planned land uses in the area.
Archaeology/Natural Heritage	The potential for this alternative to impact any archaeological sites and/or significant natural heritage areas.
Technical Considerations	
Ease of Operation	The relative complexity of this alternative as it relates to operation and maintenance of the facility and its unit processes.
Ease of Implementation	The relative complexity of implementing this alternative within the existing plant site.
Resiliency	The ability of this alternative to adapt to changes in the environment and emergency situations.

Criteria	Description
Ease of Procurement	The relative complexity of procuring the technology within this alternative.
Geotechnical and Hydrogeology	The extent of potential geotechnical challenges and impact to hydrogeology as related to the infrastructure during and post construction.
Energy Use	The ability of this alternative to include energy efficient technologies and reduce overall energy requirements.
Permits and Approvals	Ease of receiving permits and approvals.
Economic Considerations	
Capital Cost	Capital cost estimates to provide a relative comparison of the alternatives. Capital costs are derived from costing benchmarks from reference upgrade projects.
Operation and Maintenance (O&M) Costs	O&M cost estimates to provide a relative comparison of the alternatives. O&M costs are derived from vendor information and costing benchmarks from reference facilities. Operating costs are based on flows over the 30-year planning horizon.
Lifecycle Costs	Lifecycle cost estimates to provide a relative comparison of the alternatives. Life cycle costs are calculated based on a 30-year life expectancy, with a 5% inflation rate and 5% discount rate.

Table 3-2: Evaluation Rating Scale

Impact Description	Impact Rating
Positive or no impact	9-10
Minor impact	7-8
Moderate impact	5-6
High impact	3-4
Severe impact	1-2

4 Alternative Design Concepts

In developing alternative design concepts, the constraints of the existing site were considered.

Every design concept would include preliminary treatment, biological treatment, filtration and disinfection. However, disinfection technology alternatives are evaluated separately. The preferred disinfection technology would be implemented with the preferred biological and filtration design concept.

4.1 Summary of Short-Listed Technologies

4.1.1 Preliminary Treatment

New preliminary treatment facilities would be required to replace aging infrastructure, to provide redundancy and protect downstream equipment and processes. The existing preliminary treatment processes at Dundas WWTP include screening and grit removal.

To meet the proposed total phosphorus effluent criteria, membrane filtration is required regardless of the biological treatment process selected. Fine screens with 2 mm opening are required to protect the membrane filters.

The grit removal system would be the same regardless of the design concept.

4.1.2 Primary Treatment

Primary treatment is not required for the biological treatment processes short-listed. Thus, it is not considered in the evaluation of alternative design concepts.

4.1.3 Biological Treatment

The biological treatment process alternatives short-listed for further evaluation are summarized in **Table 4-1** below. As noted above, the new biological treatment processes would replace the existing Plant A and Plant B.

Table 4-1: Short List of Biological Treatment Technologies

Technology Alternative	Description
Aerobic Granular Sludge (AGS)	This alternative utilizes a sequencing bioreactor (SBR) process operated to form granular biomass. This technology would be implemented in combination with membrane filtration.
Membrane Bioreactor (MBR)	This alternative utilizes ultrafiltration membrane filters within a bioreactor to provide biological treatment and separate particulates to achieve low level effluent phosphorus and TSS. This option would eliminate the need for tertiary filtration.

4.1.4 Filtration Technologies

The filtration technology for TP removal short listed for further evaluation was membrane filtration as shown in **Table 4-2** below.

Table 4-2: Short List of Filtration Technologies

Technology Alternative	Description
Tertiary Membrane Filtration (TMF)	This alternative utilizes ultrafiltration membrane filters to separate particulates to achieve low levels of effluent phosphorus and TSS concentrations.

4.1.5 Disinfection Technologies

The disinfection technologies short listed for further evaluation are summarized in **Table 4-3** below.

Table 4-3: Short List of Disinfection Technologies

Technology Alternative	Description
Chlorination/dechlorination	This process involves the addition of sodium hypochlorite upstream of a chlorine contact tank and injection of sodium bisulphite prior to discharge to receiving body. This disinfection approach is already used at the existing facility for Plants A and B.
UV Disinfection	This technology involves using UV disinfection reactors before discharging to the outfall. Reactors could be installed in a channel or in a pressurized pipe configuration.

The two disinfection technology alternatives are discussed below in **Section 4.4**.

4.1.6 Sludge Handling

New sludge handling and storage facilities would be required to replace aging infrastructure that is in poor condition and to restore sludge storage capacity. The existing sludge handling facility at Dundas WWTP includes sludge transfer equipment and two sludge storage tanks. Dewatering and thickening equipment may be considered to reduce the number of trucks on a regular basis to haul sludge to Woodward Ave. WWTP.

Sludge handling and storage facilities would be similar for both design concepts.

4.2 Alternative Wastewater Treatment Design Concepts

The new treatment process train would be designed with a rated design capacity of with a rated capacity of 18,200 m^3/day per the design criteria outlined in **Table 2-1**.

The existing site presents significant spatial constraints that pose challenges for construction sequencing of the new infrastructure. Plant A and Plant B would need to be demolished to create the necessary space for the construction of the new facilities.

To facilitate implementation CIMA+ recommended constructing the new treatment facility in the area currently occupied by baseball diamonds in Romano Park. This is documented in the *Evaluation of Alternative Site Layouts TM* (CIMA+, 2024).

The evaluation and selection of the preferred design concept is dependent on the location of the new plant. To minimize impacts to existing operations during construction, it is assumed that the new treatment facility would be constructed in Romano Park. Alternative design concepts are evaluated henceforth based on that assumption.

4.2.1 Design Concept 1: Aerobic Granular Sludge with Tertiary Membrane Filtration

Design Concept 1 involves constructing Aerobic Granular Sludge (AGS) reactors followed by tertiary membrane filters (TMF) and a new disinfection system (disinfection technologies are discussed further in **Section 4.4**). Due to the age and condition of other existing infrastructure, it is recommended that other facilities on site also be replaced including the raw sewage pumping station, screening and grit removal, the chemical building, and the sludge handling facility.

Figure 4-1 shows a process flow diagram (PFD) of Design Concept 1.

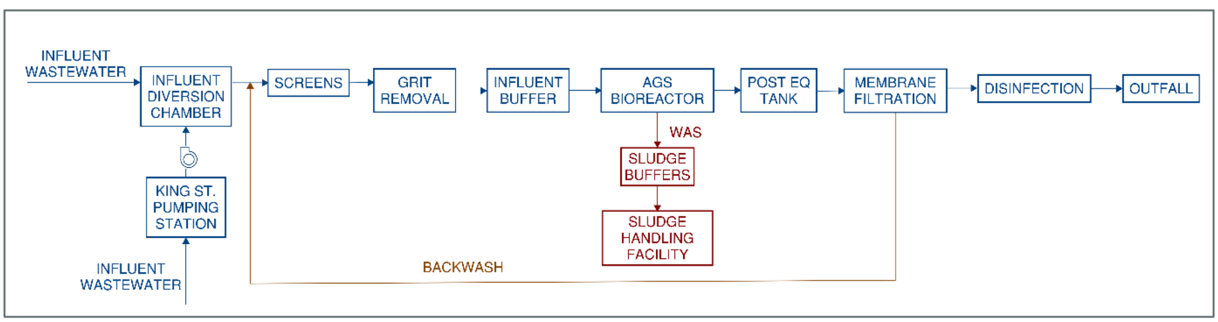

Figure 4-1: Design Concept 1 - Process Flow Diagram of the AGS Process with TMF

4.2.1.1 Site Layout

Design Concept 1 includes the following:

- New Influent Pumping Station
- Modifications to existing sewers to divert flows to the new Influent Pumping Station
- Modifications to existing diversion chamber
- New sewers to connect flows from the diversion chamber to the new treatment facility

- New Headworks Facility complete with screening and grit removal
- New AGS facility complete with an influent buffer, AGS reactors, sludge storage tanks (with capacity to be utilized as sludge buffers for the AGS system), and an equalization (EQ) tank
- New tertiary membrane filters (TMF)
- New disinfection system
- New sludge handling facility including sludge/slurry buffer and storage tanks

Raw influent would be conveyed to the new headworks by gravity from the existing influent diversion chamber and by pumping from the new raw pumping station The screened and degritted influent would flow by gravity to the new AGS facility and then to the TMF facility. The hydraulic grade line of the plant could be potentially designed such that only one pumping station would be required to convey flows from tertiary filtration to the outfall. This will be evaluated further during conceptual design. Effluent from the TMF would be disinfected and then conveyed to the existing outfall.

A new administration and control building would be constructed as well as a sludge storage facility, chemical building and odour control facility.

The bulk of the new facility would be constructed in the vacant area east of the existing site while maintaining the existing plant in operation. However, Plant B would need to be demolished to make space to accommodate some of the new process areas. Thus the plant would need to operate at a reduced capacity (i.e., the capacity of Plant A) with excess flows being diverted towards Woodward Avenue WWTP. After commissioning of the new facility, Plant A, the existing headworks and the Tertiary Filtration facility would be demolished.

Figure 4-2 shows a schematic site layout of the new buildings and tankage associated with this concept.

Additional details on each process area as well as a discussion on staging and constructability are provided below.

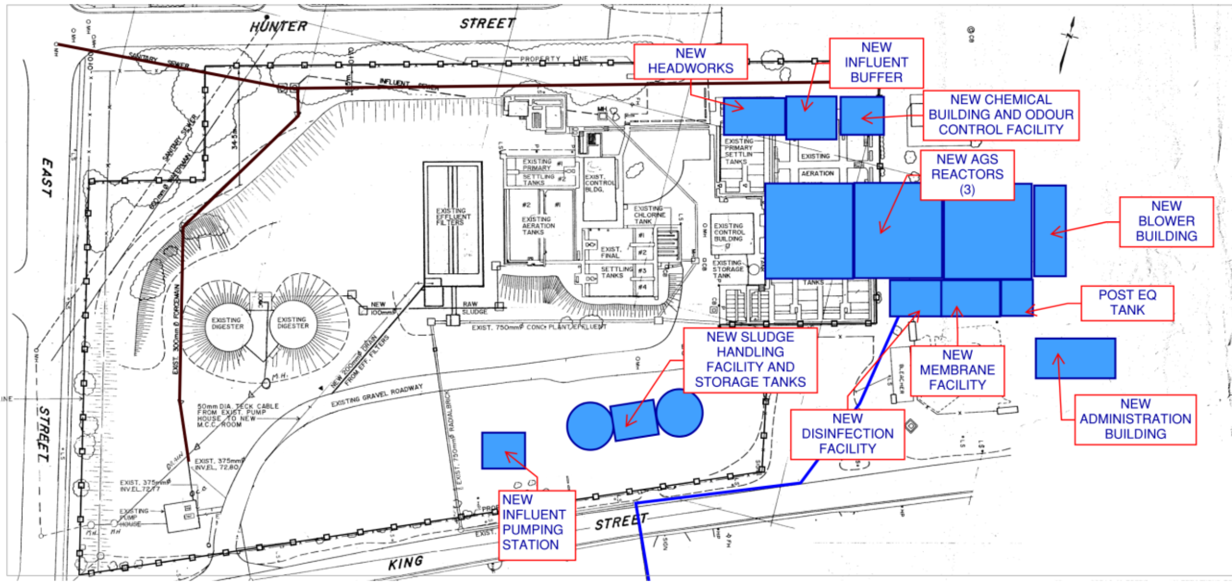

Figure 4-2: Design Concept 1 - Conceptual Site Layout of the AGS Process with TMF

4.2.1.2 Preliminary Treatment

Given the age of the existing King St. Pumping Station and the inability to isolate the pumps for maintenance, replacement of the pumping station is recommended.

A new headworks is recommended due to the age of the existing infrastructure and to provide system redundancy.

The aerated grit lift in the existing grit removal unit has been reported by operations to be non-functional. Thus, it is recommended the grit removal system also be replaced.

According to Aqua-Aerobics System Inc, the supplier of the AGS system, fine screens with 6 mm openings would be adequate pretreatment prior to the AGS reactors. However, a second set of fine screens with 2 mm opening are recommended downstream to protect the membrane filters. Both the 6 mm and 2 mm opening screens would be sized for a firm capacity of 42,200 m^3/day corresponding to the design peak instantaneous flow. Screening could be achieved by using double screening with 6 mm in-channel fine screens and 2 mm in-channel band screens, or the use of internally fed 2 mm opening rotary drum screens.

The new grit removal system would be designed to have a firm capacity of 36,400 m^3/day under peak hourly flow conditions and a hydraulic capacity of 42,200 m^3/day during peak instantaneous flow.

A summary of the conceptual design basis of the screening and grit removal units can be found in **Table 4-4** below.

Table 4-4: Design Concept 1 - Preliminary Treatment Sizing

Parameter	Value	MECP Design Guideline/Notes
Screening		
Opening Size	6 mm, followed by 2 mm	
Firm Design Capacity	42,200 m^3/day	PIF
Grit Removal Facility		
Firm Design Capacity	36,400 m^3/day	PHF

4.2.1.3 Biological Treatment

This design concept is based on the AquaNereda® AGS system supplied by Aqua-Aerobics System Inc. Conceptual sizing has been provided by Aqua-Aerobics.

The concept involves the construction of three new rectangular AGS reactor tanks in parallel each with a volume of 4,370 m^3. All reaction phases occur within the AGS reactor tanks including aeration, sludge settling, wasting of excess sludge and simultaneous filling/drawing. The AGS tanks would have a side water depth (SWD) of 7 m to minimize the footprint and improve oxygen transfer.

The design of the AGS facility incorporates an influent buffer tank with a volume of 840 m^3 to attenuate peaks upstream of the AGS reactors, and a post-AGS equalization tank with a volume of 612 m^3 prior to membrane filtration based on the decanting flow rate. However, the footprint and costs for this option can potentially be optimized by integrating the influent buffer with the influent pumping station and excluding the post-equalization tank.

Intermediate pumping may also be required upstream of the AGS reactors due to the depth of the tanks. The hydraulic grade line and pumping requirements will be evaluated further during conceptual design.

Sludge in excess of what is required in the tank is wasted to two sludge storage tanks further described below in **Section 4.2.1.5**.

The design basis for the AGS reactors and associated tanks is included below in **Table 4-5**. Conceptual sizing information provided by Aqua-Aerobics is included in **Appendix A**.

Table 4-5: Design Concept 1 - AGS Reactor Sizing

Parameter	Value
Influent Buffer[1]	
Number of Tanks	1
Volume, each	840 m^3
Dimensions, each L W SWD	 14 m 12 m 5 m
AGS Reactors	
Number of Tanks	3 rectangular tanks, in parallel
Volume, each	4,370 m^3
Cycle Duration	4.5 hrs/cycle
MLSS	8,000 mg/L
Solids Retention Time (SRT)	21 days
Volume, each	4,370 m^3
Dimensions, each L W SWD	 26 m 24 m 7 m
Post EQ Tank[1]	
Number of Tanks	1
Volume, each	612 m^3

Parameter	Value
Dimensions, each	
L	9.4 m
W	10 m
SWD	6.5 m

Note:

1. The design of the AGS facility incorporates an influent buffer and a post-equalization tank, based on the information received from Aqua Aerobic Systems Inc. However, the design can be potentially optimized to reduce footprint and cost by integrating the influent buffer with the influent pumping station and excluding the post-equalization tank.

Power requirements related to aeration based on average day loading of BOD_5 and TKN are shown below in **Table 4-6**, based on data provided by Aqua-Aerobics. Additional information can be found in **Appendix A**.

Table 4-6: Design Concept 1 Aeration System Power Requirements

Parameter	Value
Aeration Requirements	
Average Power Consumption	2,050 kWh/day

4.2.1.4 Filtration

This concept requires tertiary membrane filters (TMF) following the new AGS facility to meet the stringent TP effluent criteria. The discussion below is based on information provided by Aqua-Aerobics System Inc.

The concept involves the construction of four parallel membrane trains each consisting of 72 membrane modules. The tertiary membrane system could be designed with either an inside to outside flow pattern or an outside to inside flow pattern. The feed pumps would pump the influent through the membrane modules in the inside to outside flow pattern, so particulates would be collected within the membrane fibres while the filtered effluent (permeate) would pass through the fibres. In the outside to inside flow pattern, the permeate pumps would vacuum draw the influent through the membrane modules, so particulates would be collected on the outside of the membrane fibres while the permeate would pass through the fibres.

The membrane system would include permeate pumps, backwash pumps, a chemical cleaning system and/or air scouring blowers. Periodic backwash cycles and/or air scouring would flush out the particulates collected on the outside of the fibres. The backwash water would be conveyed back to the head of the plant.

The design basis for the TMF system is included below in **Table 4-7**. Conceptual sizing information provided by Aqua-Aerobics is included in **Appendix A**.

Table 4-7: Design Concept 1 - Filtration Sizing

Parameter	Value
Membrane Filtration	
Number of Trains	4
Number of Modules, each train	72
Dimensions, each train L W SWD	 5.9 m 1.4 m 2.6 m

4.2.1.5 Sludge Handling

The existing sludge storage tanks would be replaced to provide sufficient capacity. A new sludge transfer pumping station would be constructed. Sludge storage facilities would be designed to meet MECP guidelines for the storage of solids that have yet to be processed/stabilized. An estimated storage volume of 1,250 m^3 is required for seven days of storage assuming a 2% solids concentration. Dewatering and thickening equipment may be considered during conceptual design to reduce the number of trucks required on a regular basis to haul the sludge to Woodward Ave. WWTP.

In this concept, wasted sludge would consist of excess sludge from the AGS reactors. A slurry of sludge and mixed liquor exceeding what is required in the AGS reactors would be wasted to two sludge buffer tanks each with a volume of 288 m^3. Sludge is separated from the slurry within the buffers prior to being conveyed to the sludge storage tanks. The supernatant would be pumped back to the head of the plant. The estimated average daily dry solids production would be 3,300 kg/day. The AGS technology has some inherent biological phosphorus removal so the estimated average daily chemical sludge production would be 280 kg/day.

The design basis for sludge handling is presented below in **Table 4-8**.

Table 4-8: Design Concept 1 - Sludge Handling

Parameter	Value	Notes
Average Dry Solids Production	3,300 kg/d	Average loading conditions.
Average Chemical Sludge Production	280 kg/d	Assuming ferric sulphate addition.
Total Estimated Sludge Production (Dry Solids)	3,580 kg/d	
Total Estimated Sludge Production (Volume)	1,250 m^3	Assuming seven-day storage capacity and 2% TS

4.2.2 Design Concept 2: Membrane Bioreactor

Design Concept 2 involves constructing a membrane bioreactor facility and a new disinfection system (disinfection technologies are discussed further in **Section 4.4**). Due to the age and condition of other existing infrastructure, it is recommended that other facilities on site also be replaced including the raw sewage pumping station, screening and grit removal, the chemical building, and the sludge handling facility.

Figure 4-3 shows a PFD of Design Concept 2.

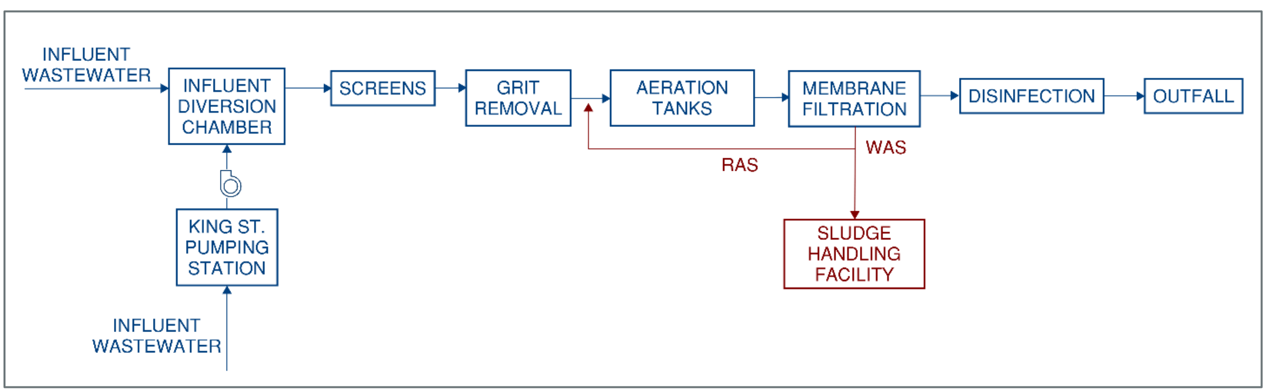

Figure 4-3: Design Concept 2 - Process Flow Diagram of the MBR Process

4.2.2.1 Site Layout

Design Concept 2 includes the following:

- New Influent Pumping Station
- Modifications to existing sewers to divert flows to the new Influent Pumping Station
- Modifications to existing diversion chamber
- New sewers to connect flows from the diversion chamber to the new treatment facility
- New Headworks Facility complete with screening and grit removal
- New membrane bioreactor trains (includes aeration tanks and membrane filtration)
- New disinfection system
- New sludge handling facility and storage tanks

Raw influent would be conveyed to the new headworks via gravity and the new raw sewage pumping station from the existing influent diversion chamber. The screened and degritted influent would be conveyed to the new aeration tanks followed by membrane filters. A new disinfection facility is proposed for the new treatment plant and it will discharge to the existing outfall. A new chemical building and odour control facility would be located adjacent to the new headworks.

Raw influent would be conveyed to the new headworks by gravity from the existing influent diversion chamber and by pumping from the new raw pumping station. The screened and degritted influent would flow by gravity to the new MBR. Effluent from the MBR would be disinfected and then conveyed to the existing outfall.

A new administration building would be constructed as well as a sludge storage facility, chemical building and odour control facility.

The new facility would be constructed in the area east of the existing site without the need to demolish the existing treatment trains. Thus, the existing facility would continue to operate during construction. Upon commissioning of the new facility, the existing Plant A and Plant B would be demolished and the space would be used for future expansion. **Figure 4-4** shows a conceptual layout of the new buildings and tankage associated with this concept.

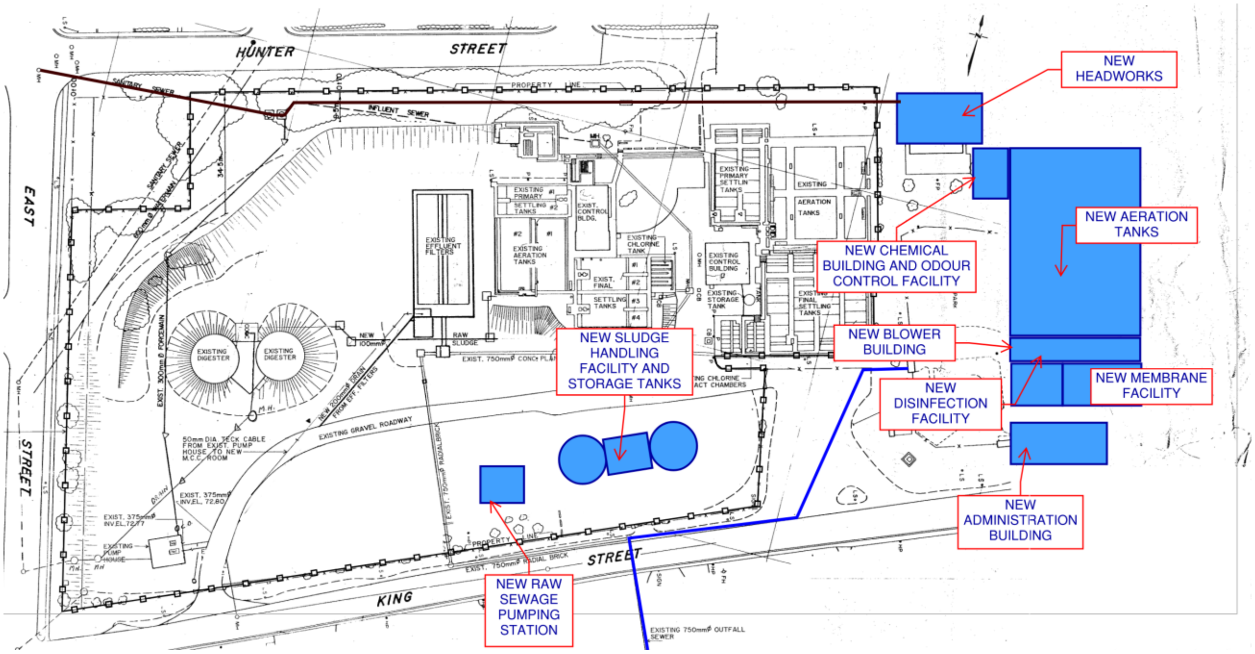

Figure 4-4: Design Concept 2 - Conceptual Site Layout of the MBR Process

4.2.2.2 Preliminary Treatment

Given the age of the existing King St. Pumping Station and the inability to isolate the pumps for maintenance, replacement of the pumping station is recommended.

A new headworks is recommended due to the age of the existing infrastructure and to provide system redundancy. The screens would be sized for a firm capacity of 42,200 m^3/day corresponding to the design peak instantaneous flow. The headworks would either include double screening using both 6 mm in-channel fine screens and 2 mm in-channel band screens, or internally fed 2 mm opening rotary drum screens.

In Design Concept 2, 2 mm fine screens would be required as pretreatment for the MBR. Screens would be sized for peak instantaneous flows providing a firm capacity 42,200 m^3/day.

The aerated grit lift in the existing grit removal unit has been reported by operations to be non-functional. Thus, it is recommended the grit removal system also be replaced. The new grit removal system would be designed to have a firm capacity of 36,400 m^3/day under peak hourly flow conditions and a hydraulic capacity of 42,200 m^3/day during peak instantaneous flow.

A summary of the design basis of the screening and grit removal units can be found in **Table 4-9** below.

Table 4-9: Design Concept 2 Preliminary Treatment Sizing

Parameter	Value	MECP Design Guideline/Notes
Screening		
Opening Size	2 mm	
Firm Design Capacity	42,200 m^3/day	PIF
Grit Removal Facility		
Firm Design Capacity	36,400 m^3/day	PHF

4.2.2.3 Biological Treatment

This option involves the construction of a MBR facility at Dundas WWTP. The discussion below is based on the ZeeWeed® MBR system as supplied by Veolia Water Technologies Inc. An evaluation of alternative vendor technologies should be carried out during preliminary design.

The concept involves the construction of three new rectangular plug-flow aeration tanks in parallel each with a volume of 3,000 m^3. Each tank would have a small swing anoxic selector zone for filamentous bacteria mitigation that makes up 600 m^3 of each tank. The swing anoxic zone requires mixing to sufficiently suspend and distribute solids. The provision of a swing anoxic zone has the benefit of reducing aeration requirements and improving sludge settleability.

The aeration tanks are proposed to have a 6 m SWD to minimize footprint. The aeration tanks were conservatively sized for a MLSS concentration of 6,000 mg/L.

The design basis for the aeration tanks is summarized below in **Table 4-10**. Conceptual sizing information provided by Veolia is included in **Appendix A** and conceptual sizing calculations are included in **Appendix B**.

Table 4-10: Design Concept 2 Aeration Tank Sizing

Parameter	Value
Aeration Tanks	
Number of Tanks	3 rectangular tanks

Parameter	Value
Swing Anoxic Zone	20% of tank volume
Anoxic Volume, each tank	600 m^3
Aerobic Volume, each tank	2,400 m^3
Total Volume, each tank	3,000 m^3
MLSS	6,000 mg/L
SRT	18 days
Dimensions, each tank L W SWD	 50 m 10 m 6 m

The power requirements related to aeration based on average day loading of BOD_5 and TKN are shown below in **Table 4-11**. These are based on information provided by Veolia included in **Appendix A**.

Table 4-11: Design Concept 2 - Aeration System Power Requirements

Parameter	Value
Aeration Requirements	
Average Power Consumption	6,216 kWh/day

4.2.2.4 Filtration

Membrane filtration is integral to the MBR system mentioned above in **Section 4.2.2.3**.

The concept involves the construction of four parallel membrane trains each consisting of 340 membrane modules. The membrane system would include permeate pumps, backwash pumps, blowers for air scouring and a chemical cleaning system. The permeate pumps would vacuum draw the influent through the membrane modules. This system has an outside to inside flow pattern, so particulates would be collected on the outside of the membrane fibres while the permeate would pass through the fibres. This also allows for filtration and clarification to occur at the same time within the membrane tank. Periodic backwash cycles and air scouring would flush out the particulates collected on the outside of the fibres. The backwash water would be conveyed back to the head of the plant.

The design basis for the membrane system is included below in **Table 4-12**. Conceptual sizing information provided by Veolia is included in **Appendix A**.

Table 4-12: Design Concept 2 Filtration Sizing

Parameter	Value
Membrane Filtration	
Number of Trains	4
Number of Modules, each train	340
Dimensions, each train L W SWD	 16.8 m 2.4 m 4 m

4.2.2.5 Sludge Handling

The existing sludge storage tanks would be replaced to provide sufficient capacity. A new sludge transfer pumping station would be constructed. Sludge storage facilities would be designed to meet MECP guidelines for the storage of solids that have yet to be processed/stabilized. An estimated storage volume of 3,400 m^3 is required for seven days of storage assuming a 1% solids concentration. Dewatering and thickening equipment may be considered during conceptual design to reduce the number of trucks required on a regular basis to haul the sludge to Woodward Ave. WWTP.

Excess solids from the MBRs would be wasted to the sludge storage tanks. The estimated average daily dry solids production is 4,800 kg/day.

The design basis for sludge handling is presented below in **Table 4-13.**

Table 4-13: Design Concept 2 Sludge Handling

Parameter	Value	MECP Guideline/Notes
Average Dry Sludge Production	4,800 kg/d	Average loading conditions.
Total Estimated Sludge Production (Volume)	3,400 m^3	Assuming a 1% solids concentration and 7 days of storage.

4.3 Evaluation of Alternative Wastewater Treatment Design Concepts

The following sections describe the results of the evaluation of the two concepts with respects to the various criteria. A summary of the evaluation is presented in **Section 4.3.5**.

4.3.1 Environmental Considerations

As noted above, the potential to relocate the existing baseball fields east of Plant B and build the new plant within that space is being considered by the City.

The majority of the Dundas WWTP and the Martino Park property have been previously disturbed. There are some undisturbed natural areas concentrated along the north and west edges of the property.

The footprint of design concept would be located within the existing site boundary and the Martino Park on lands that have been previously disturbed with minimal disturbance of the surrounding natural areas.

There are no open water sources located within or close to the site that would be directly impacted by construction of the upgrades and the effluent does not discharge near any intake protection zones (IPZs). However, the effluent from Dundas WWTP is discharged to the West Pond of Cootes Paradise which is an environmentally sensitive marsh. Both concepts would be designed to meet the proposed effluent criteria which is stringent and protective of the surface water quality of the receiver (CIMA+, 2023). Refer to the *DRAFT Effluent Criteria TM* (CIMA+, 2023) for additional detail on the recommendation of the proposed effluent objectives.

In terms of groundwater quantity and quality, the Dundas WWTP site is located approximately 1,800 m from Hamilton Harbour which flows into Lake Ontario, so it is expected that groundwater levels on site would be near or just above the water level of the lake. From boreholes completed on site in 1969, the groundwater level is shown from 1.4 to 2 m below the ground surface. Shoring during construction would likely be required. Shoring and dewatering plans would be developed during detailed design to protect groundwater resources.

Any upgrades to the Dundas WWTP would include controls to limit air emissions such that the plant would meet MECP requirements. All alternatives would be designed to include emission control and treatment to ensure air quality standards are met and impacts are mitigated.

GHG emissions consist of Scope 1, 2 and 3 emissions. Scope 1 corresponds to direct emissions from owned or controlled sources at the WWTP. Scope 2 represents indirect emissions resulting from purchased electricity, heating and cooling used at the plant. Lastly, Scope 3 corresponds to all other indirect emissions related to materials and goods required at the facility (e.g., chemicals, equipment, etc.) across their supply chain. A description of each emission classification is provided in **Table 4-14** below.

Table 4-14: Greenhouse Gas Emission Classifications and Considerations for Wastewater Treatment

Classification	Description	Consideration for Project
Scope 1	Direct GHG emissions.	Fugitive methane (CH_4) and nitrous oxide (N_2O) emissions from the biological treatment process and effluent discharge estimated using the approach in Chapter 6 of the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2019).
Scope 2	GHG emissions from the purchased electricity and heat sources.	Electricity for process mechanical equipment.
Scope 3	Indirect GHG emissions from the production of material that is either purchased for use in the	Chemical used for phosphorus removal and disinfection. Haulage of sludge from Dundas

Classification	Description	Consideration for Project
	process or avoided as a result of the process. materials.	WWTP to Woodward Ave. WWTP.

The GHG Inventory Tool developed by the Ontario Water Works Association (OWWA) and Water Environment Association of Ontario (WEAO) was used to assist in the analysis. The Tool estimates Scope 1 emissions related to the formation of CH_4 and N_2O emissions using the methodology outlined in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2019). Scope 2 emissions were estimated based on an emission factor of 28 gCO_2eq/kWh used for electricity as outlined in the Canada National Inventory Report (NIR) 1990-2020 (ECCC, 2022). Scope 3 emissions are difficult to quantify and there is no standard approach to assessing them. Thus, Scope 3 emissions were qualitatively assessed instead of using the Inventory Tool.

The evaluation of overall GHG emissions is based on quantitative estimate for Scope 1 and 2 emissions and a qualitative/relative assessment of Scope 3 emissions. For this reason, an alternative's impact in terms of Scope 1 and 2 emissions is assigned 75% of the overall score for GHG emissions, while Scope 3 emissions are given 25% of the score.

The estimate of Scope 1 and 2 emissions for each technology are presented below in **Table 4-15**.

The emissions analysis presented below focuses only on GHG emissions resulting from the operation of the wastewater treatment process at the new plant. The GHG emissions below do not include embodied carbon or emissions resulting from the offsite biosolids management at Woodward Ave. WWTP. The sludge hauled from Dundas WWTP would make up only a small portion of the biosolids managed at Woodward Ave. WWTP and would have an overall small impact on the resulting GHG emissions. The Scope 3 emissions from truck haulage were considered.

Both concepts could be designed to denitrify and mitigate N_2O formation, which is released from incomplete nitrification or partial denitrification. Thus, both concepts are expected to produce similar Scope 1 emissions since they would be designed to the same effluent criteria for TAN. The MBR process is expected to produce the most Scope 2 emissions due to greater energy requirements from aeration, mixing, recirculation and the membrane filtration process. Both concepts are expected to produce similar Scope 3 emissions. The AGS option is expected to require less coagulation chemical as the process has inherent biological phosphorus removal capabilities. However, the overall chemical shipment of chemicals to the site would be similar for both concepts. Sludge hauling requirements for both concepts would also be similar.

Table 4-15: GHG Emission Estimate for each Alternative Design Concept

Parameter	Upgrades Using AGS with TMF	Upgrades Using MBR
Scope 1 GHG Emissions (2,3)	1,888 tCO_2 eq/yr	1,888 tCO_2 eq/yr
Scope 2 GHG Emissions (4,5)	50 tCO_2 eq/yr	118 tCO_2 eq/yr
Scope 3 GHG Emissions (1)	Production and shipment of ferric sulphate chemical (monthly). Weekly hauling of sludge to Woodward Ave. WWTP	Production and shipment of ferric sulphate chemical (monthly). Weekly hauling of sludge to Woodward Ave. WWTP

Notes:

1. Estimates do not include embodied carbon.
2. Scope 1 emissions were estimated based on the methodology in Chapter 6 from the 2019 Refinement of the 2006 IPCC Guidelines for Greenhouse Gas Inventories (IPCC, 2019).
3. Scope 1 emissions were estimated using the Global Warming Potential (GWP) of N_2O and CH_4 (298 tCO_2eq/tNO_2 and 25 tCO_2eq/tCH_4) (IPCC, 2007).
4. Scope 2 emissions are based on the emission factor (28 gCO_2eq/kWh) used for electricity as outlined in the Canada National Inventory Report (NIR) 1990-2020 (ECCC, 2022).
5. Electricity use estimates per **Table 4-16.**

4.3.2 Social-Cultural Considerations

The Dundas WWTP site is surrounded by residential areas to the north and west, a recreational park space to the south and east, and some businesses to the south. Due to proximity of the residential areas, there is some concern related to the odour, noise and visual aesthetics of the processes on site. Regardless, the buildings would be designed to be aesthetically pleasing, tree screening and landscaping would be provided and the systems would include odour control and treatment to meet air quality standards and mitigate impacts to human health. Similarly, noise and vibrations during construction and operation would be mitigated to meet requirements of the nearest receptors. Odour and noise assessments would be completed during detailed design to confirm design details for odour and noise controls.

The effluent from Dundas WWTP discharges into Cootes Paradise which is an environmentally sensitive receiver owned and maintained by the Royal Botanical Gardens (RBG). RBG was consulted in the recommendation of future effluent criteria and both concepts would be designed to treat wastewater to the new stringent effluent criteria to protect Cootes Paradise.

Truck traffic to deliver chemicals and to haul sludge to Woodward Ave. WWTP is expected to be similar for both design concepts. Both design concepts would result in similar disruption during construction that would impact neighbouring residential and recreational users. However, odour, noise, dust and traffic issues can be mitigated. In addition, material transportation routes during construction would be planned to minimize impact to residential and recreational land use areas.

The Desjardins Canal area south of the Dundas WWTP site is listed as a non-designated property being of cultural heritage value or interest in the City of Hamilton (City of Hamilton, 2022). However, the upgrades would have no impact on this property. The upgrades would be constructed within the existing site on previously disturbed land, so no archaeological potential is expected. However, this should be confirmed through an Archaeological Screening Process.

4.3.3 Technical Considerations

As discussed in **Section 4.2**, the new facility can either be constructed within the existing site, which would present significant challenges with construction sequencing, or to the east in Martino Park as recommended in the *Evaluation of Alternative Site Layouts TM* (CIMA+, 2024).

The evaluation of the preferred design concept is dependent on the location of the new plant. To minimize impacts to existing operations during construction, it is assumed that the new treatment facility would be constructed in Martino Park.

Based on the preliminary sizing for both design concepts, Design Concept 2 based on the MBR process is anticipated to have a footprint approximately 25% smaller than Design Concept 1 (AGS).

As shown in **Section 4.2,** to accommodate the new infrastructure, Design Concept 1 would require Plant B to be demolished to accommodate some of the process facilities as the space available in Martino Park would be insufficient to accommodate the entire facility. Thus, a portion of the influent flow would need to be temporarily diverted to Woodward Ave. WWTP. On the other hand, Design Concept 2 could be constructed entirely within Martino Park while maintaining the existing plant in operation.

The hydraulic gradeline in both concepts would require careful consideration to reduce the need for intermediate pumping.

For Design Concept 1, permits and approvals would be required to temporarily divert a portion of the flow to Woodward Ave. WWTP during construction. Demolition permits would be required for both concepts. Furthermore, an MECP ECA amendment would be required regardless of the concept selected.

Design Concept 2 based on the MBR process would have a simplified MECP approvals process as it is a well-established technology in Ontario. AGS is a new technology in Ontario so it may require a more extensive approvals process with the MECP. It should be noted, however, that the use of this technology has recently been approved by the MECP in Napanee, Ontario.

Both concepts would be designed according to the on-site geotechnical and hydrogeological conditions.

Both design concepts would increase operation and maintenance complexity as both utilize technologies that are different than the existing CAS process on site. In Design Concept 1, the AGS system involves a proprietary operating philosophy that would be unfamiliar to operations staff. Both design concepts involve the use of membrane filters, which would require regular cleaning with automated air scouring, backwashing and chemical cleaning cycles. The membranes modules would also require replacement at the end of their service life or in case of membrane damage. The tertiary membranes in the AGS concept are expected to require less frequent cleaning due to the higher quality of the effluent being filtered (i.e., the membranes in the MBR process would filter mixed liquor while the membranes for the AGS process would filter secondary treatment effluent).

A relative comparison of energy requirements for each design concept was conducted. The energy assessment focused only on the differentiating components. The pumping and sludge handling requirements of each concept are expected to similar and were therefore not included in the comparison.

The MBR process has the greatest energy demand due to mixing and recirculation requirements and greater aeration demands. Also, the membranes in the AGS design concept are a tertiary filtration step with less membranes (72 modules vs. 340 modules for the MBR process) requiring less power overall for pumping and air scouring.

A comparison of the energy requirements from regular operation of each of the design concepts is presented in **Table 4-16** below.

Table 4-16: Alternative Design Concept Annual Average Energy Use Requirements Comparison

Parameter	Upgrades Using AGS with TMF (4)	Upgrades Using MBR (4)
Process Aeration Requirements	748,600 kWh/yr (1)	2,269,000 kWh/yr (2)
Buffer Energy Requirements	512,600 kWh/yr (1)	-
Mixing Energy Requirements	-	65,300 kWh/yr (2)
Recirculation Energy Requirements	-	287,300 kWh/yr (2)
Membrane Filtration Energy Requirements	516,600 kWh/yr (1,3)	1,604,700 kWh/yr (2)
Total Average Energy Requirements	1,777,800 kWh/yr	4,226,300 kWh/yr

Notes:

1. Average power consumption estimates provided by Aqua-Aerobics. Additional information included in **Appendix A**.
2. Average power consumption estimates provided by Veolia. Additional information included in **Appendix A**.
3. TMF could be designed as either an inside-outside flow pattern (does not require air scouring) or an outside-inside flow pattern (requires air scouring). Aqua-Aerobics provided TMF sizing for an inside-outside flow pattern system which does not require air scouring. For the purposes of the evaluation, an energy estimate for air scouring was added to be conservative.

Parameter	Upgrades Using AGS with TMF (4)	Upgrades Using MBR (4)
4. Based on operation 24 hours/day, 365 days/year at 18,200 m^3/day.		

4.3.4 Economic Considerations

A 30-year Net Present Value (NPV) cost analysis was completed for each alternative design concept, including estimated capital and operation and maintenance (O&M) costs. The cost analysis is based on the following assumptions:

- It was assumed that construction of the expansion would span a period of 4 years starting in 2027 and the commissioning would occur in 2031. Capital costs were prorated proportionally across the 4 years.
- Capital cost estimates for the headworks, bioreactors and membrane filtration facilities are high-level estimates based on recent project experience in Ontario at similar facilities and vendor information. Disinfection was not included in the analysis as it is evaluated separately.
- Operating costs include items such as energy use for aeration, mixing, pumping, chemical consumption, equipment maintenance/replacement, and labour. Screening and sludge management costs were not included as they are expected to be similar for both alternatives.
- Operating costs were assumed to start in 2031. Energy and chemical use costs were prorated based on the projected future average day flows to Dundas WWTP. Daily average operation costs were multiplied by 24-hour operation, 365 days of the year. Labour and equipment maintenance costs are an estimated based on the upgrade requirements.
- Life cycle costs were calculated based on a 30-year planning horizon, with a 5% inflation rate and 5% discount rate.

As noted above, the cost estimates were developed to assess the relative difference between design concepts. For the purposes of this evaluation, elements assumed to be common to each concept were not included in the cost estimate. Cost estimates for the AGS facility includes an influent buffer and a post-equalization tank based on the information received from Aqua Aerobic Systems Inc.

The overall design and related costs will be refined for the preferred alternative during the conceptual design phase. Additional details related to the cost estimates including all assumptions made and information used can be found in **Appendix C**. Estimated annual operating (i.e., energy and chemical use), labour and equipment maintenance costs of the two concepts are summarized in **Table 4-17.**

Table 4-17: Annual Average O&M Cost Breakdown of Alternative Design Concepts

Parameter	Upgrades Using AGS with TMF	Upgrades Using MBR
Energy (Aeration)	$74,900	$226,900
Energy (Buffers)	$51,300	-
Energy (Mixing)	-	$6,500
Energy (Recirculation)	-	$28,700
Energy (Membrane Filtration)	$51,700	$160,500
Chemical Consumption	$211,300	$371,700
Equipment Maintenance /Replacement	$909,900	$909,900
Labour	$613,200	$525,600
Total Annual Average O&M Costs	**$1,912,000**	**$2,230,000**

Notes:

1. Assumed electricity costs based on $0.10/kWh (based on weighted average of electricity costs across 24 hours) (Ontario Energy Board, 2023).
2. Dosage of 6.9 mg Fe/L for AGS with TMF and 7 mg/L Fe/L for MBR at average day flow for phosphorus removal. Cleaning chemical volumes for membrane filters were provided by the vendors. Vendor information provided in **Appendix A**.
3. Assumed $0.82/L ferric sulphate, $1.10/L sodium hypochlorite, $6.70/L citric acid, $0.53/L sodium hydroxide and $1.96/L sulfuric acid based on unit costs from reference facilities.
4. Annual equipment maintenance costs expected to be similar for both concepts. The cost is only based on upgrades in each design concept and assumed to be 3% of the subtotal capital cost of the MBR concept.

Parameter	Upgrades Using AGS with TMF	Upgrades Using MBR
5. Assumed lowest labour requirements for MBR: 3 operators working 8 hrs/day for $60/hr. Assumed slightly greater labour requirements for AGS with TMF option: 3.5 operators working 8 hrs/day for $60/hr.		

Table 4-18 below presents a summary of the cost comparison for the alternative design concepts. The AGS with TMF option (Design Concept 1) is estimated to have the highest initial capital cost. However, the MBR option (Design Concept 2) is expected to have the highest O&M costs due to greater energy and chemical requirements. Overall, based on the assumptions above, the MBR option resulted in the lowest 30-year NPV life cycle cost.

Table 4-18: Cost Comparison of Alternative Design Concepts

Parameters	Upgrades Using AGS with TMF	Upgrades Using MBR
NPV Capital Cost	$114,793,000	$92,202,000
NPV Annual O&M Cost	$23,133,000	$27,866,000
30-Year NPV Life Cycle Cost	$137,926,000	$120,068,000
Notes: 1. All costs are conceptual level opinions of probable costs in 2023 dollars and should be considered accurate to +/-50% 2. Costs do not include disinfection. Disinfection costs would be the same for both alternative design concepts.		

4.3.5 Summary of the Evaluation of Alternative Wastewater Treatment Design Concepts

Table 4-19 below summarizes the evaluation and scoring of the two design concepts using the criteria and rating scale as described in **Table 3-1** and **Table 3-2**, respectively.

Table 4-19: Evaluation of Alternative Design Concepts

Sub-Criteria	Upgrades Using AGS with TMF	Upgrades Using MBR
Environmental Considerations		
Terrestrial System	The footprint of both concepts would be located within the previously disturbed sites.	
	7	7
Aquatic System	No open water sources located within or close to the site.	
	9	9
Surface Water Quality and Source Water Protection	The effluent discharges to the West Pond of Cootes Paradise which is an environmentally sensitive marsh. Both concepts would be designed to meet the proposed effluent criteria which is protective of the receiver. The effluent does not discharge near any IPZs.	
	6	6
Groundwater Water Quality and Quantity	Groundwater would be near or just above the level of Lake Ontario/Hamilton Harbour. Shoring and dewatering plans would be developed for both concepts to protect groundwater resources.	
	6	6
Air Quality	Both concepts would be designed to include air emissions control and treatment to ensure air quality standards are met and impacts are mitigated.	
	7	7
Greenhouse Gas Emissions (GHG)	Both concepts are expected to produce similar Scope 1 emissions since they would be designed to the same effluent criteria. The MBR process is expected to produce the most Scope 2 and 3 emissions due to greater energy requirements and chemical use.	
	7	6
Total Score (Out of 60)	42	41
Weight	25	25
Normalized Score (Total 25)	**17.5**	**17.1**
Social - Cultural Considerations		

Sub-Criteria	Upgrades Using AGS with TMF	Upgrades Using MBR
Odour	Neighbouring residential areas have a potential to be impacted. Both concepts would be designed to include odour control and treatment such that all air quality standards are met, and impacts mitigated.	
	6	6
Noise/Vibrations	Neighbouring residential areas have a potential to be impacted by noise. Both concepts would be designed to mitigate noise/vibrations to meet requirements at the nearest receptors.	
	6	6
Visual Aesthetics	Visual aesthetics of the site can be improved with new facilities so that neighbouring residential areas are not impacted. The trees along the edges of the property also provide a visual barrier.	
	6	6
Truck Traffic	Truck traffic for haulage of sludge is expected to be similar for both concepts. Traffic resulting from chemical deliveries would be less for the AGS concept.	
	7	6
Disruption During Construction	Both concepts would create disruption during construction and have potential to impact the neighbouring residential and recreational areas. These are short-term impacts and they can be mitigated.	
	5	7
Property Acquisition and Easement	Property acquisition and easements would not be required if both concepts are constructed within the existing site and the Martino Park which is owned by the City. The City would likely require to acquire additional land to accommodate a new baseball diamond.	
	7	7
Recreational Use and Users	Both concepts would impact the park users as Martino Park would be utilized as the new site for the new infrastructure.	
	5	5
Agricultural Use and Users	Agricultural use and users would not be impacted.	
	10	10

Sub-Criteria	Upgrades Using AGS with TMF	Upgrades Using MBR
Human Health and Well-Being	Both concepts would be designed to meet air emission and effluent quality requirements to protect human health.	
	8	8
Existing and Future Adjacent Land Use Compatibility	The Dundas WWTP site can be considered incompatible with the neighbouring residential and recreational areas. However, the upgrades provide an opportunity to enhance odour and noise controls and visual aesthetics of the site. The upgrades would be designed to mitigate impacts to adjacent users.	
	7	7
Archaeology/Cultural Heritage	The upgrades would be within previously disturbed land within the existing site so no archaeological potential is expected. The Desjardins Canal area south of Dundas WWTP is listed as a non-designated property being of cultural heritage value/interest. However, these upgrades would have no impact on this property.	
	7	7
Total Score (Out of 110)	74	75
Weight	25	25
Normalized Score (Total 25)	**16.8**	**17.0**
Technical Considerations		
Ease of Operation	Both concepts utilize different technologies than what is existing. Both introduce membrane filtration cleaning cycles and replacements. AGS involves a proprietary operating philosophy that has not yet been implemented in Ontario.	
	5	6
Ease of Implementation	The AGS option requires a larger footprint than MBR. This would introduce greater challenges with implementation due to space constraints and the need to maintain the plant in operation during construction. Space available to the east of Plant B at the site of existing baseball fields would not be sufficient to accommodate all process infrastructure for the AGS concept. Thus, Plant B would need to be demolished to make space for the new infrastructure. A portion of influent flows would need to be	

Sub-Criteria	Upgrades Using AGS with TMF	Upgrades Using MBR
	diverted to the Woodward Ave. WWTP during construction. The MBR option could be implemented within Martino Park without impacting the existing plant operation. The hydraulic grade line would require careful consideration in both concepts due to the need for deep tanks and to eliminate the need for intermediate pumping.	
	5	8
Resiliency	The AGS option provides both biological treatment and settling in one process, so flow could bypass the membranes and still receive some treatment in case of an emergency event. In the MBR option, the membranes replace secondary clarifiers and are incorporated with the biological treatment process and would not be able to be bypassed.	
	8	7
Ease of Procurement	There are limited vendors available that provide the AGS system, while there are a variety of vendors that could provide the MBR option.	
	6	7
Geotechnical and Hydrogeology	Both concepts would be designed according to on-site geotechnical and hydrogeological conditions.	
	7	7
Energy Use	The MBR option has the greatest energy consumption due to mixing and recirculation requirements and greater aeration demands.	
	7	6
Permits and Approvals	The MBR option would have a simplified MECP approvals process. The AGS option is a new technology in Ontario and may involve a more extensive approvals process.	
	6	7
Total Score (Out of 70)	44	48
Weight	25	25
Normalized Score (Total 25)	**15.7**	**17.1**
Economic Considerations		

Sub-Criteria	Upgrades Using AGS with TMF	Upgrades Using MBR
Capital Cost	The MBR option is expected to have the lowest capital cost as it requires less tankage overall, has lower process equipment cost and does not require significant coordination and staging.	
	7	10
Operating and Maintenance (O&M) Costs	The AGS option is expected to have the lowest O&M costs due to reduced energy and chemical requirements.	
	10	8
Life Cycle Costs	The MBR option would produce the lowest 30-year NPV life cycle costs.	
	9	10
Total Score (Out of 30)	26	28
Weight	25	25
Normalized Score (Total 25)	**21.7**	**23.3**
Total Score	**71.7%**	**74.6%**

A sensitivity analysis of the evaluation scoring was completed using the weighting changes presented in **Table 4-20** below. This was completed to determine whether the final score is sensitive to a weighting change of the criteria categories. In all scenarios, the MBR option still produced the highest score. However, the difference is marginal.

Table 4-20: Alternative Design Concept Sensitivity Analysis Scenarios

Criteria Category	Weighting (base)	Sensitivity Analysis			
Natural Environment	25%	30%	35%	30%	20%
Social - Cultural Environment	25%	30%	35%	30%	20%
Technical Considerations	25%	20%	15%	30%	30%
Economic Considerations	25%	20%	15%	10%	30%

Upgrades Using AGS with TMF	**71.7%**	**71.1%**	**70.5%**	**68.7%**	**72.3%**
Upgrades Using MBR	**74.6%**	**73.3%**	**72.1%**	**70.9%**	**75.9%**

4.3.6 Preferred Wastewater Treatment Design Concept

Based on the evaluation and scoring in **Table 4-19** and **Table 4-20** above, overall both design concepts scored closely but the MBR option produced the highest scoring compared to the other alternative. Taking this into consideration, **the MBR process** is the preferred design concept as it would fit with Martino Park without impacting the operation of the existing plant during construction (and eliminating the need to divert flows to Woodward Ave. WWTP). Furthermore, the MBR technology is proven in Ontario, provides more flexibility with procurement, and it is expected to have a lower capital cost which is of value to the City when obtaining funding for the upgrades.

4.4 Disinfection Technology Alternatives

As mentioned above, the disinfection technology alternatives were evaluated separately from the biological treatment and filtration design concepts. The selection of the preferred biological treatment and filtration design concept does impact the evaluation and selection of the preferred disinfection technology. The preferred disinfection technology would be implemented with the preferred biological and filtration design concept.

4.4.1 Technology 1: Chlorination and Dechlorination

In this option, the disinfection technology for the new plant would involve the construction of a new chlorine contact tank complete with sodium hypochlorite and sodium bisulphite storage and feed systems.

4.4.1.1 Site Layout

The chlorine contact tank would be integrated with the design of the biological treatment and filtration processes illustrated in **Figure 4-2** or **Figure 4-4**. The filtrate from the membrane filters would be conveyed to the chlorine contact tank where it would be disinfected using sodium hypochlorite. The disinfected effluent would be dechlorinated prior to discharging to the outfall using sodium bisulphite. Chemical storage and feed systems would be stored in a new chemical building.

4.4.1.2 Conceptual Sizing

The chlorine contact tank would be sized to achieve a 30-minute contact time at average daily flows and a 15-minute contact time at peak hourly flows. A 380 m^3 chlorine contact tank would be required.

The design basis for the chlorination/dechlorination system is presented below in **Table 4-21**.

Table 4-21: Chlorination/Dechlorination Sizing

Parameter	Value	MECP Guideline/Notes
Design Basis		
Design Capacity	36,400 m^3/d	PHF
Chlorine Contact Tank		
Volume Required at ADF	380 m^3	30 min contact time
Volume Required at PHF	380 m^3	15 min contact time
Dimensions L W SWD	 14 m 9 m 3 m	

4.4.2 Technology 2: UV Disinfection

In this option, the disinfection technology for the new plant would involve the construction of a new UV facility utilizing either UV reactors within open channels or closed vessel reactors. For this evaluation, UV reactors within open channels were considered to be conservative in terms of size and power used.

4.4.2.1 Site Layout

The UV disinfection system would be integrated with the design of the biological and filtration processes shown in **Figure 4-2** or **Figure 4-4** above. The disinfection facility would house the channels, banks of UV reactor lamps and electrical equipment. The dimensions of the facility were estimated based on the channel dimensions provided by Trojan Technologies™. The filtrate from the membrane filters would be conveyed to the channels where it would be disinfected as it flows through the UV reactor lamps. The disinfected effluent would then be discharged to the outfall.

4.4.2.2 Conceptual Sizing

The concept involves the construction of two channels (one duty, one standby), each including two banks of UV lamps and a fixed weir. Conceptual sizing Information provided by Trojan is included in **Appendix A**.

Conceptually, a UV transmittance of 65% was applied to size the UV system. This is typical of a facility with high quality effluent such as membrane filtered effluent.

The design basis for the UV disinfection system is presented below in **Table 4-22**.

Table 4-22: UV Disinfection Sizing

Parameter	Value	MECP Guideline/Notes
Design Basis		
Design Capacity	36,400 m^3/d	PHF
UV Transmittance	65%	
Channels		
Number of Channels	2	1 duty, 1 standby
Dimensions, each channel L W SWD	 10 m 1 m 2.3 m	
UV Banks		
Number of Banks, each channel	2	

4.5 Evaluation of Alternative Disinfection Technologies

4.5.1 Environmental Considerations

Both disinfection technology alternatives would be constructed within previously disturbed areas. Both chlorination/dechlorination and UV are effective disinfection methods and can meet effluent quality requirements before discharge to receiving waters. With chlorination/dechlorination there is a risk of disinfection by-product formation and release into Cootes Paradise. As a result, chlorination/dechlorination has slightly more potential to impact surface water quality than UV disinfection. There is a low risk that construction of either disinfection facility will impact groundwater quantity and quality and any impacts can be mitigated.

The regular operation of chlorination/dechlorination and UV disinfection would not impact air quality at the Dundas WWTP.

A description of each GHG emission classification and considerations for disinfection is provided in **Table 4-23** below.

Table 4-23: Greenhouse Gas Emission Classifications and Considerations for Disinfection

Classification	Description	Consideration for Project
Scope 1	Direct GHG emissions.	No direct emissions under regular operation.
Scope 2	GHG emissions from the purchased electricity and heat sources.	Electricity for process mechanical equipment.
Scope 3	Indirect GHG emissions from the production of material that is either purchased for use in the process or avoided as a result of the process.	Chemical used for disinfection. UV lamp disposal and manufacturing.

The methodology for evaluation of overall GHG emissions is as described in **Section 4.3.1.** The estimate of Scope 2 emissions for each technology is presented below in **Table 4-24**.

Of the two technologies, the UV disinfection process would produce the most Scope 2 GHG emissions due to the electricity required to power the UV systems. Chlorination and dechlorination requires some electricity for metering pumping equipment used for dosing into the contact tank, but this amount is negligible in comparison to the power draw from the UV lamps.

Alternatively, chlorination/dechlorination would produce the most Scope 3 emissions associated with the production and transport of the two chemicals to the plant. There would also be Scope 3 emissions associated with the production, shipment, and end of life disposal of the UV lamps, which would need to be replaced approximately once per year.

Table 4-24: GHG Emission Estimate for each Disinfection Technology

Parameter	Upgrades Using Chlorination/ Dechlorination	Upgrades Using UV Disinfection
Scope 2 GHG Emissions [1,2]	Negligible	3 tCO_2 eq/yr
Scope 3 GHG Emissions	Production and shipment of sodium hypochlorite and sodium bisulphite on a regular basis (monthly).	Production, shipment, and end of life disposal of UV lamps on an 1-1.5 year basis.

Notes:

1. Scope 2 emissions are based on the emission factor (28 gCO_2eq/kWh) used for electricity as outlined in the Canada National Inventory Report (NIR) 1990-2020 (ECCC, 2022).
2. Electricity use estimates per **Table 4-25.**

4.5.2 Social-Cultural Considerations

Due to the proximity of the residential and recreational areas, there are concerns related compatibility with the neighbouring land uses, specifically odour, noise, and visual aesthetics. Visual aesthetics can be improved with new facilities and any odour and noise concerns would only be during construction. Any chemical odour would be contained within the chemical building. UV disinfection would not have any impacts with respect to odour and noise. Any disruption caused by construction would be short-term and any noise, dust, and traffic issues can be mitigated.

There would be regular truck traffic to deliver chemicals for chlorination/dechlorination, while no regular deliveries would be required for UV disinfection.

The Desjardins Canal area south of the Dundas WWTP site is listed as a non-designated property being of cultural heritage value or interest in the City of Hamilton (City of Hamilton, 2022). However, the upgrades would have no impact on these properties. Both concepts would be implemented within the existing site on previously disturbed land so no archaeological potential is expected.

4.5.3 Technical Considerations

Each alternative would be designed to effectively disinfect wastewater to meet effluent objectives. The UV system would be designed with a spare train to provide firm capacity and redundancy in case of maintenance.

A relative comparison of energy requirements for each disinfection technology was conducted. The UV disinfection option has the highest energy requirements due to the power draw from the UV lamps. The chlorination/dechlorination requires minimal energy to dose chemical to the contact tank, so the energy consumed is negligible in comparison.

A comparison of the energy requirements from regular operation of each of the design concepts is presented in **Table 4-25** below.

Table 4-25: Disinfection Technologies Annual Average Energy Use Requirements Comparison

Parameter	Upgrades Using Chlorination/ Dechlorination	Upgrades Using UV Disinfection [1]
Total Energy Requirements	Negligible	97,230 kWh/yr
Notes: 1. Based on operation 24 hours/day, 365 days/year at 18,200 m^3/day.		

The operation and maintenance requirements of the chlorine contact tank would be similar to the current requirements of the existing chlorination/dechlorination system at Dundas WWTP. The UV system includes an automatic lamp sleeve cleaning system which involves mechanical wiping with a cleaning solution. Routine maintenance such as changing the lamps approximately every 1-1.5 years and refilling the cleaning solution is required. For channel maintenance, there is an automatic raising arm to lift the banks out of the channel.

The UV channels requires a weir to control the flow and maintain the UV lamps submerged to ensure adequate contact time with the UV light and avoid overheating.

4.5.4 Economic Considerations

A 30-year NPV cost analysis was completed for each disinfection technology, including estimated capital and O&M costs. The cost analysis is based on the following assumptions:

- It was assumed that construction of the expansion would span a period of 4 years starting in 2027 and the commission would occur in 2031. Capital costs were prorated proportionally across the 4 years. It is assumed that the construction of disinfection would occur in conjunction with the new treatment train.
- Equipment costs for the UV disinfection system were provided by Trojan Technologies for the system they recommend as best suited for Dundas WWTP. As noted above, this is based on a 65% UV transmissivity.
- Capital costs estimates for the UV facility and the chlorine contact tank are high-level estimates based on recent Ontario experience with such facilities of similar capacity and vendor information.
- Operating costs include items such as energy use for UV lamps, chemical consumption, equipment maintenance/replacement, and labour.
- Operating costs were assumed to start in 2031 and were prorated based on the projected future average day flows to Dundas WWTP. Daily average operation costs were multiplied by 24-hour operation, 365 days of the year.
- Life cycle costs were based on 30-year planning horizon, a 5.0% inflation rate and a 5.0% discount rate.

As noted above, the cost estimates were developed to assess the relative difference between disinfection technologies. The overall design and related costs will be refined for the preferred alternative during the conceptual design phase. Additional details related to the cost estimates including all assumptions made and information used can be found in **Appendix C**.

Operating (i.e., energy and chemical use), labour and equipment maintenance costs of the disinfection technologies were estimated as shown in **Table 4-26.**

Table 4-26: Annual Average O&M Cost Breakdown of Disinfection Technologies

Parameter	Upgrades Using Chlorination/ Dechlorination	Upgrades Using UV Disinfection
Energy Consumption	-	$10,000
Chemical Consumption	$62,000	-
Equipment Maintenance /Replacement	$10,000	$11,000
Labour	$22,000	$22,000
Total Annual Average O&M Costs	$94,000	$43,000

Notes:

1. Assumed electricity costs based on $0.10/kWh (based on weighted average of electricity costs across 24-hour day) (Ontario Energy Board, 2023).
2. Dosage of 6 mg/L of sodium hypochlorite and 0.5 mg/L of sodium bisulphite at average day flow from process control narrative setpoints.
3. Assumed $0.22/L sodium hypochlorite and $0.28/kg sodium bisulphite from chemical costs at reference facility.
4. Annual equipment maintenance/replacement cost assumed as 1% of equipment cost for UV and 3% of equipment cost for chlorination/dechlorination based on reference projects.
5. For both concepts: assumed 1 operator working 1 hr/day for $60/hr.
6. Values based on operation at 18,200 m^3/day.

Table 4-27 below presents a summary of the cost comparison for the disinfection technologies. The UV disinfection option is estimated to have the highest initial capital cost, while the chlorination/dechlorination option is estimated to have the highest O&M costs due to chemical consumption. Based on the assumptions above, the chlorination/dechlorination option resulted in the lowest 30-year NPV life cycle cost.

Table 4-27: Cost Comparison of Disinfection Technologies

Parameters	Upgrades Using Chlorination/ Dechlorination	Upgrades Using UV Disinfection
NPV Capital Cost	$2,056,000	$3,252,000
NPV Annual O&M Cost	$1,744,000	$751,000
30-Year NPV Life Cycle Cost	$3,800,000	$4,003,000
Notes: 1. All costs are conceptual level opinions of probable costs in 2023 dollars and should be considered accurate to +/-50%		

4.5.5 Summary of the Evaluation of Alternative Disinfection Technologies

Table 4-28 below summarizes the evaluation and scoring of the two design concepts using the criteria and rating scale as described in **Table 3-1** and **Table 3-2**, respectively.

Table 4-28: Evaluation of Disinfection Technologies

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Environmental Considerations		
Terrestrial System	The footprint of the disinfection would be constructed within the existing site boundary on previously disturbed land.	
	9	9
Aquatic System	No open water sources located within or close to the site.	
	9	9

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Surface Water Quality and Source Water Protection	With chlorination/dechlorination there is a risk of disinfection by-product formation and release into Lake Ontario. As a result, chlorination/dechlorination has slightly more potential to impact surface water quality than UV disinfection.	
	7	9
Groundwater Water Quality and Quantity	Shoring and dewatering plans would be developed for both concepts to protect groundwater resources	
	8	8
Air Quality	Regular operation of both technologies would not impact air quality at Dundas WWTP.	
	9	9
Greenhouse Gas Emissions (GHG)	UV disinfection has high Scope 2 emissions from the power draw of the lamps. Chlorination/dechlorination has high Scope 3 emissions due to chemical use.	
	8	7
Total Score (Out of 60)	50	51
Weight	25	25
Normalized Score (Total 25)	20.8	21.3
Social - Cultural Considerations		

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Odour	Neither technology would have odour impacts from regular operations. Any impacts during construction are short-term and would be mitigated.	
	9	9
Noise/Vibrations	Neither technology would produce significant noise or vibrations from regular operation. Any impacts during construction are short-term and would be mitigated.	
	9	9
Visual Aesthetics	The facility would be designed to be aesthetically pleasing to neighbouring residential areas.	
	9	9
Truck Traffic	Truck traffic would be greater for chlorination/dechlorination due to regular chemical deliveries.	
	6	9
Disruption During Construction	Both alternatives are expected to produce some disruption during construction, but mitigation measures would be implemented.	
	7	7
Property Acquisition and Easement	No property acquisition and easements would be required for either alternative.	
	9	9

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Recreational Use and Users	Both technologies have potential to impact recreational users at the neighbouring park during construction. These are short-term impacts and they can be mitigated.	
	7	7
Agricultural Use and Users	Agricultural use and users would not be impacted.	
	9	9
Human Health and Well-Being	Both technologies would be designed to meet air emission and effluent quality requirements to protect human health.	
	9	9
Existing and Future Adjacent Land Use Compatibility	The Dundas WWTP site can be considered incompatible with the neighbouring residential and recreational areas. However, the upgrades provide an opportunity to enhance odour and noise controls and visual aesthetics of the site. The upgrades would be designed to mitigate impacts to adjacent users.	
	7	7
Archaeology/Cultural Heritage	Both technologies would be implemented on previously disturbed land so no archaeological potential is expected. The Desjardins Canal area south of Dundas WWTP is listed as a non-designated property being of cultural heritage value/interest. However, these upgrades would have no impact on this property.	
	7	7
Total Score (Out of 110)	88	91

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Weight	25	25
Normalized Score (Total 25)	20.0	20.7
Technical Considerations		
Ease of Operation	Both technologies are easy to operate and maintain. The chlorination/ dechlorination option is the same process as existing. The UV system has an automatic cleaning system and lamp replacements are done with banks remaining in the channel.	
	9	9
Ease of Implementation	Both technologies would be implemented in conjunction with the preferred wastewater design concept and would not introduce significant constructability challenges.	
	8	8
Resiliency	Both technologies would be designed to have adequate levels of redundancy.	
	8	8
Ease of Procurement	Both technologies are easy to procure with multiple equipment vendors in Ontario.	
	9	9
Geotechnical and Hydrogeology	Both technologies would be designed according to on-site geotechnical and hydrogeological conditions.	
	8	8

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Energy Use	UV disinfection has high energy requirements due to the power draw from the lamps. Energy use for chlorination/dechlorination is negligible.	
	8	6
Permits and Approvals	Both technologies would be readily approved by the MECP.	
	9	9
Total Score (Out of 70)	59	57
Weight	25	25
Normalized Score (Total 25)	21.1	20.4
Economical Considerations		
Capital Cost	Chlorination/dechlorination is expected to produce the lowest capital cost.	
	10	9
Operating and Maintenance (O&M) Costs	The UV option is expected to produce the lowest annual O&M costs since there is no chemical use.	
	9	10
Life Cycle Costs	Chlorination/dechlorination produced the lowest 30-year NPV life cycle cost, but the UV option was within 5%.	
	10	10
Total Score (Out of 30)	29	29

Sub-Criteria	Upgrades Using Chlorination/Dechlorination	Upgrades Using UV Disinfection
Weight	25	25
Normalized Score (Total 25)	24.2	24.2
Total Score	**86.1%**	**86.5%**

A sensitivity analysis of the evaluation scoring was completed using the weighting changes presented in **Table 4-29** below. This was completed to determine whether the final score is sensitive to a weighting change of the criteria categories. In most scenarios, the UV option produced the highest score. However, the difference in scores between both options is minimal.

Table 4-29: Disinfection Technology Sensitivity Analysis Scenarios

Criteria Category	Weighting (base)	Sensitivity Analysis			
Natural Environment	25%	30%	35%	30%	20%
Social - Cultural Environment	25%	30%	35%	30%	20%
Technical Considerations	25%	20%	15%	30%	30%
Economic Considerations	25%	20%	15%	10%	30%
Chlorination/ Dechlorination	**86.1%**	**85.2%**	**84.3%**	**84.0%**	**87.0%**
UV Disinfection	**86.5%**	**85.9%**	**85.4%**	**84.4%**	**87.0%**

4.5.6 Preferred Disinfection Technology

Based on the evaluation and scoring in **Table 4-28** and **Table 4-29** above, overall both design concepts scored closely but the UV option produced the highest scoring compared to the other technology in most scenarios. Taking this into consideration, **UV disinfection** is the preferred disinfection technology as it is well suited for membrane filtered effluent, there is no risk of byproduct formation in the receiver and there is no chemical use required.

4.6 Summary and Next Steps

This TM presented an evaluation of alternative biological treatment and filtration design concepts and disinfection technologies. The design concepts considered were the AGS system with TMF and the MBR process. The design concepts were evaluated based on a set of criteria and a rating scale as described in **Section 3.** A sensitivity analysis was conducted by modifying the weights/relative importance of various evaluation criteria on the scoring of the design concepts.

The recommended biological treatment and filtration design concept for the Dundas WWTP is the MBR process. This technology has a successful track record in Ontario and internationally and provides flexibility and competitiveness with procurement, while still being an innovative technology to the City of Hamilton. This solution requires less tankage (and reduced footprint) allowing it to be constructed in the Martino Park area without impacting the operation of the existing facility.

UV disinfection was identified as the preferred solution for disinfection. This technology has lower O&M costs and chemical use, and it is expected to have improved overall public acceptability as it would eliminate chemical discharges to Cootes Paradise.

The preferred wastewater treatment upgrade solution would consolidate the preferred biological treatment, filtration and disinfection technologies into a conceptual design. Further details on the upgrades will be developed in the conceptual design including facility sizing and layout, a high-level implementation plan including staging and sequencing, and further refinement of cost estimates.

5 Bibliography

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A

Appendix A: Vendor Information

JWC Environmental®
A Sulzer Brand

Global Headquarters
2850 S. Red Hill Ave, Suite 125
Santa Ana, CA 92705, USA
phone (949) 833-3888
toll-free (800) 331-2277
fax (949) 833-8858
jwce@jwce.com

BUDGET INFORMATION MSS PRODUCT LINE

DATE: 8/28/2023
PROJECT: Hamilton, ON - Dundas WWTP
Number of screens: 2 Number of Compactors (MWP0018): 0

Thank you for choosing JWCE's screening equipment. Enclosed you will find a specification, drawing, and flow curves based on the design parameters listed below. Please advise JWCE if any of the information below changes. The estimated performance below is based on the listed downstream flow parameters as provided to us while the equipment is operating. Any changes to these conditions will affect the overall head drop across the screen.

Model:	**MFS (Finescreen Monster®)**
Channel width:	1524.00 mm
Channel depth:	1371.60 mm
Top of channel to operating floor:	0.00 m
Discharge height:	1219.20 mm
Screen panel perforation diameter:	1/4" (6mm) (High Performance panels)
Screen panel material:	SST (curved)
Angle of inclination:	70 degrees
Waste fluid type:	Domestic Wastewater
Amount of vertical screen recessing:	None (standard installation configured)
Minimum flow:	758.34 m3/hr
Water level downstream at minimum flow:	440.00 mm
Average flow:	758.34 m3/hr
Water level downstream at average flow:	440.00 mm
Peak flow:	1758.34 m3/hr
Water level downstream at peak flow:	440.00 mm

Peak flow hydraulic performance summary (refer to attached flow curves for full performance)

Hydraulic flow regime:	Subcritical flow (standard open channel flow)
Head drop at 0% blinding:	280.92 mm at peak flow
Water level upstream at 0% blinding:	720.92 mm at peak flow
Head drop at 50% blinding:	436.26 mm at peak flow
Water level upstream at 50% blinding:	876.26 mm at peak flow
Head drop at 30% blinding:	347.85 mm at peak flow
Water level upstream at 30% blinding:	787.85 mm at peak flow
Weight:	2,248 kg
Material:	304L SST

Budget price per screen:	$235,000 CAD
Total budget price for all equipment:	$470,000 CAD
*Optional adder; MWP0018	$82,000 CAD

Note: The Information above is preliminary and not intended to be used for construction.

JWC Environmental®
A Sulzer Brand

Global Headquarters
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Santa Ana, CA 92705, USA
phone (949) 833-3888
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fax (949) 833-8858
jwce@jwce.com

BUDGET INFORMATION MSS PRODUCT LINE

DATE: 8/29/2023
PROJECT: Hamilton, ON - Dundas WWTP
Number of screens: 2 Number of Compactors (MWP0018): 0

Thank you for choosing JWCE's screening equipment. Enclosed you will find a specification, drawing, and flow curves based on the design parameters listed below. Please advise JWCE if any of the information below changes. The estimated performance below is based on the listed downstream flow parameters as provided to us while the equipment is operating. Any changes to these conditions will affect the overall head drop across the screen.

Model:	**MBS (Bandscreen Monster®)**
Channel width, approach:	1524.00 mm
Channel width, recess (if applicable):	1524.00 mm
Channel width, downstream:	1524.00 mm
Channel depth:	1828.80 mm
Top of channel to operating floor:	0.00 m
Discharge height:	1219.20 mm
Screen panel width:	48 inches
Screen panel perforation diameter:	2 mm (High Performance panels)
Screen bottom panel style:	5 Panels
Chain pitch:	8"
Waste fluid type:	Domestic Wastewater
Amount of vertical screen recessing:	None (standard installation configured)
Minimum flow:	758.34 m3/hr
Water level downstream at minimum flow:	440.00 mm
Average flow:	758.34 m3/hr
Water level downstream at average flow:	440.00 mm
Peak flow:	1758.34 m3/hr
Water level downstream at peak flow:	440.00 mm

<u>Peak flow hydraulic performance summary (refer to attached flow curves for full performance)</u>

Hydraulic flow regime:	Subcritical flow (standard open channel flow)
Head drop at 0% blinding:	459.56 mm at peak flow
Water level upstream at 0% blinding:	899.56 mm at peak flow
Head drop at 50% blinding:	722.11 mm at peak flow
Water level upstream at 50% blinding:	1162.11 mm at peak flow
Head drop at 30% blinding:	570.13 mm at peak flow
Water level upstream at 30% blinding:	1010.13 mm at peak flow
Weight:	1,696 kg
Material:	304L SST

Budget price per screen:	$260,000 CAD
Total budget price for all equipment:	$520,000 CAD
*Optional adder; MWP0018	$82,000 CAD

Note: The Information above is preliminary and not intended to be used for construction.

quote ver: MBS-JUN2022-Y

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2889 Norland Avenue
Burnaby BC, Canada V5B3A9
P: 604-291-7150
F: 604-291-7190
E: sales@jwce.com

JWC ENVIRONMENTAL CANADA ULC

Proposal No. 20230816

To: CIMA
c/o ACG-Envirocan – Dale Jackson
131 Whitmore Road, Unit 7
Woodbridge, ON L4L 6E3

Voice: 647-746-1569 (cell)
Fax:
Email: dale@acg-envirocan.ca
Project: Dundas WWTP, Hamilton, ON
Date: August 21, 2023

WE ARE PLEASED TO QUOTE AS FOLLOWS:

ITEM A

Two (2) only **JWCE - IPEC Drumscreen Monster, Model IFM 60144P Internally Fed Rotary Screen**, in all 304 stainless steel construction, described as follows:

- 60" diameter by 144" long, perforated screen drum;
- **2mm** screen perforations;
- headbox tank assembly, extending 2/3 the length of the drum, in 3/16" plate, c/w flanged inlet;
- **30" inlet connection** c/w 304 stainless steel ANSI flange;
- **36" outlet connection** c/w 304 stainless steel ANSI flange;
- splash guards in 10 gauge plate;
- integral drainage pan in 11 gauge construction;
- integrated solids discharge chute in 11 gauge construction;
- shaft mounted, 10" diameter by 3" wide UHMW polyurethane, roll wheels, supported by trunnion bearing assembly;
- external spray bar 2" Sch.40, 304 stainless steel pipe c/w 47 fan jet spray nozzles (1 USGPM per nozzle @ 40 psi), NC Class 1 Div 2 solenoid valve, PRV, ball valve, pressure gauge, manifold and hinged splash cover;
- #80 stainless steel roller chain, stainless steel driven sprocket and drive sprocket;
- helical gear drive c/w 2 hp, TEFC EX Class 1 Div 2 motor, 575V/3Ph/60Hz (additional voltages and classifications available, additional cost may apply);
  c/w
- odor vent flange;
- epoxy coating.

Option 1A: Two (2) only **JWCE - IPEC PLC LITE Control panel** to operate one (1) IFM 60144 specifications as follows

Enclosure
- NEMA 4X enclosure;
- Stainless steel panel box c/w hinged door with separate sections for power and control equipment each with an access door:

Devices / Components
- 15 amp main circuit breaker;
- control transformer, 575 – 115, 250 Va;
- common alarm failure dry contact for remote indication;
- PLC 'Allen-Bradley Compact Logix';
- OIT 'Allen-Bradley;
- control power selector switch – illuminate ON;
- H/O/A operator switches;
- status monitor lights;
- one (1) IEC motor contactors c/w overload;
- 3% impedance line reactor;
- ethernet communication to plant SCADA.

Option 2A: Field Devices (EX Class 1 Div 2)
- two (2) only E-stop.

Option 3A: Factory trained site visit, one (1) trip, two (2) days for inspection, start-up and operator training.

Option 4A: Estimated prepaid freight and Handling to Hamilton, ON.

Manual: Two copies of the Installation, Operation and Maintenance Manual.

Service: To screen 42.2 MLD (7,742 USGPM) each screen, peak pumped domestic municipal wastewater with 250 mg/L TSS, running one (1) duty / one (1) stand-by.

The quoted screen will meet the stated flow, provided maximum solids loading does not exceed 450 mg/L.

ITEM B

Two (2) only **JWCE - IPEC Drumscreen Monster, Model IFM 60120P Internally Fed Rotary Screen**, in all 304 stainless steel construction, described as follows:

- 60" diameter by 120" long, perforated screen drum;
- **6mm** screen perforations;
- headbox tank assembly, extending 2/3 the length of the drum, in 3/16" plate, c/w flanged inlet;
- **30" inlet connection** c/w 304 stainless steel ANSI flange;
- **36" outlet connection** c/w 304 stainless steel ANSI flange;
- splash guards in 10 gauge plate;
- integral drainage pan in 11 gauge construction;
- integrated solids discharge chute in 11 gauge construction;
- shaft mounted, 10" diameter by 3" wide UHMW polyurethane, roll wheels, supported by trunnion bearing assembly;
- external spray bar 2" SCH 40, 304 stainless steel pipe c/w 39 fan jet spray nozzles (1 USGPM per nozzle @ 40 psi), NC Class 1 Div 2 solenoid valve, PRV, ball valve, pressure gauge, manifold and hinged splash cover;
- #80 stainless steel roller chain, stainless steel driven sprocket and drive sprocket;
- helical gear drive c/w 2 hp, TEFC EX Class 1 Div 2 motor, 575V/3Ph/60Hz (additional voltages and classifications available, additional cost may apply);
  c/w
- odor vent flange;
- epoxy coating.

JWC ENVIRONMENTAL CANADA ULC
2889 Norland Avenue Burnaby BC Canada V5B 3A9 Toll Free: (800) 663-8409 Tel: (604) 291-7150 Fax: (604) 291-7190
Email: sales@jwce.com Web Page: http://www.jwce.com

Option 1B: Two (2) only **JWCE - IPEC PLC LITE Control panel** to operate one (1) IFM 60120 specifications as follows

Enclosure

- NEMA 4X enclosure;
- Stainless steel panel box c/w hinged door with separate sections for power and control equipment each with an access door:

Devices / Components

- 15 amp main circuit breaker;
- control transformer, 575 – 115, 250 Va;
- common alarm failure dry contact for remote indication;
- PLC ‘Allen-Bradley Compact Logix’;
- OIT ‘Allen-Bradley;
- control power selector switch – illuminate ON;
- H/O/A operator switches;
- status monitor lights;
- one (1) IEC motor contactors c/w overload;
- 3% impedance line reactor;
- ethernet communication to plant SCADA.

Option 2B: Field Devices (EX Class 1 Div 2)

- two (2) only E-stop.

Option 3B: Factory trained site visit, one (1) trip, two (2) days for inspection, start-up and operator training.

Option 4B: Estimated prepaid freight and Handling to Hamilton, ON.

Manual: Two copies of the Installation, Operation and Maintenance Manual.

Service: To screen 42.2 MLD (7,742 USGPM) each screen, peak pumped domestic municipal wastewater with 250 mg/L TSS, running one (1) duty / one (1) stand-by.

The quoted screen will meet the stated flow, provided maximum solids loading does not exceed 450 mg/L.

Notes:

1. The engineer should size their sludge feed pumps so as not to exceed the thickeners hydraulic capacity.
2. Seismic / anchor bolt calculations are NOT included. If required, an additional cost will apply.

ITEM A

IFM 60144P x 2, NET Budget Price (\$217,860 ea), Incoterms EXW:	**C \$435,720**
Option 1A: PLC Lite Control Panel x 2, NET Budget Price (\$36,160 ea), Incoterms EXW:	**C \$ 72,320**
Option 2A: Field Devices x 2, NET Budget Price (\$2,010 ea), Incoterms EXW:	**C \$ 4,020**
Option 3A: Site Visit, NET Budget Price, Incoterms EXW:	**C \$ 11,050**
Option 4A: Estimated Prepaid Freight, NET Budget Price, Incoterms EXW:	**C \$ 10,615**

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ITEM B

IFM 60120P x 2, NET Budget Price ($200,410 ea), **Incoterms EXW:**	**C $400,820**
Option 1B: PLC Lite Control Panel x 2, NET Budget Price ($36,160 ea), **Incoterms EXW:**	**C $ 72,320**
Option 2B: Field Devices x 2, NET Budget Price ($2,010 ea), **Incoterms EXW:**	**C $ 4,020**
Option 3B: Site Visit, NET Budget Price, Incoterms EXW:	**C $ 11,050**
Option 4B: Estimated Prepaid Freight, NET Budget Price, Incoterms EXW:	**C $ 10,615**

Shipping & Handling Estimate: (Will be prepaid and billed at cost plus handling charges)

Taxes: All orders will be billed the applicable sales tax, based on the "ship to address", unless a valid tax exemption certificate is provided prior to shipment.

Terms: 100% net 30 days on shipment of equipment, OAC.

Shipment: **Municipal Orders**
Shipment would be 12-14 weeks after return of Approved Submittal documents. Typically documents for approval are generated and supplied within 3-4 weeks after receipt of P.O. and agreement on Terms and Conditions.
Due to Covid labor shortages, shipment dates may be extended.

Validity: 30 days from quotation date.

If favored with an order, please address PO to: JWC Environmental Canada, ULC
2889 Norland Avenue
Burnaby, BC V5B 3A9

WARRANTY

JWCE - IPEC warrants that the goods sold are fit for the particular purpose of use for which they were offered, and that they conform with, and will perform in accordance with the Purchaser's specifications.

JWCE - IPEC also warrants the goods against any defects in material, workmanship and design for the entire warranty period.

JWCE - IPEC warrants, for a period of 12 months from the delivery of equipment, that any component that is defective shall be replaced. Change out of said components shall be for the Purchaser's account.

All warranty claims must be submitted to JWCE - IPEC in writing, either by mail, fax or email.

Notes:
1. Please fax or mail a purchase order for the total amount and we can process your order. Please include the following:
   Billing Address, Ship to Address, and sales tax exemption certificate.
2. Please reference our quote number on your purchase order.
3. Availability of parts are subject to change at any time.
4. 20% restocking fee on all returns.

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5. Sales tax is not included in price.
6. JWCE-IPEC standard one year warranty included.

Thank-You for your Business!

Bonnie Wong – Inside Municipal Sales
JWC Environmental Canada ULC

JWC ENVIRONMENTAL CANADA ULC
TERMS AND CONDITIONS OF SALE

Unless otherwise specifically agreed to in writing by the buyer ("Buyer") of the products and or related services purchased hereunder (the "Products") and JWC Environmental (the "Seller"), the sale of the Products is made only upon the following terms and conditions. Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional, conditional and different terms in Buyer's form or documents.

PAYMENT TERMS

Subject to any contrary terms set forth in our price quotation, order acceptance or invoice the full net amount of each invoice is due and payable in cash within 30 days from the date of the invoice. If any payment is not received within such 30-day period, Buyer shall pay Seller the lesser of 1 ½% per month or the maximum legal rate on all amounts not received by the due date of the invoice, from the 31st day after the date of invoice until said invoice and charges are paid in full. Unless Sellers documents provide otherwise, freight, storage, insurance and all taxes, duties or other governmental charges related to the Products shall be paid by the Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller for said charges. In all cases, regardless of partial payment, title to the Products shall remain the Sellers until payment for the Products has been made in full. All orders are subject to credit approval by Seller. All offers by Seller and/or acceptance of Buyer's order shall be nullified by any failure of Buyer to obtain credit approval. Furthermore, Buyer shall not assert any claim against Seller due to Buyer's inability to obtain credit approval. Irrevocable Letter of Credit from Buyer in form and term acceptable to Seller is required for Product orders delivered outside the United States of America.

DELIVERY

Unless otherwise provided in our price quotation, delivery of the Products shall be made F.O.B. place of manufacture. Any shipment, delivery, installation or service dates quoted by the Seller are estimated and the Seller shall be obligated only to use reasonable efforts to meet such dates. The Seller shall in no event be liable for any delays in delivery or failure to give notice of delay or for any other failure to perform hereunder due to causes beyond the reasonable control of the Seller. Such causes shall include, but not be limited to, acts of God, the elements, acts or omissions of manufacturers or suppliers of the Products or parts thereof, acts or omissions of Buyer or civil and military authorities, fires, labor disputes or any other inability to obtain the Products, parts thereof, or necessary power, labor, materials or supplies. The Seller will be entitled to refuse to make, or to delay, any shipments of the Products if Buyer shall fail to pay when due any amount owed by it to the Seller, whether under this or any other contract between the Seller and Buyer. Any claims for shortages must be made to the Company in writing within five calendar days from the delivery date and disposition of the claim is solely subject to Sellers determination.

PRICES

Prices of the Seller's Products are subject to change without notice. Quotations are conditioned upon acceptance within 30 days unless otherwise stated and are subject to correction for errors and/or omissions. Prices include charges for regular packaging but, unless expressly stated, do not include charges for special requirements of government or other purchaser. **Prices are subject to adjustment** should Buyer place an order past the validity period of the quotation or **delay delivery of Products beyond the quoted lead time for any reason.**

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RETURNS

No Products may be returned for cash. No Product may be returned for credit after delivery to Buyer without Buyer first receiving written permission from the Seller. Buyer must make a request for return of Product in writing to Seller at its place of business in Costa Mesa, California. A return material authorization number must be issued by the Seller to the Buyer before a Product may be returned. Permission to return Product to Seller by Buyer is solely and exclusively the Sellers. Product must be returned to Seller at Buyers expense, including packaging, insurance, transportation and any governmental fees. Any credit for Product returned to Seller shall be subject to the inspection of and acceptance of the Product by the Seller and is at the sole discretion of the Seller.

LIMITED WARRANTY

Subject to the terms and conditions hereof, the Seller warrants until one year after commissioning (written notification to Seller by Buyer required) of the Product or until 18 months after delivery of such Product to Buyer, whichever is earlier, that each Product will be free of defects in material and workmanship. If (a) the Seller receives written notification of such defect during the warranty period and the defective Products use is discontinued promptly upon discovery of alleged defect, and (b) if the owner ("Owner") forwards the Product to the Seller's nearest service/repair facility, transportation and related insurance charges prepaid. The Seller will cause any Products whose defect is covered under this warranty to either be replaced or be repaired at no cost to the Owner. The foregoing warranty does not cover repairs required due to repair or alteration other than by the Seller's personnel, accident, neglect, misuse, transportation or causes other than ordinary use and maintenance in accordance with the Seller's instructions and specifications. In addition, the foregoing warranty does not cover any Products, or components thereof, which are not directly manufactured by the Seller. To the extent a warranty for repair or replacement of such Products or components not manufactured directly by the Seller is available to Buyer under agreements of the Seller with its vendors; the Seller will make such warranties available to Buyer. Costs of transportation of any covered defective item to and from the nearest service/repair center and related insurance will be paid or reimbursed by Buyer. Any replaced Products will become the property of the Seller. Any replacement Products will be warranted only for any remaining term of the original limited warranty period and not beyond that term.

DISCLAIMER OF WARRANTIES AND LIMITATIONS OF LIABILITIES

THE SELLER'S FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE AND ONLY WARRANTY WITH RESPECT TO THE PRODUCTS AND SHALL BE IN LIEU OF ALL OTHER WARRANTIES (OTHER THAN THE WARRANTY OF TITLE), EXPRESS, STATUTORY OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ANY STATEMENTS MADE BY EMPLOYEES, AGENTS OF THE SELLER OR OTHERS REGARDING THE PRODUCTS. THE OBLIGATIONS OF THE SELLER UNDER THE FOREGOING WARRANTY SHALL BE FULLY SATISFIED BY THE REPAIR OR THE REPLACEMENT OF THE DEFECTIVE PRODUCT OR PART, AS PROVIDED ABOVE. IN NO EVENT SHALL THE SELLER BE LIABLE FOR LOST PROFITS OR OTHER SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, EVEN IF THE SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE TOTAL LIABILITY OF THE SELLER TO BUYER AND OTHERS ARISING FROM ANY CAUSE WHATSOEVER IN CONNECTION WITH BUYER'S PURCHASE, USE AND DISPOSITION OF ANY PRODUCT COVERED HEREBY SHALL, UNDER NO CIRCUMSTANCES, EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCT BY BUYER. NO ACTION, REGARDLESS OF FORM, ARISING FROM THIS AGREEMENT OR BASED UPON BUYER'S PURCHASE, USE OR DISPOSITION OF THE PRODUCTS MAY BE BROUGHT BY EITHER PARTY MORE THAN ONE YEAR AFTER THE CAUSE OF ACTION ACCRUES, EXCEPT THAT ANY CAUSE OF ACTION FOR THE NONPAYMENT OF THE PURCHASE PRICE MAY BE BROUGHT AT ANY TIME.

The remedies provided to Buyer pursuant to the limited warranty, disclaimer of warranties and limitations of liabilities, described herein are the sole and exclusive remedies.

Unless specifically agreed to in writing by the Seller, no charges may be made to the Seller by Buyer or any third party employed by buyer for removing, installing or modifying any Product.

The Seller and its representatives may furnish, at no additional expense, data and engineering services relating to the application, installation, maintenance or use of the Products by Buyer. The Seller will not be responsible for, and does not assume any liability whatsoever for, damages of any kind sustained either directly or indirectly by any person through the adoption or use of such data or engineering services in whole or in part.

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JWC ENVIRONMENTAL CANADA ULC
2889 Norland Avenue Burnaby BC Canada V5B 3A9 Toll Free: (800) 663-8409 Tel: (604) 291-7150 Fax: (604) 291-7190
Email: sales@jwce.com Web Page: http://www.jwce.com

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This agreement is entered into in Costa Mesa, California. This agreement and performance by the parties hereunder shall be construed in accordance with, and governed by, the laws of the State of California. Any claim or dispute arising from or based upon this agreement or the Products which form its subject matter shall be resolved by binding arbitration before the American Arbitration Association in Los Angeles, California, pursuant to the Commercial Arbitration Rules, excepting only that each of the parties shall be entitled to take no more than two depositions, and serve no more than 30 interrogatories, 10 requests for admissions and 20 individual requests for production of documents, such discovery to be served pursuant to the California Code of Civil Procedure. Any award made by the arbitrator may be entered as a final judgment, in any court having jurisdiction to do so. If any provision of this agreement shall be held by a court of competent jurisdiction or an arbitrator to be unenforceable to any extent, that provision shall be enforced to the full extent permitted by law and the remaining provisions shall remain in full force and effect.

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AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

DUNDAS WWTP ON

Design# 171024
Option: Preliminary Design

AquaNereda®
Aerobic Granular Sludge Technology

March 30, 2023
Designed By: Thea Davis

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- For primary influent designs, ¼ inch (6 mm) perforated plate-style screening and grit removal, consisting of 95% removal at 140 mesh, is required ahead of the AquaNereda system. For primary effluent designs, screening requirements may be relaxed at the discretion of Aqua-Aerobic Systems. If alternative screening and grit removal methods are planned ahead of the AquaNereda system, please discuss screening with Aqua-Aerobic Systems to understand the impacts of the approach.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 1.7 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The following parameters have been assumed, as displayed on the design (engineer to verify): Waste Temperatures, Ambient Temperatures, Elevation.

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 8 °C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- To achieve the effluent monthly average total phosphorus limit, the biological process, chemical feed systems, and Cloth Media Filters need to be designed to facilitate optimum performance.

- A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for total phosphorus analysis.

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Secondary effluent phosphorus shall be in a reactive phosphate form and/or a filterable particulate form.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary. Metal salts shall be added to each reactor during the React phase of the cycle.

- Chemical addition (i.e. metal salts, and/or polymer) shall be furnished prior to the filter. Adequate rapid mixing must be provided as part of the chemical feed system. The chemical dosage should be flow-paced and controlled to avoid overdosing. Jar testing with various metal salts and polymers is recommended to determine the most effective metal salt and polymer as well as the optimum dosages of each, and to estimate the degree of phosphorus removal that can be achieved. In addition, a pilot study may be required to verify the actual performance capability.

- A flocculation tank with a minimum of 5-minute HRT at the maximum daily flow shall be furnished after chemical addition and prior to the filter.

- pH monitoring in a range of 6.5-8.5 of the biological reactor is required when adding metal salts.

- The cloth media filter will only remove TP that is associated with the TSS removed by the filter. Since only insoluble, particle-associated phosphorous is capable of being removed by filtration, phosphorous speciation shall be provided by the owner to substantiate the concentrations of soluble and insoluble phosphorous in the filter influent. If the proportions of soluble (unfilterable) and insoluble phosphorous are such that removal to achieve the desired effluent limit is not practical, the owner will provide for proper conditioning of the wastewater, upstream of the filter system, to allow for the required removal.

- A treatability study is required to assure that the required effluent quality is achievable.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average and maximum day conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process:
- Effluent flow equalization.
- Tertiary filtration

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report.

- The filter influent should be free of algae and other solids that are not filterable through a nominal 2 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The cloth media filter has been designed to handle the maximum design flow while maintaining one unit out of service.

- The filters have been designed to operate in series.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 7.85 m.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- If the cloth media filter will be offline for extended periods of time, protection from sunlight is required.

Influent Buffer - Design Summary

INFLUENT BUFFER DESIGN PARAMETERS

Avg. Daily Flow:	= 6.01 MGD	= 22,750 m3/day
Max. Daily Flow:	= 8.41 MGD	= 31,850 m3/day
No. of AGS Reactors:		= 3

INFLUENT BUFFER VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

INFLUENT BUFFER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 45.9 ft	= (14.0 m)			
Width of Basin:	= 39.4 ft	= (12.0 m)			
Min. Water Depth:	= 0.0 ft	= (0.0 m)	**Min. Basin Vol. Basin:**	= 0 gallons	= (0.0 m³)
Max. Water Depth:	= 16.4 ft	= (5.0 m)	**Max. Basin Vol. Basin:**	= 221,905 gallons	= (840.0 m³)

INFLUENT BUFFER EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 8,959 GPM	= (2,037 m³/hr)
Avg. Power Required:	= 706 kWhr/day	

AquaNereda® - Aerobic Granular Sludge Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 6.01 MGD	= 22,750 m3/day
Max Design Flow	= 8.41 MGD	= 31,850 m3/day

DESIGN PARAMETERS

	Influent	mg/l	Effluent (After Filtration in Series) Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	182	CBOD5	5	CBOD5	5
Total Suspended Solids:	TSS	301	TSSa	2	TSSa	2
Total Kjeldahl Nitrogen:	TKN	42	TKN	--	TKN	--
NH3-N (Summer):	--	--	NH3-N	0.28	NH3-N	0.28
NH3-N (Winter):	--	--	NH3-N	0.5	NH3-N	0.5
Phosphorus:	Total P	6	Total P	0.05	Total P	0.05

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	90 F	32.0 C	0 F	-18.0 C	262 ft
Influent Waste Temperatures:	68 F	20.0 C	46 F	8.0 C	80.0 m

AGS BASIN DESIGN VALUES

				Water Depth		Basin Vol./Basin	
No./Basin Geometry:	3 Rectangular Basin(s)		**Process Level (PWL):**	23.0 ft	(7.0 m)	1.15 MG	(4,370 m³)
Freeboard (from PWL):	2.8 ft	(0.8 m)	**Discharge Level (DWL):**	24.3 ft	(7.4 m)		
Length of Basin:	85.3 ft	(26.0 m)	**Top of Wall (TOW):**	26.0 ft	(7.9 m)		
Width of Basin:	78.7 ft	(24.0 m)					

PROCESS DETAILS

Cycle Duration:	= 4.5 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.040 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.58 Days	
Solids Retention Time:	= 20.90 Days	
Est. Net Sludge Yield:	= 1.16 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 10568.0 lbs. WAS/Day	= (4793.6 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.00	
Actual Oxygen Required:	= 21158 lbs./Day	= (9597.2 kg/Day)
Max. Discharge Pressure:	= 11.74 PSIG	= (81 KPA)
Max. Air Flowrate/Basin:	= 2,586 SCFM	
Min. Air Flowrate/Basin:	= 646 SCFM	
Max. Simultaneous Air:	= 4,863 SCFM	
Min. Simultaneous Air:	= 1,659 SCFM	

RETURN FLOW ESTIMATES

Daily Estimated Return Flow:	= 0.90 MGD
Max. Instantaneous Return Flow:	= 928 GPM

POWER CONSUMPTION

Average Aeration Power Consumption: = 2051 kWh/day (at 67% design load)

Sludge Buffer - Design Summary

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 2 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 17.4 ft	= (5.3 m)
Max. Basin Volume:	= 76,638 gallons	= (288.0 m³)
Length of Basin:	= 22.3 ft	= (6.8 m)
Width of Basin:	= 26.2 ft	= (8.0 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 176 gpm	= (40 m³/hr)
Max. Supernatant Flow Rate Required:	= 704 gpm	= (160 m³/hr)
Average Power Consumption:	= 64 kWh/day (at 67% design load)	

POST-EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 6.01 MGD	= (22,750 m³/day)
Max. Daily Flow (MDF):	= 8.41 MGD	= (31,850 m³/day)
Decant Flow Rate from (Qd):	= 8,954 gpm	= (2,033 m³/hr)
Decant Duration (Td):	= 65 min	

POST-EQUALIZATION VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua-Aerobic. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

POST- EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 31.0 ft	= (9.4 m)			
Width of Basin:	= 32.8 ft	= (10.0 m)			
Min. Water Depth:	= 0.0 ft	= (0.0 m)	**Min. Basin Vol. Basin:**	= 0 gal	= (0 m³)
Max. Water Depth:	= 21.2 ft	= (6.5 m)	**Max. Basin Vol. Basin:**	= 161,406 gal	= (612 m³)

POST- EQUALIZATION EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 6,472.2 gpm	= (1,470.0 m³/hr)
Avg. Power Required:	= 698.4 kW-hr/day	

AquaDisk® Tertiary Filtration - Design Summary - First Stage

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	AquaNereda		
Avg. Design Flow	= 6.01 MGD	= 4173.55 gpm	= 22750.00 m³/day
Max Design Flow	= 9.32 MGD	= 6472.22 gpm	= 35280.00 m³/day

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 3
Number Of Disks Per Unit	= 10
Total Number Of Disks Recommended	= 30
Total Filter Area Provided	= 1614.0 ft² = (149.95 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 10E-PC
Filter Media Cloth Type	= OptiFiber PES-14®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 4173.6 / 1614 ft²
= 2.59 gpm/ft² (6.32 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 6472.2 / 1614 ft²
= 4.01 gpm/ft² (9.80 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 1165.9 lbs/day / 1614 ft²
= 0.72 lbs. TSS /day/ft² (3.52 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 6 gpm / ft² = (4.1 L/s / m²)

AquaNereda: Influent Buffer

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Pressure transducer(s).
- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- Top support(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda

Influent Valves

3 Influent Valve(s) will be provided as follows:

- 24 inch electrically operated plug valve(s).

Influent Distribution System

3 Influent Distribution Assembly(ies) consisting of:

- Influent distribution system consisting of HDPE and PVC pipe with supports.

Effluent Weir Assembly

3 Effluent Weir Assembly(ies) consisting of:

- Concrete main effluent channel(s) provided by others.
- Stainless steel weir assembliy(ies) with supports.

Sludge Removal System

3 Solids Waste System(s) consisting of:

- HDPE or Stainless steel solids waste system(s).
- Pressure transmitter(s).

3 Sludge Decant/WLC Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic control valves and two (2) of the following manual throttling valves:
- 24 inch electrically operated butterfly valve(s).
- 24 inch diameter Miliken manual plug valve(s).

3 Air Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic valves and one (1) of the following manual valves:
- 4 inch manually operated butterfly valve(s) with lever handle.
- 4 inch electrically operated butterfly valve(s) with actuator.

Fixed Fine Bubble Diffusers

3 Fixed Fine Bubble Diffuser Assembly(ies) consisting of:

- 304 SS, 12 Ga. drop pipe(s).
- PVC, Sch 40 Manifold(s) with connection to drop pipe.
- PVC, Air distributor(s) with connection to the manifold and required PVC pipe joint connections.
- 304 Stainless steel piping supports with vertical supports, clamps, adjusting mechanism and anchor bolts.
- Fine bubble diffuser assemblies.
- Air muffler(s).

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Aerzen 200HP Rotary Positive Displacement Blower(s).
- 10" manual butterfly valve(s).

Air Valves

3 Air Control Valve(s) will be provided as follows:

- 6 inch electrically operated butterfly valve(s) with actuator.
- Auma actuator will be upgraded from open/close service to modulating service.
- Air flow meter(s).
- Flow conditioner(s).
- 6 inch manually operated butterfly valve(s) with lever handle.

Level Sensor Assemblies

3 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

3 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

1 Server Based Control and Monitoring System will be provided as follows:

- Process Controller Server.
- Small server monitor.
- Process Operator Station.

3 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

3 TSS Sensor(s) will be provided as follows:

- TSS probe(s).

3 ORP Sensor(s) will be provided as follows:

- ORP sensor(s).

3 pH Sensor(s) will be provided as follows:

- pH probe(s).

3 Phosphorus Analyzer(s) will be provided as follows:

- Phosphate analyzer(s).

3 Filtrax Sampling System(s) will be provided as follows:

- Sampling system.

4 Process Controller(s) consisting of:

- Controller and display module(s).

3 Process Controller(s) consisting of:

- Controller(s).

2 Process Control System will be provided as follows:

- Hach SC1000 display module.

- FRP enclosure(s) for SC1000 Display.

1 Ammonium Probe(s) will be provided as follows:

- Ammonium probe(s).
- Controller(s).

AquaNereda: Post-Equalization

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda: Sludge Buffer

Transfer Pumps/Valves

2 External Pump Assembly(ies) consisting of the following items:

- 15HP Pump assembly(ies).
- 6" Manual plug valve(s).

2 Sludge Valve(s) consisting of the following items:

- 6 inch electrically operated plug valve(s).

2 Supernatant Valve(s) consisting of the following items:

- 8 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

2 Sludge Buffer Inlet Valve(s) consisting of:

- 24 inch electrically operated butterfly valve(s).

Sludge Removal System

2 Solids Removal Assembly(ies) consisting of:

- Solids removal assembly(ies) consisting of PVC and/or HDPE pipe with supports.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

2 Hach TSS WAS Sensor(s) will be provided as follows:

- Hach Solitax Inline sc stainless steel pipe isertion probe with stainless steel wiper and 33 ft electric cable. One (1) probe per basin.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

DUNDAS WWTP ON

Design# 171645
Option: Preliminary Membrane Design

Aqua MultiBore®
Ultrafiltration Membranes

June 06, 2023
Designed By: Nicholas Fortsas

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Design Notes

Project: ***DUNDAS WWTP ON***

Option: ***Preliminary Membrane Design***

Designed by Nicholas Fortsas on Tuesday, June 6, 2023

Process/Site

- The following parameters have been assumed, as displayed on the design (engineer to verify): Elevation, in basin temperatures, ambient temperatures.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average and maximum day conditions, respectively.

Membrane

- The following components are not included in Aqua-Aerobic Systems' scope of supply and shall be provided by others:
    - Chemicals required for process and/or cleaning and their containers.
    - Starters, VFDs and/or motor control centers.
    - Neutralization system.
    - Interconnecting wiring and piping, unless specifically called out within this design.
    - CIP system piping.

- A single CIP system is included to clean one (1) membrane train or row at a time.

- The membranes are sized to process the maximum daily flow with all membrane trains online.

- Chemical feed systems for the membrane maintenance clean processes (CEB) are included for the membrane system. Containers and chemicals shall be supplied by others.

- A pH adjustment system is not included. Depending on the particular characteristics of the wastewater (hardness, etc.) a caustic feed system (by others) may be required to optimize membrane performance.

- The design of the backwash system assumes flow discharges into an open drain near the membranes.

- Influent to the membrane system must not contain any substance that is incompatible with the membrane, epoxy potting, SS/PVC piping, or EPDM gaskets/seals, if applicable. This includes silicones, solvents, free oil, etc.

- Influent to the membranes shall not exceed 3 mg/l of fats, oils, or grease (FOG).

- Chemical pump sizing is based on an influent alkalinity of 500 mg/l as $CaCO_3$, conductivity of 1000 uS/cm, & hardness of 100 mg/l as $CaCO_3$ and assumes there are no additional contaminants that will affect the pH.

Equipment

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The product(s) offered as part of this project is classified as ECCN 2B352 under U.S. Export Compliance laws and regulations. This product will require an export license from the Department of Commerce Bureau of Industry and Security (BIS) to all countries listed in the current CB Column 2 on the BIS country chart, if the goods (or technology, defined as a "deemed export") are exported from the United States. Deemed export is defined as sending technology/source code to a foreign national, within the United States or outside the United States. See http://www.bis.doc.gov website for details and additional information.

Aqua MultiBore P-Series Membrane System - Design Summary

Project: DUNDAS WWTP ON

Option: Preliminary Membrane Design

Designed by Nicholas Fortsas on Tuesday, June 6, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-UF Treatment:	AquaSBR			
Avg. Design Flow:	=	6.010 MGD	=	22,752 m^3/day
Max. Design Flow:	=	8.414 MGD	=	31,852 m^3/day

INFLUENT PARAMETERS

	Influent	mg/l	Effluent Required	≤ mg/l	Effluent Anticipated	≤ mg/l
Dissolved Organic Carbon:	DOC	10	DOC	5	DOC	5
Turbidity (NTU):	Turb.	10	Turb.	2	Turb.	<2
Suspended Solids:	TSS	10	TSS	2	TSS	<2
Phosphorus:	Total-P	0.6	Total-P	0.05	Total-P	<0.1

SITE CONDITIONS

	Maximum		Minimum		Elevation
Ambient Air Temperature:	90 F	32.2 C	0 F	-17.8 C	262.5 ft
Influent Waste Temperature:	68 F	20 C	46.4 F	8 C	80 m

MEMBRANE PROCESS VARIABLES:

Number of Parallel Membrane Trains:	=	4			
No. Membrane Modules per Train:	=	72			
Active Membrane Area per Module:	=	861 ft2		=	80 m2
Total Membrane Area Provided:	=	248,025 ft2		=	23040 m2
Maximum Membrane Flux:	=	36.8 Gallons/ft2/day (GFD)		=	62.3 Liters/m2/hour (LMH)
Recovery:	=	91.8 %			
Est. Membrane Average Power Consumption:	=	840.6 kWh/day			
Est. Membrane Average Chemical Consumption:	=	6.4 gallons/day	50.0% CEB NaOH		
	=	4.3 gallons/day	50.0% CEB H2SO4		
	=	0.3 gallons/day	12.5% CEB NaOCl		
	=	255.3 gallons/day	48.5% Alum		

SYSTEM DIMENSIONS:

		Length			Width (Depth)			Height	
Feed Tank:	=	By Others		=	13540.64 gallons				
Membrane Assembly (ea):	=	19.5 ft	= 5.9 m	=	4.7 ft	= 1.4 m	=	8.69 ft	= 2.6 m
Feed Skid (ea):[1]	=	5.6 ft	= 1.7 m	=	9.2 ft	= 2.8 m	=	10.5 ft	= 3.2 m
Backwash Skid (if applicable):	=	#N/A others	#N/A m	=	#N/A ft	#N/A m	=	#N/A ft	#N/A m
Backwash Tank:	=	By Others		=	7905.723 gallons				
Chemical Feed System (ea):[2]	=	4.33 ft	= 1.3 m	=	1.6 ft	= 0.5 m	=	4 ft	= 1.2 m
Main Control Panel:	=	4 ft	= 1.2 m	=	1.0 ft	= 0.3 m	=	5 ft	= 1.5 m
CIP Tank:	=	7.5 ft diameter	= 2.3 m	=	2000 gallons		=	7 ft	= 2.1 m

Notes:

[1]Each feed skid is typically mounted to its membrane assembly.

[2]Each chemical feed system can be mounted to a wall/frame and contains equipment for pumping two separate chemicals (tanks/containers by others).

Aqua MultiBore P-Series

Air Compressor

1 Valve Actuation Compressed Air System(s) will be provided as follows:

- (2) compressor pumps rated for 1.0 hp each pump with a 80-gallon receiver tank, air dryer, alternating control panel, and wide range pressure switches.
- (1) Coalescing, oil removing filter
- (1) Set of 4 machine vibration isolators
- (1) Adjustable pressure regulator

Membranes

288 Membrane Module(s) with T-Rack(s), each consisting of:

- 80 square meter PES membrane modules encased in PVC housing.
- T-Rack 3.0 mounting assembly(ies)

4 Membrane Feed Skid(s) consisting of:

- Painted steel feed skid frame(s).
- Piping within the membrane skid, required for interconnection of skid mounted membrane system components. Piping will be schedule 80 PVC, socket welded or threaded. Air piping will be stainless steel tubing and schedule 10 stainless steel piping.
- 10 inch pneumatically operated wafer style butterfly valve(s).
- Pressure transmitter(s).
- 1/4" Solenoid valve(s).
- 10" magnetic flow-meter and converter(s).
- Air filter(s).
- 6" Expansion joint(s).
- 4 inch gasket kit(s)

4 Membrane Feed Skid(s) consisting of:

- Painted steel feed skid frame(s).
- Piping within the membrane skid, required for interconnection of skid mounted membrane system components. Piping will be schedule 80 PVC, socket welded or threaded. Air piping will be stainless steel tubing and schedule 10 stainless steel piping.
- 16 inch pneumatically operated wafer style butterfly valve(s)
- 20 inch pneumatically operated wafer style butterfly valve(s).
- BLMX V100 4-20 mA positioner(s).
- 18 inch pneumatically operated wafer style butterfly valve(s).
- Pressure transmitter(s).
- 1/4" Solenoid valve(s).
- 16" magnetic flow-meter and converter(s).
- Air filter(s).

4 Strainer(s) will be provided as follows:

- 10 inch automatic backwashable Y-strainer with NSF-approved epoxy lining and 60 mesh 304 stainless steel screen.

1 Control Panel(s) consisting of:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuses and fuse blocks.
- GFI convenience outlet(s).

- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Ethernet switch(es).
- Hubbell Cat 6 Ethernet Cable.
- Power supply(ies).
- Terminal blocks.
- Compactlogix Processor.
- Compactflash.
- End cap(s).
- Power supply(s).
- Input card(s)
- Relay output(s).
- Analog input(s).
- Analog output(s).
- Panelview plus 6 1250 operator interface(s).
- UL label(s).
- Panel will be CSA labeled.

4 Remote feed Skid I/O Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Fuses and fuse blocks.
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Ethernet switch(es).
- Power supply(ies).
- Terminal blocks.
- Ethernet adapter module(s).
- Input card(s).
- Output module(s).
- Analog output card(s).
- Terminal base(s).
- UL label(s).
- Panel will be CSA labeled.
- Disconnect switch(es).

1 CIP System(s) will be provided as follows:

- 2000 gallon capacity heavy duty polyethelene holding tank.
- Mixer(s).
- Float switch(es).
- 316 stainless steel float switch mounting bracket(s).
- Gorman-Rupp pump model T3A3S-B with base and direct drive 5 HP, TEFC, 3 ph. motor.
- 3" butterfly valve(s) with lever operator as manufacturer by Nibco or equal.
- 3 inch diameter Nibco F-918-B check valve(s) with cast iron body with bronze disk.
- Immersion heater(s) 25KW.
- Local control station(s) with on/off switches, on indicating lights, in a Nema 4X enclosure.
- Polyethylene tank(s).
- 1/2 HP Mixer(s).
- Centrifugal pump with 15 HP, 3 ph. motor.
- 6" manual butterfly valve(s).

Membrane Accessories

Equipment Summary

Project: **DUNDAS WWTP ON**

Option: **Preliminary Membrane Design**

Designed by Nicholas Fortsas on Tuesday, June 6, 2023

1 UF Feed Tank(s) consisting of:

- Feed tank by others.
- 1/2 HP Mixer(s).
- Pressure transducer(s).
- 3" PVC flange with coupling.
- 1/2" PVC pipe.
- Float switch(es).
- Float switch mounting bracket(s).

1 UF Backwash Tank(s) consisting of:

- Backwash tank by others.
- Pressure transducer(s).
- 3" PVC flange with coupling.
- 1/2" PVC pipe.

Permeate Discharge Components

4 Turbidity Meter Assembly(ies) consisting of:

- Turbidity sensor(s).
- Controller and display module(s).
- Calibration start-up kit(s).
- Turbidity mounting plate(s).

Transfer Pumps/Valves (Membranes)

5 Membrane Feed Pump Installation(s) consisting of:

- Centrifugal pump with 40 HP, 3 ph. motor.
- 10" manual butterfly valve(s).
- 10 inch pneumatically operated wafer style butterfly valve(s).

1 Membrane Backwash Skid(s) consisting of:

- 18" magnetic flow-meter and converter(s).
- 10 inch pneumatically operated wafer style butterfly valve(s).
- Air filter(s).

5 Backwash pump(s) consisting of the following:

- Centrifugal pump with 60 HP, 3 ph. motor.
- 6" manual butterfly valve(s).
- 6 inch diameter swing check valve.

Chemical Feed Systems

1 Chemical Feed System for acid and coagulant, each system consisting of the following:

- PVC backing panel(s).
- Calibration columns.
- Chemical feed pumps.
- Pressure relief valves.
- GFI outlet(s).
- Ball valves.
- 316 stainless steel shelf weldments.
- Polypropylene utility trays.

8 Chemical Flow Control Valve(s) consisting of:

- 1/2" Solenoid valve(s).

VEOLIA

Budget Proposal for the

Dundas WWTP

ZeeWeed* Membrane Bioreactor System

Submitted to:
CIMA
500–5935 Airport Road,
Mississauga, ON
L4V 1W5
Attention: Maria Bovtenko, EIT

July 10, 2023

Proposal Number: 559679

Submitted by:
Geoff Totten - Regional Sales Manager
Cell: (289)242-6172
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ProAqua Sales
Scott Lenhardt
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Table of Contents

1. Basis Of Design

The proposed ZeeWeed® Membrane Bioreactor System for Dundas WWTP is offered based on the design parameters summarized in the following sections.

1.1 Influent Flow Data

The influent design flows are summarized in the table below.

influent design flows

flow conditions	value	units
average day flow (ADF)	18,200	m^3/d
maximum month flow (MMF)	22,750	m^3/d
maximum day flow (MDF)	31,850	m^3/d
peak hour flow (PHF)	1,517	m^3/hr
maximum flow with one train offline for maintenance or cleaning (for less than 24 hours)	18,200	m^3/d

note 1: any flow conditions that exceed the above-noted flow limits must be equalized prior to treatment in the ZeeWeed membrane bioreactor system.

ADF – the average flow rate occurring over a 24-hour period based on annual flow rate data.

MMF – the average flow rate occurring over a 24-hour period during the 30-day period with the highest flow based on annual flow rate data.

MDF – the maximum flow rate averaged over a 24-hour period occurring within annual flow rate data.

PHF – the maximum flow rate sustained over a 1-hour period based on annual flow rate data.

1.2 Influent Quality

The design solution proposed is based on the wastewater characteristics detailed below. The concentrations listed below are specific to the flow used for the biological design as listed in section 2.1 below.

Influent Design Parameters

Influent Design Parameters	Value	Unit
design influent temperature	10	ºC
BOD5	158	mg/L
TSS	224	mg/L
NH3-N[1]	15	mg/L
TKN	34	mg/L
TP	5	mg/L
alkalinity[2]	n/a	mg/L as $CaCO_3$

note 1: Parameter value assumed.

note 2: Veolia is assuming that sufficient influent alkalinity is available for proper performance of the biological system. Should influent alkalinity not be sufficient, chemical addition by buyer will be required.

1.3 Effluent Quality

The following performance parameters are expected once the biological system has stabilized based on the data listed in sections 1.1 and 1.2.

Effluent Design Parameters

Effluent Design Parameters	Value	Unit
BOD_5	≤ 3	mg/L
TSS	≤ 2	mg/L
TP[1]	≤ 0.05	mg/L
turbidity	≤ 1	NTU
TAN May 1 – Oct. 31 Nov. 1 – Apr. 30	0.28 0.5	mg/L

note 1. With coagulant addition.

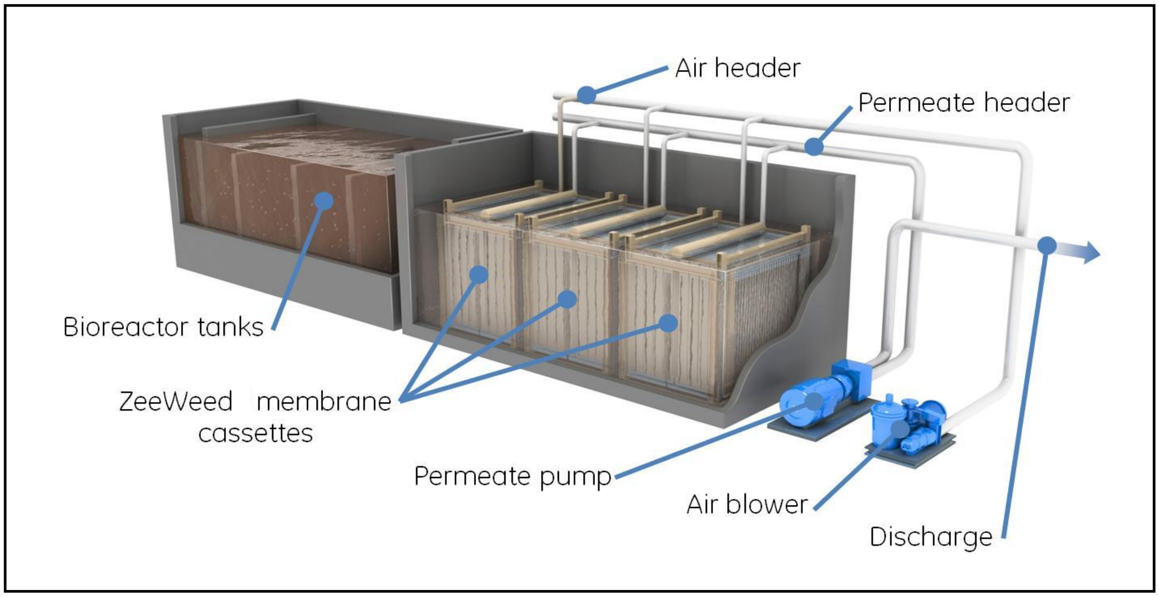
1.4 Influent Variability

Influent wastewater flows or loads in excess of the design criteria defined above must be equalized prior to entering the membrane tanks. In the event that the influent exceeds the specifications used in engineering this proposal, or the source of influent changes, the ability of the treatment system to produce the designed treated water quality and/or quantity may be impaired. Buyer may choose to continue to operate the system, but assumes the risk of damage to the system and/or additional costs due to increased membrane cleaning frequency, potential for biological upset and/or increased consumables usage.

2. System Design and Scope

The membrane bioreactor (MBR) process consists of a suspended growth biological reactor integrated with a membrane filtration system, using the ZeeWeed hollow fiber ultrafiltration membrane. The membrane filtration system essentially replaces the solids separation function of secondary clarifiers and tertiary sand filters used in a conventional activated sludge process.

ZeeWeed ultrafiltration membranes are directly immersed in mixed liquor. Using a permeate pump, a vacuum is applied to a header pipe connected to the membranes. The vacuum draws the treated water through the hollow fiber membranes. Permeate is then directed to downstream disinfection or discharge facilities. Air, in the form of large bubbles, is introduced below the bottom of the membrane modules, producing turbulence that scours the outer surface of the hollow fibers to keep them clean.



The proposed MBR design utilizes LEAPmbr aeration, Veolia's latest technology for wastewater treatment, which offers the lowest cost of ownership in the industry. LEAPmbr aeration incorporates several innovations, including the latest ZeeWeed 500 module with increased membrane surface area, increased productivity through proven membrane design flux improvements, an optimized membrane tank design, along with a more efficient membrane aeration system (known as LEAPmbr aeration technology) that simplifies the aeration system and reduces aeration requirements. These innovations combine to offer:

- 15% productivity improvement
- 20% footprint reduction
- 50% reduction in membrane aeration equipment
- 30% membrane aeration energy savings

The use of LEAPmbr aeration offers some of the most important benefits of a ZeeWeed MBR systems – simplicity, reliability, and lowest life-cycle cost.

Simplicity

Over the years, Veolia has continually improved the design of ZeeWeed MBR systems, making them the simplest MBR systems in the industry to operate and maintain. The system is fully automated, with operators having the ability to review operation, adjust set points, or schedule operating tasks through the easy-to-understand HMI graphical display.

A fully automated suite of membrane maintenance procedures will ensure long-term, successful operation, including:

- in situ chemical membrane cleaning performed directly in the membrane process tanks so your operators don't waste time moving cassettes;
- the ability to increase or decrease the frequency of maintenance cleans to fit the operating conditions;
- the ability to backpulse when needed to greatly improve your operator's ability to recover from non-design conditions.

The above cleaning systems are automated resulting in operators having available a full suite of comprehensive cleaning systems which are simple to use and initiate.

Reliability

Veolia's reinforced ZeeWeed hollow fiber membrane incorporates a patented internal support to which the membrane is bonded, creating the most robust membrane in the industry. In addition, Veolia's automated manufacturing processes ensure a consistent membrane product meeting the highest standards of workmanship and quality. This exceptionally strong and reliable membrane forms the backbone of ZeeWeed MBR systems, which consistently exceeds the toughest regulatory standards around the world.

Veolia is the world leader in MBR technology, with the majority of the industry's largest and longest-operating MBR plants. Veolia now has over two decades of experience with the well-proven ZeeWeed membrane. The earliest MBR plants using the ZeeWeed 500 membrane, Veolia's current standard for MBR applications, have now been in operation for over 10 years. Veolia's long-term and wide-ranging MBR experience ensures that plant operators can count on many years of successful operation of the proposed ZeeWeed MBR plant.

Lowest Lifecycle Cost

LEAPmbr aeration is a significant innovation for ZeeWeed MBR technology that offers a 30% reduction in air flow versus Veolia's previous air cycling technology. When combined with LEAPmbr's other features, membrane aeration energy savings are almost 50% compared with the previous generation of ZeeWeed membranes. In addition to the substantial energy savings, LEAPmbr requires fewer membrane modules and cassettes, smaller membrane tanks, fewer valves and pipes, and lower connected horsepower. In many cases, a ZeeWeed MBR system using LEAPmbr technology has an equivalent lifecycle cost to conventional treatment options.

2.1 Biological System Design

Biological Design Parameters

Biological Design Parameters	Value	Unit
flow basis for biological design	22,752	m^3/day
total pre-anoxic tank working volume	2,318	m^3
total aerobic working volume (excluding membranes)	6,710	m^3
total design HRT	10.1	hours
total design SRT	24	days
waste sludge removal (based on ADF and 10 g/L)	263	m^3 /day
design MLSS concentration in bioreactor	8,000 - 10,000	mg/L
design liquid depth in bioreactor	5.5	m

note 1: Tank volumes are preliminary only and may change once final detail design commences.

note 2: The biological system is designed for installation within concrete tanks supplied by buyer.

2.2 Membrane System Design

Membrane Design Parameters

Membrane Design Parameters	Value	Unit
number of membrane trains	4	no.
number of cassette spaces per train	8	no.
number of cassettes installed per train	7	no.
type of cassette	52M	modules/ cassette
module design per train	(5x52)+ (2x40)+ (1x0)	n/a
total number of modules installed per train	340	no.
total number of modules installed per plant	1360	no.
spare space	18.3	%
membrane tank internal dimensions	55 x 8 x 13	L x W x H (ft)

note 1: Tank dimensions and volumes are preliminary only and may change slightly once final detail design commences.

note 2: The ultrafiltration system is designed for installation within concrete tanks supplied by buyer.

2.3 Scope of Supply by Veolia

Veolia's scope of supply for a ZeeWeed 500 membrane wastewater treatment system is as follows:

- electrical rating on all motors is 460V / 3ph / 60 Hz. Single phase power requirement is 120V.
- all proposed equipment and instrumentation quoted is to be installed in a NFPA 820 non classified area.
- all devices will be Veolia standard devices and the proposed equipment will be supplied to Veolia specifications. Any changes to the proposed equipment to meet the Buyer's specification, including custom tag numbering, will require re-evaluation.
- equipment will be **supplied loose shipped** unless otherwise noted.

Zeeweed Membranes and Associated Equipment

- ZeeWeed 500 membrane cassettes and modules
- membrane tank cassette mounting assemblies
- permeate collection & air distribution header pipes
- membrane tank level transmitters, one per membrane tank
- membrane tank level switches, a set per tank

Process Pumping System

- process pumps supplied loose, complete with required isolation valves, pressure gauges, and flow meters, one set per membrane train
- vacuum ejectors and associated valves, one per membrane train
- pressure transmitter for measure of transmembrane pressure, one per membrane train
- turbidimeters, one per membrane train

Membrane Air Scour Blowers

- common membrane air scour blowers supplied loose, complete with required isolation valves, pressure gauges and flow switches and acoustic enclosures

Backpulse System

- backpulse pumps supplied loose, complete with required isolation valves, check valves, switches and flow meter
- backpulse water storage tank, with isolation valves and level transmitter

Biological Equipment

- process aeration blowers supplied loose, complete with required isolation valves, pressure gauges and flow switches and acoustic enclosures
- process mixers
- fine bubble diffusers and lateral piping

- aerobic dissolved oxygen sensors and pH sensors

Mixed Liquor Recirculation

- mixed liquor recirculation pumps used to transfer mixed liquor from membrane tanks to aerobic zone, supplied loose, complete with required isolation valves and check valves, pressure gauges, and flow meters

Chemical Addition Systems

- coagulant addition system

Membrane Cleaning Systems

- sodium hypochlorite chemical feed system
- citric acid chemical feed system

Electrical And Control Equipment

- master control panel containing PLC and touch screen HMI

Miscellaneous

- air compressors and refrigerated air dryers for ejectors and pneumatic valves operation

General

- equipment layout, membrane tank general arrangement and process and instrumentation drawings
- operating & maintenance manuals
- field service and start-up assistance[2] - 45 days support over 8 site visits from Veolia water field-service personnel for installation assistance, commissioning, plant start-up and operator training
- membrane warranty – 10 years prorated
- equipment mechanical warranty – 1 year or 18 months from shipment of equipment
- InSight digital asset monitoring and 24/7 emergency telephone technical support service – 1 year

note 1: additional man-hours will be billed separately from the proposed system capital cost at a rate of $1,300 per day plus living and traveling expenses. Detailed Veolia service rates are available upon request.

note 2: all Veolia supplied equipment is designed for installation in an unclassified area.

note 3: to receive complete 24/7 Emergency Telephone Technical Support Service and to allow for InSight Monitor Service, a suitable secure remote internet connection, by buyer, is required.

3. Buyer Scope of Supply

The following items are for supply by buyer and will include but are not limited to:

- overall plant design responsibility
- review and approval of design parameters related to the biological process and membrane separation system
- review and approval of Veolia-supplied equipment drawings and specifications
- detail drawings of all termination points where Veolia equipment or materials tie into equipment or materials supplied by buyer
- design, supply and installation of lifting devices including overhead traveling bridge crane and/or monorail able to lift 4,535 kg (10,000 lb) for membrane removal, lifting davits c/w a hoist, guide rails for submersible mixers and pumps etc.
- civil works, provision of main plant tank structure, buildings, equipment foundation pads etc. including but not limited to:
  - common channels, housekeeping pads, equipment access platforms, walkways, handrails, stairs etc.
  - equalization tank – as required
  - bioreactor tank – complete with pre-anoxic and aerobic zones
- membrane tanks c/w tank covers or grating, and their support over membrane tanks
- treated water storage tank, as required
- all chemical storage tanks, day tanks, and secondary containments
- HVAC equipment design, specifications and installation (where applicable)
- UPS, power conditioner, emergency power supply and specification (where applicable)
- 2-mm Pretreatment fine screens
- VFDs and MCC for all Veolia supplied equipment
- plant SCADA system
- process and utilities piping, pipe supports, hangers, valves, etc. including but not limited to:
  - piping, pipe supports and valves between Veolia-supplied equipment and other plant process equipment
  - piping between any loose-supplied Veolia equipment
  - process tank aeration system air piping, equalization tank system piping, etc.
- electrical wiring, conduit and other appurtenances required to provide power connections as required from the electrical power source to the Veolia control panel

and from the control panel to any electrical equipment, pump motors and instruments external to the Veolia-supplied enclosure

- supply and installation of suitable, secure remote internet connection for 24/7 emergency telephone technical support service and InSight remote monitoring & diagnostics service
- design, supply and installation of equipment anchor bolts and fasteners for Veolia supplied equipment. All seismic structural analysis and anchor bolt sizing
- receiving (confirmation versus packing list), unloading and safe storage of Veolia-supplied equipment at site until ready for installation
- installation on site of all Veolia supplied skids and loose-shipped equipment
- alignment of rotating equipment
- raw materials, chemicals, and utilities during equipment start-up and operation
- disposal of initial start-up wastewater and associated chemicals
- supply of seed sludge for biological process start-up purposes
- laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation
- touch up primer and finish paint surfaces on equipment as required at the completion of the project
- weather protection as required for all Veolia-supplied equipment. Skids and electrical panels are designed for indoor operation and will need shelter from the elements
- all permits

4. Commercial

4.1 Pricing

Pricing for the proposed equipment and services, as outlined in section 2.3, is summarized in the table below. All pricing is based on the design operating conditions and influent characteristics detailed in section 1. The pricing herein is for budgetary purposes only and does not constitute an offer of sale. No sales, consumer use or other similar taxes or duties are included in the pricing below.

Equipment And Service Pricing

Price: All Equipment & Service	
ZeeWeed membrane bioreactor system, as per Section 2.3.	$ 6,450,000 CAD

4.2 Annual Power & Chemical Consumption Estimates

The data presented below is for information purposes only and is based on the design information provided by the buyer and presuming that the equipment is operated according to the design basis and in accordance with seller's operations and maintenance manuals.

Annual Power Consumption Estimate [1]

Equipment	kWh/year
process pumps [2]	577,881
membrane blowers	1,024,131
process blowers	2,269,011
recirculation pumps	287,338
process mixers	65,323
air compressors	2,722
total	**4,226,407**

note 1: Annual power consumption estimate is calculated at ADF condition

note 2: Assumes membrane relaxation mode used

Annual Chemical Consumption Estimate

Chemical	US gal/year
sodium hypochlorite (10.3% w/w, SG: 1.168)	6,900
citric acid (50.0% w/w, SG: 1.24)	5,600

note 1: Cleaning chemical consumption estimates are based on the frequencies and concentrations summarized in the table below. Frequencies are typical for ZW-MBR operation, actual frequency of maintenance and recovery cleans may change with final design, or may change once system is in operation.

Basis of Chemical Consumption Estimates

Chemical		Maintenance Clean	Recovery Clean
sodium hypochlorite solution (10.3% w/w, SG: 1.168)	frequency	2 times per week	2 times per year
	concentration	200 mg/L	1,000 mg/L
citric acid solution (50.0% w/w, SG: 1.24)	frequency	1 time per week	2 times per year
	concentration	2,000 mg/L	2,000 mg/L

4.3 Equipment Shipment and Delivery

Equipment shipment is estimated at 64 to 73 weeks after order acceptance. The buyer and seller will arrange a kick-off meeting after contract acceptance to develop a firm shipment schedule.

Typical Drawing Submission and Equipment Shipment Schedule

Deliverables		8-12 Weeks	2-3 Weeks	52-56 Weeks		2 Weeks
acceptance of PO						
submission of drawings						
drawings approval						
equipment manufacturing						
equipment shipment						
plant operations manuals						

The delivery schedule is presented based on current workload backlogs and production capacity. This estimated delivery schedule assumes no more than 2 weeks for buyer review of submittal drawings. Any delays in buyer approvals or requested changes may result in additional charges and/or a delay to the schedule.

4.4 Freight Terms

The following freight terms used are as defined by INCOTERMS 2010.

All pricing is CIP to Dundas WWTP project site.

4.5 Terms and Conditions of Sale

This proposal has been prepared and is submitted based on seller's standard terms and conditions of sale.

TROJAN UV SIGNA™

PROPOSAL FOR DUNDAS WWTP, ONTARIO
QUOTE: 241733
08/28/2023

TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

ROB JANSEN | REGIONAL SALES MANAGER
TROJANUV | SALSNES FILTER
(519) 457-3400 ext. 2830 *office* | (519) 851-2253 *mobile*
rjansen@trojantechnologies.com

Representative:
Jeff Dobbin
Director of Municipal Sales
H2Flow Equipment Inc.
580 Oster Lane, Vaughan, Ontario, Canada L4K 2C1
Tel: (905) 660-9775 x31 Fax: (905) 660-9744 Cell: (416) 500-5388
jeff@h2flow.com

TROJAN UV SIGNA™

DESIGN CRITERIA

Peak Design Flow:	**34.60 ML/d**
UV Transmittance:	**65%** (minimum)
Total Suspended Solids:	**30 mg/l (30 Day Average,** grab sample)
Disinfection Limit:	**100 E.coli per 100 ml**, 30 day Geometric Mean of consecutive daily grab samples

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	
Number of Channels:	**2 (1 In Duty + 1 Redundant)**
Approximate Channel Length Required:	**34 ft**
Channel Width at UV Banks:	**39.5 in**
Channel Depth Recommended:	**7 ft 8 in**
Head loss through banks @ 34.6 ML/d	**1.34 in**
Upstream Water Lever with weir @ 34.6 ML/D	**67.6 in**
UV BANKS	
Number of Banks per Channel:	**2 in Duty**
Number of Lamps per Bank:	**12**
Total Number of UV Lamps:	**48 (Including 24 Redundant Lamps)**
Maximum Power Draw:	**50.5 kW**
UV PANELS	
Power Distribution Center Quantity:	**2**
Hydraulic System Center Quantity:	**2**
System Control Center Quantity:	**1**
ANCILLARY EQUIPMENT	
Level Controller Quantity and Type:	**1 Fixed Weir**
Integral Bank Walls:	**Included**
On-line UVT Monitoring:	**Hach UVAS sc Sensor**
Other Equipment:	**4 Lamps, 4 Sleeves**
ELECTRICAL REQUIREMENTS	
1. Each Power Distribution Center requires an electrical supply of one (1) 480/277V 60Hz, 26.1 kVA **2.** Electrical supply for Hydraulic System Center will be (1) 480V 60Hz, 2.5 kVA **3.** Electrical supply for System Control Center will be (1) 120V 60Hz, 1.8 kVA **4.** The On-line UVT monitor requires (1) 120 Volts, 1 phase, 2 wire + ground, 1A **5.** Electrical disconnects are not included in this proposal. Refer to local electrical codes	

TROJANUVSIGNA™

COMMERCIAL INFORMATION

Total Capital Cost: $ 779 590 (CAD)

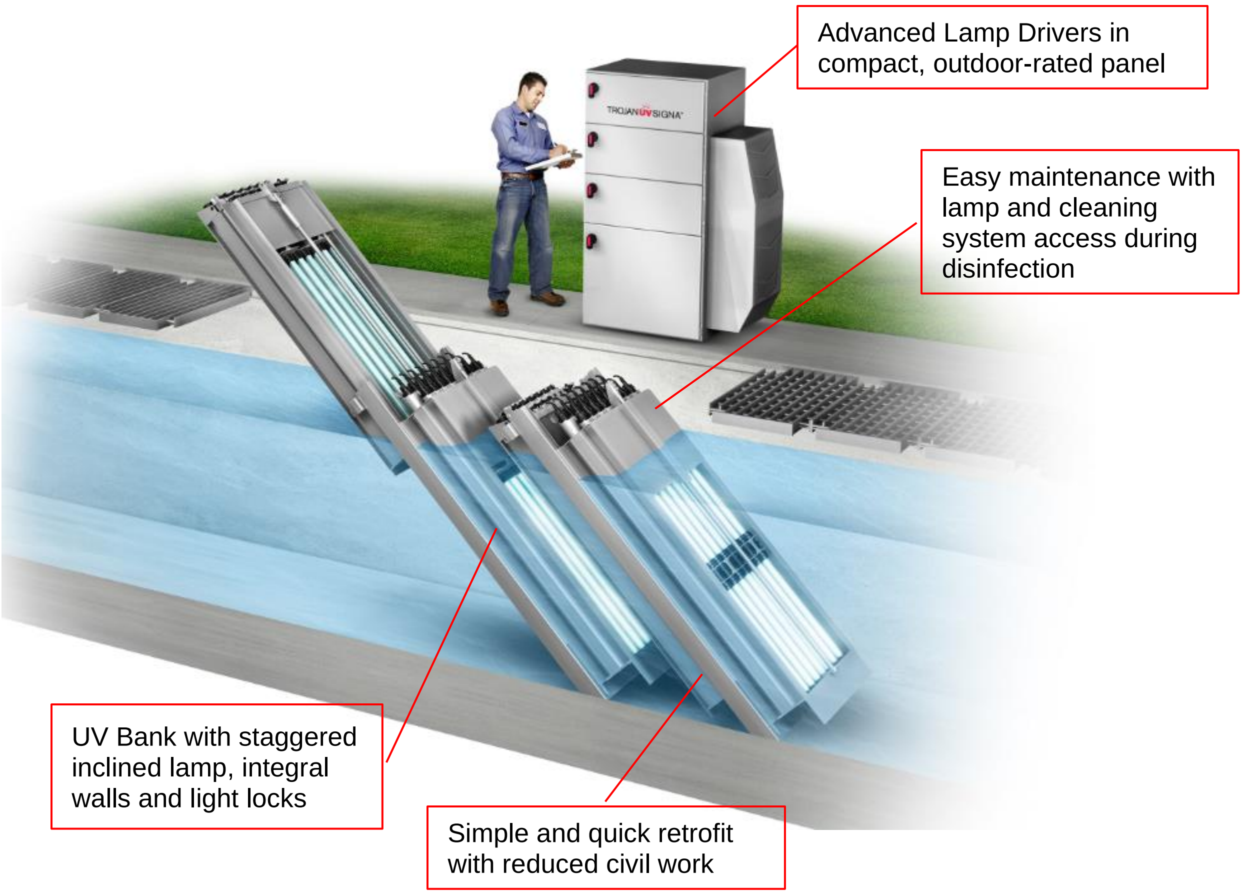
This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

SYSTEM OVERVIEW

SOLO LAMP
TECHNOLOGY



Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

B

Appendix B: Conceptual Sizing Calculations

Engineering
for **people**

Project Name: Facility Upgrade Plan for Dundas WWTP
Project No: T001744A
Title: Design Basis

Prepared By: Maria Bovtenko
Date: November 2, 2023

Description/Parameter	Symbol	Value	Units	Notes
Influent Flow				
Average Daily Flow (ADF)	Q_{ADF}	18,200	m^3/d	
Maximum Month Flow (MMF)	Q_{MMF}	22,750	m^3/d	
Peak Day Flow (PDF)	Q_{PDF}	31,850	m^3/d	
Peak Hour Flow (PHF)	Q_{PHF}	36,400	m^3/d	
Peak Instantaneous Flow (PIF)	Q_{PIF}	41,860	m^3/d	
Peaking Factors				
Maximum Month		1.3		
Peak Day		1.8		
Peak Hour		2.0		
Peak Instantaneous		2.3		
Loading Factors				
CBOD Peak Month		1.4		
TSS Peak Month		1.7		
TKN Peak Month		1.6		
TP Peak Month		1.6		
Diurnal Peaking Factors				
Minimum Diurnal		0.5		Mar-21
Maximum Diurnal		1.4		Mar-21
Design Wastewater Characteristics				
CBOD		158	mg/L	
TSS		224	mg/L	
TP		5	mg/L	
TKN		34	mg/L	
Temperature		15	C	

Project Name: Facility Upgrade Plan for Dundas WWTP
Project No: T001744A
Title: MBR Aeration Tank Sizing

Prepared By: Maria Bovtenko
Date: November 2, 2023

Parameter	Value	Unit	Reference	Notes
1. Select aeration tank configuration				
MBR				
2. Determine volume required for aeration tanks				
2.1 Determine overall MLSS				
Design MLSS	6000	mg/L		6,000 mg/L at average loading. During maximum month conditions, MLSS would be 8,000 mg/L - consistent with vendor recommendations for bioreactors which are sized at maximum month conditions.
MLVSS	4500	mg/L		
2.2 Determine volume required				
Aerobic Volume	= Q_{ADF} * (PE BOD * Y_{BOD}) * SRT / MLSS			
PE BOD	158			
SRT	18			
	9000	m^3		Calculated
2.3 Determine total volume of aeration tank				
Total Tank Volume Required	9000	m^3		Provided by vendor
2.4 Determine volume of swing anoxic zone				
% of Total Tank Volume	20%			
	1800	m^3		
2.5 Verify HRT				
HRT	=V / Q * 24 hrs			
	11.9	hrs		
2.6 Verify F/M				
F/M	=PE BOD*Q_{ADF}/(MLVSS*V)			
	0.07	d^{-1}	MECP Guideline: 0.05-0.25 d^{-1}	
3. Determine dimensions of aeration tanks				
3.1 Select number of aeration tanks				
Number of Duty Tanks	3			
3.2 Select number of passes				
Number of Passes	3			
3.3 Dimensions of each tank				
Volume per tank	3000	m^3		
Anoxic volume per tank	600	m^3		
Length	50	m		
Width	10.0	m		
Width per pass	3.3	m		
Surface area per tank	500	m^2		
SWD	6	m		
3.4 Total Footprint Estimate				
Influent Channel Width	1.50	m		
Step Feed Channel Width	1.5	m		
Internal Wall Width	0.4	m		
External Wall Width	0.6	m		
Total Width	34.8	m		
Total Length	54	m		

Project Name: Facility Upgrade Plan for Dundas WWTP
Prepared By: Maria Bovtenko
Project No: T001744A
Date: November 2, 2023
Title: Conceptual Sludge Production Estimate

Parameter	Value	Unit	Reference	Notes
1. Sludge Storage Assumptions				
Solids Concentration	2%	%		
Days of Storage Provided	7	days		
2. AGS Sludge Storage Requirements				
Dry Solids Production	3300	kg/d		
Chemical Sludge Production	280	kg/d		Assumed use of ferric sulphate.
Total Estimated Solids Production	3580	kg/d		
Volume Required	1250	m^3		
3. AGS Sludge Storage Requirements				
Dry Solids Production	3300	kg/d		
Chemical Sludge Production	480	kg/d		Assumed use of ferric sulphate.
Total Estimated Solids Production	3780	kg/d		
Volume Required	1300	m^3		

Project Name: Facility Upgrade Plan for Dundas WWTP
Prepared by: Maria Bovtenko
Project No.: T001744A
Date: November 2, 2023
Title: Chlorine Contact Tank Sizing

Parameter	Value	Unit	Reference	Notes
1. Determine size of chlorine contact tank				
Contact Time at ADF	30	min	MECP Guideline: 30 min at ADF	
Volume Required at ADF	379	m^3		
Contact Time at PHF	15	min	MECP Guideline: 30 min at PHF	
Volume Required at PHF	379	m^3		
Total Length	84	m	L:W >40:1	
Width of Pass	1.5	m		
SWD	3	m	H:W <2:1	
Number of Passes	6			
Width of Tank	9	m		
Length of Tank	14	m		
Surface Area of Tank	126			

Scope 2 - GHG Emissions associated with Electricity Consumption

ELECTRICITY COMSUMPTION EMISSIONS

Step 1 - Estimate the emissions associated with electricity consumption on-site

$$E_{elec} = EF_{elec} * V_{elec}$$

		Unit	TOTAL	AGS with TMF	MBR	UV
EF_{elec}	Ontario Electricity Generation EF	gCO_2eq/kWh		28.0	28.0	28.0
V_{elec}	Annual Electricity Consumption	kWh/year		1,777,800	4,226,300	97,236
E_{elec}	Electricity Consumption Emissions	$tCO_2eq/year$	171	50	118	3

Scope 1 - GHG Emissions Associated with Treatment Processes

WARMING GLOBAL POTENTIAL

	Unit	AGS with TMF	MBR	Reference/Source
Biogenic CH_4 Global Warming Potential (100-year horizon)	-	25.0	25.0	IPCC 2007, Table 2.14
N_2O Global Warming Potential (100-year horizon)	-	298	298	IPCC 2007, Table 2.14

METHANE EMISSIONS FROM DOMESTIC WASTEWATER

Methodology: The following five steps were adapted from the 2019 Refinement of the IPCC Guidelines, Volume 5, Chapters 4 and 6.

Step 1 - Estimate the amount of organic material in kgBOD/year in the wastewater influent, and the bypass and effluent discharged to the aquatic environment

Total Plant Influent Organics

$$TOW_{in} = F_{in} * C_{BOD\ in}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{in}	Annual Average Plant Influent Flow	m^3/day	18,200	18,200	Utility-data source
$C_{BOD\ in}$	Plant Influent BOD_5 Concentration	mgBOD/L	158	158	Utility-data source
TOW_{in}	Total Influent Organic Material	kgBOD/year	1,049,594	1,049,594	

Total Secondary Treatment Influent Organics

$$TOW_{in} = F_{in,sec} * C_{BOD\ eff,prim}$$

		Unit	AGS with TMF	MBR	Reference/Source
$F_{in,sec}$	Annual Average Secondary Influent Flow	m^3/day	18,200	18,200	Utility-data source
$C_{BOD\ eff,prim}$	Secondary Influent BOD_5 Concentration	mgBOD/L	158	158	Utility-data source
$TOW_{in,sec}$	Total Secondary Influent Organic Material	kgBOD/year	1,049,594	1,049,594	

Total Wastewater Secondary Effluent Organics

$$TOW_{eff} = F_{eff} * C_{BOD\ eff}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{Eff}	Annual Average Secondary Treatment Effluent Flow	m^3/day	18,200	18,200	Utility-data source
$C_{BOD\ eff}$	Secondary Effluent BOD_5 Concentration	mgBOD/L	3.0	3.0	Utility-data source
TOW_{eff}	Total Secondary Effluent Organic Material	kgBOD/year	19,929	19,929	

Total Wastewater Bypass Organics

$$TOW_{bypass} = F_{bypass} * C_{BOD\ bypass}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{bypass}	Annual Average Secondary Treatment Bypass Flow	m^3/day	-	-	Utility-data source
$C_{BOD\ bypass}$	Secondary Bypass BOD_5 Concentration	mgBOD/L	-	-	Utility-data source
TOW_{bypass}	Total Secondary Bypass Organic Material	kgBOD/year	-	-	

Scope 1 - GHG Emissions Associated with Treatment Processes

Step 2 - Estimate emissions from the aerobic treatment

$$Q_{CH4\_aerobic} = \Sigma_t TOW_{t,in}(1 - e_{t,rem} * \alpha_t) * EF_{aerobic}$$

Canada's National Inventory Report, 2021 Edition Part 2

Symbol	Description	Unit	TOTAL	AGS with TMF	MBR	Source
$TOW_{prim,in}$	Total Influent Organic Material	kgBOD/year		1,049,594	1,049,594	
$TOW_{sec,in}$	Total Secondary Influent Organic Material	kgBOD/year		1,049,594	1,049,594	
$e_{rem,prim}$	Primary Treatment BOD_5 Removal %	%BODremoved		0%	0%	Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, 2003
$e_{rem,sec}$	Secondary Treatment BOD_5 Removal %	%BODremoved		97%	97%	Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, 2003
$\alpha_{t\ prim}$	Primary Treatment Factor for Amount of BOD_5 Removed	SludgeBOD/WWBOD		1.0	1.0	Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, 2003
$\alpha_{t,sec}$	Secondary Treatment Factor for Amount of BOD_5 Removed	SludgeBOD/WWBOD		0.46	0.46	Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, 2003
$EF_{aerobic,prim}$	Emission Factor for Primary Treatment	$kgCH_4/kgBOD$		0.0036	0.0036	NIR 2022, Table A6.7-1
$EF_{aerobic,sec}$	Emission Factor for Secondary Treatment	$kgCH_4/kgBOD$		0.0036	0.0036	NIR 2022, Table A6.7-1
$Q_{CH4\_aerobic}$	CH_4 Emissions from Aerobic Treatment	$kgCH_4/year$	11,742	5,871	5,871	
		$tCO_2eq/year$	294	147	147	

Step 3 - Estimate emissions from the treated effluent and bypass (untreated wastewater) discharge to the aquatic environment

$$Q_{CH4\_discharge} = (TOW_{eff} + TOW_{byp}) * EF_{discharge}$$

2019 Refinement IPCC Guidelines, Volume 5, Chapter 6, adapted from Equation 6.1

Symbol	Description	Unit	TOTAL	AGS with TMF	MBR	Source
TOW_{eff}	Total Secondary Effluent Organic Material	kgBOD/year		19,929	19,929	
TOW_{bypass}	Total Secondary Bypass Organic Material	kgBOD/year		-	-	
$EF_{discharge}$	Emission Factor for Effluent Discharge	$kgCH_4/kgBOD$		0.068	0.068	IPCC 2019 Vol 5 Chap 6 Table 6.8A
$Q_{CH4\_discharge}$	CH_4 Emissions from Effluent Discharge	$kgCH_4/year$	2,710	1,355	1,355	
		$tCO_2eq/year$	68	34	34	

Scope 1 - GHG Emissions Associated with Treatment Processes

NITROUS OXIDE EMISSIONS FROM DOMESTIC WASTEWATER

Step 1 - Estimate the total amount of nitrogen in kgN/year in the wastewater influent and the effluent discharged to the aquatic environment

Total Nitrogen in wastewater influent

$$TN_{in} = F_{in} * C_{N\ in}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{in}	Annual Average Plant Influent Flow	m^3/day	18,200	18,200	Utility-data source
$C_{N\ in}$	Average Total Nitrogen Concentration in Wastewater Influent	mgN/L	34.0	34.0	Utility-data source
TN_{in}	Total Influent Nitrogen	kgN/year	225,862	225,862	

Total Nitrogen in treated wastewater effluent discharged to the aquatic environment

$$TN_{eff} = F_{eff} * C_{N\ eff}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{Eff}	Annual Average Secondary Treatment Effluent Flow	m^3/day	18,200	18,200	Utility-data source
$C_{N\ eff\_treat}$	Average Total Nitrogen Concentration in Secondary Treatment Effluent	mgN/L	0.3	0.3	Utility-data source
TN_{eff_treat}	Total Secondary Treatment Nitrogen	kgN/year	1,860	1,860	

Total Nitrogen in untreated wastewater effluent (or bypass) discharged to the aquatic environment

$$TN_{eff\_bypass} = F_{bypass} * C_{N\ eff\_bypass}$$

		Unit	AGS with TMF	MBR	Reference/Source
F_{bypass}	Annual Average Secondary Treatment Bypass Flow	m^3/day	-	-	Utility-data source
$C_{N\ eff\_bypass}$	Average Total Nitrogen Concentration in Secondary Treatment Bypass	mgN/L	-	-	Utility-data source
TN_{eff_bypass}	Total Secondary Bypass Nitrogen	kgN/year	-	-	

Step 2 - Estimate emissions from the aerobic treatment

N_2O Emissions From Domestic Wastewater Treatment Plants

$$Q_{N2O\ aerobic} = TN_{in} * EF_{aerobic} * (kg\ N_2O/kg\ N_2O\text{-}N)$$

2019 Refinement IPCC Guidelines, Volume 5, Chapter 6

		Unit	TOTAL	AGS with TMF	MBR	Reference/Source
TN_{in}	Total Influent Nitrogen	kgN/year		225,862	225,862	
$EF_{aerobic}$	Emission Factor for Centralised, Aerobic Treatment Plant	kgN_2O-N/kgN		0.016	0.016	IPCC 2019 Vol 5 Chap 6 Table 6.8A
$Q_{N2O\ aerobic}$	N_2O Emissions from Aerobic Treatment	kgN_2O/year	11,429	5,714	5,714	
		tCO_2eq/year	3,406	1,703	1,703	

Step 3 - Estimate N_2O emissions from the treated effluent and bypass (untreated wastewater) discharge to the aquatic environment

$$Q_{N2O\_discharge} = (TN_{eff\_treat} + TN_{eff\_bypass}) * EF_{eff\_dischargeN2O} * (kg\ N_2O/kg\ N_2O\text{-}N)$$

2019 Refinement IPCC Guidelines, Volume 5, Chapter 6, adapted from Equation 6.7

		Unit	TOTAL	AGS with TMF	MBR	Reference/Source
TN_{eff_treat}	Total Secondary Treatment Nitrogen			1,860	1,860	
TN_{eff_bypass}	Total Secondary Bypass Nitrogen	kgN/year		-	-	
$EF_{eff\_dischargeN2O}$	Emission Factor for Treated Effluent Discharge	kgN_2O-N/kgN		0.005	0.005	IPCC 2019 Vol 5 Chap 6 Table 6.8A
$Q_{N2O\_discharge}$	N_2O Emissions from Effluent Discharge	kgN_2O/year	29	15	15	
		tCO_2eq/year	9	4	4	
	Total Nitrous Oxide Emissions	kgN_2O/year	11,458	5,729	5,729	
		tCO_2eq/year	3,414	1,707	1,707	

C

Appendix C: Conceptual Cost Estimates

Engineering
for **people**

Project Title:	**Facility Upgrade Plan for Dundas WWTP**
Client:	City of Hamilton
Project No.:	T001744A
Task:	Opinion of Probable Cost
Prepared By:	Maria Bovtenko **Date:** 11-Jul-23

Alternative Design Concept 1 - Aerobic Granular Sludge (AGS) with Tertiary Membrane Filtration (TMF)

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
Site Works	1	L.S.	$15,928,000	1	$15,930,000	Total estimated site works assuming new facilities are constructed within the existing site.
Headworks	170	m^2	$13,000	1	$2,210,000	Based on reference project cost estimate.
AGS Facility	1	L.S.	$30,912,500	1	$30,910,000	Total estimate for AGS reactors and all associated equipment and tanks (buffers and EQ tank)
Membrane Filtration	1	L.S.	$12,142,500	1	$12,140,000	Total estimate for tertiary membrane filtration.
Subtotal Capital Cost (2023$)					**$61,190,000**	
Engineering (15%)			15%		$9,180,000	
Contingency & Estimating Allowance (30%)			30%		$18,360,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$9,180,000	
Total Project Capital Cost (2023$ - Excluding HST)					**$97,910,000**	

Annual Operation & Maintenance Cost

Description	Annual Cost	Comments
Energy (aeration)	$74,900	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Aqua Aerobics.
Energy (buffers)	$51,300	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Aqua Aerobics.
Energy (membrane filtration)	$51,700	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Aqua Aerobics.
Chemical Consumption	$210,900	Assumed $0.82/L ferric sulphate, $0.22/L sodium hypochlorite, $0.53/L sodium hydroxide and $1.96/L sulfuric acid based on unit costs from reference facilities. Ferric sulphate dosage of 6.9 mg Fe/L. Cleaning chemical volumes from Aqua Aerobics.
Equipment Maintenance/Replacement	$909,900	Assumed equal to MBR.
Labor	$613,200	$60/hr; 8 hrs/d; 3.5 operators
Total Annual O&M Cost	**$1,912,000**	

Project Title:	**Facility Upgrade Plan for Dundas WWTP**
Client:	City of Hamilton
Project No.:	T001744A
Task:	Opinion of Probable Cost
Prepared By:	Maria Bovtenko
Date:	11-Jul-23

Alternative Design Concept 2 - Membrane Bioreactors

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
Site Works	1	L.S.	$15,702,000	1	$15,700,000	Total estimated site works assuming new facilities are constructed within the existing site.
Headworks	300	m^2	$13,000	1	$3,900,000	Based on reference project cost estimate.
Membrane Bioreactor Facility	1	L.S.	$26,425,000	1	$26,430,000	Total estimate for membrane bioreactors (aeration tanks, membrane filters and process building).
Subtotal Capital Cost (2023$)					**$46,030,000**	
Engineering (15%)			15%		$6,900,000	
Contingency & Estimating Allowance (30%)			30%		$13,810,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$6,900,000	
Total Project Capital Cost (2023$ - Excluding HST)					**$73,640,000**	

Annual Operation & Maintenance Cost

Description	Annual Cost	Comments
Energy (aeration)	$226,900	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Veolia.
Energy (mixing)	$6,500	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Veolia.
Energy (recirculation)	$28,700	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Veolia.
Energy (membrane filtration)	$160,500	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Veolia.
Chemical Consumption	$348,600	Assumed $0.82/L ferric sulphate, $0.22/L sodium hypochlorite, and $6.70/L citric acid based on unit costs from reference facilities. Average ferric sulphate dosage of 7 mg Fe/L. Cleaning chemical volumes from Veolia.
Equipment Maintenance/Replacement	$909,900	Assumed 3% of subtotal capital cost excluding site works.
Labor	$525,600	$60/hr; 8 hrs/d; 3 operators

Nominal Life Cycle Costs

Calendar Year			**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Analysis Year			**0**	**0**	**0**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Active Scenario	**Scenario 0**																		
	Constant	Unit																	
O&M and Capital Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Hydro Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Chemical Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Natural Gas Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Dundas Flow Increases	0.2%	percent	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Ferric Sulphate Unit Cost (AGS)	10,849.90	$/ML	10,849.90	11,392.40	11,962.01	12,560.12	13,188.12	13,847.53	14,539.90	15,266.90	16,030.24	16,831.76	17,673.34	18,557.01	19,484.86	20,459.10	21,482.06	22,556.16	23,683.97
Ferric Sulphate Unit Cost (MBR)	11,007.15	$/ML	11,007.15	11,557.50	12,135.38	12,742.15	13,379.25	14,048.22	14,750.63	15,488.16	16,262.57	17,075.69	17,929.48	18,825.95	19,767.25	20,755.61	21,793.39	22,883.06	24,027.22
Sodium Hypochlorite Unit Cost (AGS)	5.00	$/ML	5.00	5.25	5.52	5.79	6.08	6.39	6.71	7.04	7.39	7.76	8.15	8.56	8.99	9.44	9.91	10.40	10.92
Sodium Hypochlorite Unit Cost (MBR)	315.72	$/ML	315.72	331.51	348.09	365.49	383.76	402.95	423.10	444.26	466.47	489.79	514.28	540.00	567.00	595.35	625.11	656.37	689.19
Citric Acid Unit Cost	7,815.31	$/ML	7,815.31	8,206.07	8,616.38	9,047.19	9,499.55	9,974.53	10,473.26	10,996.92	11,546.77	12,124.11	12,730.31	13,366.83	14,035.17	14,736.93	15,473.77	16,247.46	17,059.83
Sodium Hydroxide Unit Cost	186.75	$/ML	186.75	196.09	205.89	216.19	227.00	238.35	250.27	262.78	275.92	289.71	304.20	319.41	335.38	352.15	369.76	388.24	407.66
Sulphuric Acid Unit Cost	636.78	$/ML	636.78	668.62	702.06	737.16	774.02	812.72	853.35	896.02	940.82	987.86	1,037.26	1,089.12	1,143.57	1,200.75	1,260.79	1,323.83	1,390.02
Hydro Unit Cost	0.10	$/kWh	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.20	0.21	0.22
FLOW PROJECTIONS (INCREASE)																			
Average daily flows		MLD	*12*	*12*	*12*	*12*	*13*	*13*	13	13	13	13	13	13	13	13	13	13	13
DESIGN CONCEPT 1: AGS with TMF																			
WASTEWATER OPERATIONS (INCREASE)																			
Average aeration requirements from new facility		kWh/year									518,665	519,587	520,510	521,434	522,360	523,288	524,218	525,149	526,082
Average buffer energy requirements from new facility		kWh/year									355,153	355,784	356,416	357,049	357,684	358,319	358,955	359,593	360,232
Average membrane requirements from new facility		kWh/year									357,925	358,561	359,198	359,836	360,475	361,115	361,757	362,399	363,043
CAPITAL COSTS																			
Capital Cost		Nominal $					*29,752,554*	*29,752,554*	*29,752,554*	*29,752,554*									
Capital Asset Replacement		Nominal $									*1,344,337*	*1,411,554*	*1,482,131*	*1,556,238*	*1,634,050*	*1,715,752*	*1,801,540*	*1,891,617*	*1,986,198*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**29,752,554**	**29,752,554**	**29,752,554**	**29,752,554**	**1,344,337**	**1,411,554**	**1,482,131**	**1,556,238**	**1,634,050**	**1,715,752**	**1,801,540**	**1,891,617**	**1,986,198**
GENERAL OPERATING EXPENSES - WASTEWATER																			
Energy (Aeration) Cost		Nominal $									76,630	80,605	84,786	89,183	93,808	98,674	103,792	109,175	114,837
Energy (Buffer) Cost		Nominal $									52,472	55,194	58,056	61,068	64,235	67,566	71,071	74,757	78,634
Energy (Membrane) Cost		Nominal $									52,882	55,625	58,509	61,544	64,736	68,094	71,625	75,340	79,248
Ferric Sulphate Cost		Nominal $									202,138	212,622	223,650	235,250	247,451	260,285	273,785	287,985	302,921
Sodium Hypochlorite Cost		Nominal $									93	98	103	109	114	120	126	133	140
Sodium Hydroxide Cost		Nominal $									3,479	3,660	3,850	4,049	4,259	4,480	4,712	4,957	5,214
Sulphuric Acid Cost		Nominal $									11,864	12,479	13,126	13,807	14,523	15,276	16,069	16,902	17,779
Labour Cost		Nominal $									905,976	951,274	998,838	1,048,780	1,101,219	1,156,280	1,214,094	1,274,799	1,338,539
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,305,535**	**1,371,557**	**1,440,919**	**1,513,789**	**1,590,346**	**1,670,775**	**1,755,274**	**1,844,047**	**1,937,311**
DESIGN CONCEPT 2: MBR																			
WASTEWATER OPERATIONS (INCREASE)																			
Average aeration requirements from new facility		kWh/year									1,572,070	1,574,863	1,577,660	1,580,462	1,583,270	1,586,082	1,588,900	1,591,722	1,594,549
Average mixing requirements from new facility		kWh/year									45,243	45,323	45,404	45,484	45,565	45,646	45,727	45,808	45,890
Average recirculation requirements from new facility		kWh/year									199,055	199,409	199,763	200,118	200,473	200,829	201,186	201,543	201,901
Average membrane requirements from new facility		kWh/year									1,111,812	1,113,787	1,115,765	1,117,747	1,119,733	1,121,722	1,123,714	1,125,710	1,127,710
CAPITAL COSTS																			
Capital Cost		Nominal $					*22,377,470*	*22,377,470*	*22,377,470*	*22,377,470*									
Capital Asset Replacement		Nominal $									*1,344,337*	*1,411,554*	*1,482,131*	*1,556,238*	*1,634,050*	*1,715,752*	*1,801,540*	*1,891,617*	*1,986,198*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**22,377,470**	**22,377,470**	**22,377,470**	**22,377,470**	**1,344,337**	**1,411,554**	**1,482,131**	**1,556,238**	**1,634,050**	**1,715,752**	**1,801,540**	**1,891,617**	**1,986,198**
GENERAL OPERATING EXPENSES - WASTEWATER																			
Energy (Aeration) Cost		Nominal $									232,266	244,313	256,984	270,313	284,333	299,079	314,591	330,908	348,070
Energy (Mixing) Cost		Nominal $									6,684	7,031	7,396	7,779	8,183	8,607	9,054	9,523	10,017
Energy (Recirculation) Cost		Nominal $									29,409	30,935	32,539	34,227	36,002	37,869	39,833	41,899	44,073
Energy (Membrane) Cost		Nominal $									164,265	172,785	181,746	191,173	201,088	211,517	222,488	234,027	246,165
Ferric Sulphate Cost		Nominal $									205,068	215,704	226,891	238,659	251,037	264,057	277,753	292,158	307,311
Sodium Hypochlorite Cost		Nominal $									5,882	6,187	6,508	6,846	7,201	7,574	7,967	8,380	8,815
Citric Acid Cost		Nominal $									145,603	153,154	161,098	169,453	178,242	187,486	197,210	207,439	218,197
Labour Cost		Nominal $									776,551	815,378	856,147	898,954	943,902	991,097	1,040,652	1,092,685	1,147,319
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,565,729**	**1,645,487**	**1,729,310**	**1,817,404**	**1,909,987**	**2,007,288**	**2,109,548**	**2,217,019**	**2,329,967**

2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
24,868.17	26,111.58	27,417.16	28,788.02	30,227.42	31,738.79	33,325.73	34,992.01	36,741.61	38,578.69	40,507.63	42,533.01	44,659.66	46,892.64	49,237.28	51,699.14	54,284.10
25,228.58	26,490.01	27,814.51	29,205.23	30,665.49	32,198.77	33,808.71	35,499.14	37,274.10	39,137.81	41,094.70	43,149.43	45,306.90	47,572.25	49,950.86	52,448.40	55,070.82
11.47	12.04	12.65	13.28	13.94	14.64	15.37	16.14	16.95	17.79	18.68	19.62	20.60	21.63	22.71	23.85	25.04
723.65	759.83	797.82	837.71	879.60	923.58	969.75	1,018.24	1,069.15	1,122.61	1,178.74	1,237.68	1,299.56	1,364.54	1,432.77	1,504.41	1,579.63
17,912.83	18,808.47	19,748.89	20,736.34	21,773.15	22,861.81	24,004.90	25,205.14	26,465.40	27,788.67	29,178.11	30,637.01	32,168.86	33,777.30	35,466.17	37,239.48	39,101.45
428.04	449.44	471.91	495.51	520.28	546.30	573.61	602.29	632.41	664.03	697.23	732.09	768.70	807.13	847.49	889.86	934.36
1,459.52	1,532.50	1,609.12	1,689.58	1,774.06	1,862.76	1,955.90	2,053.69	2,156.38	2,264.20	2,377.41	2,496.28	2,621.09	2,752.15	2,889.75	3,034.24	3,185.95
0.23	0.24	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.36	0.37	0.39	0.41	0.43	0.45	0.48	0.50

13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13

527,016	527,952	528,890	529,830	530,771	531,714	532,658	533,604	534,552	535,502	536,453	537,406	538,360	539,317	540,275	541,234	542,196
360,872	361,513	362,155	362,798	363,443	364,088	364,735	365,383	366,032	366,682	367,333	367,986	368,640	369,294	369,950	370,608	371,266
363,688	364,334	364,981	365,629	366,279	366,929	367,581	368,234	368,888	369,543	370,200	370,857	371,516	372,176	372,837	373,500	374,163

2,085,507	*2,189,783*	*2,299,272*	*2,414,236*	*2,534,947*	*2,661,695*	*2,794,779*	*2,934,518*	*3,081,244*	*3,235,307*	*3,397,072*	*3,566,926*	*3,745,272*	*3,932,535*	*4,129,162*	*4,335,620*	*4,552,401*
2,085,507	**2,189,783**	**2,299,272**	**2,414,236**	**2,534,947**	**2,661,695**	**2,794,779**	**2,934,518**	**3,081,244**	**3,235,307**	**3,397,072**	**3,566,926**	**3,745,272**	**3,932,535**	**4,129,162**	**4,335,620**	**4,552,401**

120,793	127,058	133,648	140,580	147,871	155,540	163,607	172,093	181,018	190,407	200,282	210,670	221,596	233,090	245,179	257,895	271,271
82,712	87,002	91,515	96,261	101,254	106,505	112,029	117,840	123,951	130,380	137,142	144,255	151,737	159,607	167,885	176,592	185,751
83,358	87,681	92,229	97,012	102,044	107,336	112,903	118,759	124,919	131,398	138,212	145,381	152,921	160,852	169,195	177,970	187,201
318,632	335,158	352,541	370,826	390,058	410,289	431,569	453,952	477,496	502,262	528,311	555,712	584,535	614,851	646,741	680,284	715,567
147	155	163	171	180	189	199	209	220	232	244	256	270	284	298	314	330
5,484	5,769	6,068	6,383	6,714	7,062	7,428	7,814	8,219	8,645	9,093	9,565	10,061	10,583	11,132	11,709	12,317
18,701	19,671	20,691	21,764	22,893	24,080	25,329	26,643	28,024	29,478	31,007	32,615	34,307	36,086	37,957	39,926	41,997
1,405,466	1,475,739	1,549,526	1,627,002	1,708,352	1,793,770	1,883,458	1,977,631	2,076,513	2,180,338	2,289,355	2,403,823	2,524,014	2,650,215	2,782,726	2,921,862	3,067,955
2,035,293	**2,138,233**	**2,246,380**	**2,359,998**	**2,479,366**	**2,604,772**	**2,736,523**	**2,874,940**	**3,020,361**	**3,173,139**	**3,333,648**	**3,502,278**	**3,679,441**	**3,865,568**	**4,061,113**	**4,266,553**	**4,482,389**

1,597,382	1,600,219	1,603,062	1,605,909	1,608,762	1,611,620	1,614,482	1,617,350	1,620,223	1,623,101	1,625,984	1,628,873	1,631,766	1,634,664	1,637,568	1,640,477	1,643,391
45,971	46,053	46,135	46,217	46,299	46,381	46,464	46,546	46,629	46,712	46,795	46,878	46,961	47,044	47,128	47,212	47,295
202,260	202,619	202,979	203,340	203,701	204,063	204,425	204,788	205,152	205,517	205,882	206,247	206,614	206,981	207,348	207,717	208,086
1,129,713	1,131,720	1,133,730	1,135,744	1,137,761	1,139,782	1,141,807	1,143,835	1,145,867	1,147,902	1,149,941	1,151,984	1,154,030	1,156,080	1,158,134	1,160,191	1,162,252

2,085,507	*2,189,783*	*2,299,272*	*2,414,236*	*2,534,947*	*2,661,695*	*2,794,779*	*2,934,518*	*3,081,244*	*3,235,307*	*3,397,072*	*3,566,926*	*3,745,272*	*3,932,535*	*4,129,162*	*4,335,620*	*4,552,401*
2,085,507	**2,189,783**	**2,299,272**	**2,414,236**	**2,534,947**	**2,661,695**	**2,794,779**	**2,934,518**	**3,081,244**	**3,235,307**	**3,397,072**	**3,566,926**	**3,745,272**	**3,932,535**	**4,129,162**	**4,335,620**	**4,552,401**

366,123	385,112	405,086	426,096	448,195	471,441	495,892	521,612	548,665	577,122	607,054	638,539	671,657	706,493	743,135	781,678	822,219
10,537	11,083	11,658	12,263	12,899	13,568	14,271	15,012	15,790	16,609	17,471	18,377	19,330	20,332	21,387	22,496	23,663
46,358	48,763	51,292	53,952	56,750	59,694	62,790	66,046	69,472	73,075	76,865	80,852	85,045	89,456	94,095	98,976	104,109
258,932	272,362	286,488	301,347	316,976	333,416	350,709	368,898	388,031	408,156	429,326	451,593	475,015	499,651	525,566	552,824	581,497
323,250	340,015	357,650	376,200	395,711	416,235	437,823	460,531	484,416	509,541	535,968	563,766	593,006	623,762	656,114	690,143	725,938
9,272	9,753	10,259	10,791	11,350	11,939	12,558	13,210	13,895	14,615	15,373	16,171	17,010	17,892	18,820	19,796	20,822
229,514	241,418	253,939	267,110	280,964	295,536	310,864	326,987	343,946	361,785	380,549	400,286	421,047	442,885	465,855	490,016	515,431
1,204,685	1,264,919	1,328,165	1,394,573	1,464,302	1,537,517	1,614,393	1,695,113	1,779,868	1,868,862	1,962,305	2,060,420	2,163,441	2,271,613	2,385,194	2,504,453	2,629,676
2,448,671	**2,573,425**	**2,704,537**	**2,842,331**	**2,987,147**	**3,139,345**	**3,299,300**	**3,467,408**	**3,644,084**	**3,829,765**	**4,024,910**	**4,230,003**	**4,445,550**	**4,672,083**	**4,910,165**	**5,160,382**	**5,423,355**

Discounted Life Cycle Costs

	Constant	Unit										
Calendar Year			**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Analysis Year			**0**	**0**	**0**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Discount Factor			**1**	**0.952380952**	**0.907029478**	**0.863837599**	**0.822702475**	**0.783526166**	**0.746215397**	**0.71068133**	**0.676839362**	**0.644608916**
Active Scenario	**Scenario 0**											
DESIGN CONCEPT 1: AGS with TMF												
CAPITAL COSTS												
Capital Cost		Nominal $	-	-	-	-	*24,477,500*	*23,311,905*	*22,201,814*	*21,144,585*	-	-
Capital Asset Replacement		Nominal $	-	-	-	-	-	-	-	-	*909,900*	*909,900*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**24,477,500**	**23,311,905**	**22,201,814**	**21,144,585**	**909,900**	**909,900**
GENERAL OPERATING EXPENSES - WASTEWATER												
Energy (Aeration) Cost		Nominal $	-	-	-	-	-	-	-	-	*51,867*	*51,959*
Energy (Buffer) Cost		Nominal $	-	-	-	-	-	-	-	-	*35,515*	*35,578*
Energy (Membrane) Cost		Nominal $	-	-	-	-	-	-	-	-	*35,792*	*35,856*
Ferric Sulphate Cost		Nominal $	-	-	-	-	-	-	-	-	*136,815*	*137,058*
Sodium Hypochlorite Cost		Nominal $	-	-	-	-	-	-	-	-	*63*	*63*
Sodium Hydroxide Cost		Nominal $	-	-	-	-	-	-	-	-	*2,355*	*2,359*
Sulphuric Acid Cost		Nominal $	-	-	-	-	-	-	-	-	*8,030*	*8,044*
Labour Cost		Nominal $	-	-	-	-	-	-	-	-	*613,200*	*613,200*
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**883,637**	**884,118**
DESIGN CONCEPT 2: MBR												
CAPITAL COSTS												
Capital Cost		Nominal $	-	-	-	-	*18,410,000*	*17,533,333*	*16,698,413*	*15,903,250*	-	-
Capital Asset Replacement		Nominal $	-	-	-	-	-	-	-	-	*909,900*	*909,900*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**18,410,000**	**17,533,333**	**16,698,413**	**15,903,250**	**909,900**	**909,900**
GENERAL OPERATING EXPENSES - WASTEWATER												
Energy (Aeration) Cost		Nominal $	-	-	-	-	-	-	-	-	*157,207*	*157,486*
Energy (Mixing) Cost		Nominal $	-	-	-	-	-	-	-	-	*4,524*	*4,532*
Energy (Recirculation) Cost		Nominal $	-	-	-	-	-	-	-	-	*19,905*	*19,941*
Energy (Membrane) Cost		Nominal $	-	-	-	-	-	-	-	-	*111,181*	*111,379*
Ferric Sulphate Cost		Nominal $	-	-	-	-	-	-	-	-	*138,798*	*139,045*
Sodium Hypochlorite Cost		Nominal $	-	-	-	-	-	-	-	-	*3,981*	*3,988*
Citric Acid Cost		Nominal $	-	-	-	-	-	-	-	-	*98,550*	*98,725*
Labour Cost		Nominal $	-	-	-	-	-	-	-	-	*525,600*	*525,600*
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1,059,747**	**1,060,696**

2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0.613913254	0.584679289	0.556837418	0.530321351	0.505067953	0.481017098	0.458111522	0.436296688	0.415520655	0.395733957	0.376889483	0.358942365	0.341849871	0.325571306	0.31006791	0.295302772	0.281240735
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
909,900	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*
909,900	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**
52,051	*52,143*	*52,236*	*52,329*	*52,422*	*52,515*	*52,608*	*52,702*	*52,795*	*52,889*	*52,983*	*53,077*	*53,171*	*53,266*	*53,360*	*53,455*	*53,550*
35,642	*35,705*	*35,768*	*35,832*	*35,896*	*35,959*	*36,023*	*36,087*	*36,151*	*36,215*	*36,280*	*36,344*	*36,409*	*36,473*	*36,538*	*36,603*	*36,668*
35,920	*35,984*	*36,047*	*36,112*	*36,176*	*36,240*	*36,304*	*36,369*	*36,433*	*36,498*	*36,563*	*36,628*	*36,693*	*36,758*	*36,823*	*36,889*	*36,954*
137,302	*137,546*	*137,790*	*138,035*	*138,280*	*138,526*	*138,772*	*139,018*	*139,265*	*139,512*	*139,760*	*140,009*	*140,257*	*140,506*	*140,756*	*141,006*	*141,256*
63	*63*	*64*	*64*	*64*	*64*	*64*	*64*	*64*	*64*	*64*	*65*	*65*	*65*	*65*	*65*	*65*
2,363	*2,367*	*2,372*	*2,376*	*2,380*	*2,384*	*2,389*	*2,393*	*2,397*	*2,401*	*2,406*	*2,410*	*2,414*	*2,418*	*2,423*	*2,427*	*2,431*
8,058	*8,073*	*8,087*	*8,101*	*8,116*	*8,130*	*8,145*	*8,159*	*8,174*	*8,188*	*8,203*	*8,217*	*8,232*	*8,246*	*8,261*	*8,276*	*8,290*
613,200	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*
884,599	**885,081**	**885,564**	**886,048**	**886,532**	**887,018**	**887,504**	**887,992**	**888,480**	**888,969**	**889,459**	**889,949**	**890,441**	**890,933**	**891,427**	**891,921**	**892,416**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
909,900	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*
909,900	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**
157,766	*158,046*	*158,327*	*158,608*	*158,890*	*159,172*	*159,455*	*159,738*	*160,022*	*160,306*	*160,591*	*160,876*	*161,162*	*161,448*	*161,735*	*162,022*	*162,310*
4,540	*4,548*	*4,557*	*4,565*	*4,573*	*4,581*	*4,589*	*4,597*	*4,605*	*4,613*	*4,622*	*4,630*	*4,638*	*4,646*	*4,655*	*4,663*	*4,671*
19,976	*20,012*	*20,047*	*20,083*	*20,119*	*20,154*	*20,190*	*20,226*	*20,262*	*20,298*	*20,334*	*20,370*	*20,406*	*20,443*	*20,479*	*20,515*	*20,552*
111,577	*111,775*	*111,973*	*112,172*	*112,371*	*112,571*	*112,771*	*112,971*	*113,172*	*113,373*	*113,574*	*113,776*	*113,978*	*114,181*	*114,384*	*114,587*	*114,790*
139,292	*139,539*	*139,787*	*140,035*	*140,284*	*140,533*	*140,783*	*141,033*	*141,283*	*141,534*	*141,786*	*142,038*	*142,290*	*142,543*	*142,796*	*143,050*	*143,304*
3,995	*4,002*	*4,010*	*4,017*	*4,024*	*4,031*	*4,038*	*4,045*	*4,053*	*4,060*	*4,067*	*4,074*	*4,081*	*4,089*	*4,096*	*4,103*	*4,110*
98,900	*99,076*	*99,252*	*99,428*	*99,605*	*99,782*	*99,959*	*100,136*	*100,314*	*100,492*	*100,671*	*100,850*	*101,029*	*101,208*	*101,388*	*101,568*	*101,749*
525,600	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*
1,061,646	**1,062,598**	**1,063,552**	**1,064,508**	**1,065,465**	**1,066,424**	**1,067,385**	**1,068,347**	**1,069,311**	**1,070,277**	**1,071,245**	**1,072,214**	**1,073,185**	**1,074,157**	**1,075,132**	**1,076,108**	**1,077,086**

2050	2051	2052	2053	2054	2055	2056
24	25	26	27	28	29	30
0.267848319	0.255093637	0.242946321	0.231377449	0.220359475	0.209866167	0.19987254

-	-	-	-	-	-	-
909,900	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*
909,900	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**

53,645	*53,741*	*53,836*	*53,932*	*54,027*	*54,123*	*54,220*
36,733	*36,799*	*36,864*	*36,929*	*36,995*	*37,061*	*37,127*
37,020	*37,086*	*37,152*	*37,218*	*37,284*	*37,350*	*37,416*
141,507	*141,759*	*142,011*	*142,263*	*142,515*	*142,769*	*143,022*
65	*65*	*66*	*66*	*66*	*66*	*66*
2,436	*2,440*	*2,444*	*2,449*	*2,453*	*2,457*	*2,462*
8,305	*8,320*	*8,335*	*8,349*	*8,364*	*8,379*	*8,394*
613,200	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*	*613,200*
892,912	**893,409**	**893,907**	**894,405**	**894,905**	**895,405**	**895,906**

-	-	-	-	-	-	-
909,900	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*	*909,900*
909,900	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**	**909,900**

162,598	*162,887*	*163,177*	*163,466*	*163,757*	*164,048*	*164,339*
4,679	*4,688*	*4,696*	*4,704*	*4,713*	*4,721*	*4,730*
20,588	*20,625*	*20,661*	*20,698*	*20,735*	*20,772*	*20,809*
114,994	*115,198*	*115,403*	*115,608*	*115,813*	*116,019*	*116,225*
143,558	*143,813*	*144,069*	*144,325*	*144,581*	*144,838*	*145,095*
4,118	*4,125*	*4,132*	*4,140*	*4,147*	*4,154*	*4,162*
101,929	*102,110*	*102,292*	*102,473*	*102,656*	*102,838*	*103,021*
525,600	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*	*525,600*
1,078,065	**1,079,047**	**1,080,030**	**1,081,015**	**1,082,001**	**1,082,990**	**1,083,980**

Project Title:	**Facility Upgrade Plan for Dundas WWTP**		
Client:	City of Hamilton		
Project No.:	T001744A		
Task:	Opinion of Probable Cost		
Prepared By:	Maria Bovtenko	**Date:**	11-Jul-23

Disinfection Technology 1 - Chlorine Contact Tank

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
Chlorine Contact Tank	1	L.S.	$1,209,000	1	$1,209,000	Estimate of chlorine contact tank and associated equipment.
Subtotal Capital Cost (2023$)					**$1,209,000**	
Engineering (15%)			15%		$180,000	
Contingency & Estimating Allowance (30%)			30%		$360,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$180,000	
Total Project Capital Cost (2023$ - Excluding HST)					**$1,929,000**	

Annual Operation & Maintenance Cost

Description	Annual Cost	Comments
Energy	-	Negligible compared to UV
Chemical Consumption	$62,000	Assumed $0.22/L sodium hypochlorite and $0.28/kg sodium bisulphite based on unit costs from reference facilities. Sodium hypochlorite dosage of 6 mg/L and sodium bisulphite of 0.5 mg/L.
Equipment Maintenance/Replacement	$10,000	Assumed 3% of dosing equipment cost.
Labor	$22,000	$60/hr; 1 hr/d; 1 operators
Total Annual O&M Cost	**$94,000**	

Project Title:	**Facility Upgrade Plan for Dundas WWTP**
Client:	City of Hamilton
Project No.:	T001744A
Task:	Opinion of Probable Cost
Prepared By:	Maria Bovtenko

Date: 11-Jul-23

Disinfection Technology 2 - UV

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
UV Disinfection Facility	1	L.S.	$1,986,000	1	$1,986,000	Estimate of UV channels, lamps, and associated equipment.
Subtotal Capital Cost (2023$)					**$1,986,000**	
Engineering (15%)			15%		$300,000	
Contingency & Estimating Allowance (30%)			30%		$600,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$300,000	
Total Project Capital Cost (2023$ - Excluding HST)					**$3,186,000**	

Annual Operation & Maintenance Cost

Description	Annual Cost	Comments
Energy	$10,000	$0.10/kWh (Weighted average of electricity costs from Ontario Energy Board). Power requirements from Trojan.
Chemical Consumption	-	
Equipment Maintenance/Replacement	$11,000	Annual replacement cost provided by vendor.
Labor	$22,000	$60/hr; 1 hrs/d; 1 operator
Total Annual O&M Cost	**$43,000**	

Nominal Life Cycle Costs

	Constant	Unit										
Calendar Year			**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Analysis Year			**0**	**0**	**0**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Active Scenario	**Scenario 0**											
O&M and Capital Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Hydro Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Chemical Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Natural Gas Cost Growth Rate	5.0%	percent	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Dundas Flow Increases	0.2%	percent	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Sodium Hypochlorite Unit Cost	3,446.35	$/ML	3,446.35	3,618.67	3,799.60	3,989.58	4,189.06	4,398.52	4,618.44	4,849.36	5,091.83	5,346.42
Sodium Bisulphite Unit Cost	51.10	$/ML	51.10	53.66	56.34	59.15	62.11	65.22	68.48	71.90	75.50	79.27
Hydro Unit Cost	0.10	$/kWh	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.15	0.16
FLOW PROJECTIONS (INCREASE)												
Average daily flows		MLD	12	12	12	12	13	13	13	13	13	13
TECHNOLOGY 1: CHLORINATION AND DECHLORINATION												
WASTEWATER OPERATIONS (INCREASE)												
CAPITAL COSTS												
Capital Cost		Nominal $					*586,178*	*586,178*	*586,178*	*586,178*		
Capital Asset Replacement		Nominal $									*14,775*	*15,513*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**586,178**	**586,178**	**586,178**	**586,178**	**14,775**	**15,513**
GENERAL OPERATING EXPENSES - WASTEWATER												
Sodium Hypochlorite Cost		Nominal $									64,207	67,537
Sodium Bisulphite Cost		Nominal $									952	1,001
Labour Cost		Nominal $									32,504	34,129
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**97,663**	**102,668**
TECHNOLOGY 2: UV DISINFECTION												
WASTEWATER OPERATIONS (INCREASE)												
Average power requirements from new facility		kWh/year									67,366	67,485
CAPITAL COSTS												
Capital Cost		Nominal $					*968,151*	*968,151*	*968,151*	*968,151*		
Capital Asset Replacement		Nominal $									*16,252*	*17,065*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**968,151**	**968,151**	**968,151**	**968,151**	**16,252**	**17,065**
GENERAL OPERATING EXPENSES - WASTEWATER												
Energy Cost		Nominal $									9,953	10,469
Labour Cost		Nominal $									32,504	34,129
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**42,457**	**44,598**

2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
5,613.74	5,894.43	6,189.15	6,498.61	6,823.54	7,164.72	7,522.95	7,899.10	8,294.06	8,708.76	9,144.20	9,601.41	10,081.48	10,585.55	11,114.83	11,670.57	12,254.10
83.24	87.40	91.77	96.36	101.17	106.23	111.54	117.12	122.98	129.13	135.58	142.36	149.48	156.95	164.80	173.04	181.69
0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.36
13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
16,289	*17,103*	*17,959*	*18,856*	*19,799*	*20,789*	*21,829*	*22,920*	*24,066*	*25,270*	*26,533*	*27,860*	*29,253*	*30,715*	*32,251*	*33,864*	*35,557*
16,289	**17,103**	**17,959**	**18,856**	**19,799**	**20,789**	**21,829**	**22,920**	**24,066**	**25,270**	**26,533**	**27,860**	**29,253**	**30,715**	**32,251**	**33,864**	**35,557**
71,040	74,724	78,600	82,677	86,965	91,475	96,220	101,210	106,459	111,981	117,789	123,898	130,324	137,083	144,193	151,671	159,538
1,053	1,108	1,165	1,226	1,289	1,356	1,427	1,501	1,579	1,660	1,746	1,837	1,932	2,033	2,138	2,249	2,366
35,836	37,627	39,509	41,484	43,558	45,736	48,023	50,424	52,946	55,593	58,373	61,291	64,356	67,574	70,952	74,500	78,225
107,929	**113,460**	**119,274**	**125,387**	**131,813**	**138,568**	**145,669**	**153,135**	**160,983**	**169,234**	**177,908**	**187,026**	**196,612**	**206,689**	**217,283**	**228,420**	**240,128**
67,605	67,725	67,845	67,966	68,087	68,208	68,329	68,450	68,572	68,694	68,816	68,938	69,060	69,183	69,306	69,429	69,552
17,918	*18,814*	*19,754*	*20,742*	*21,779*	*22,868*	*24,012*	*25,212*	*26,473*	*27,796*	*29,186*	*30,646*	*32,178*	*33,787*	*35,476*	*37,250*	*39,112*
17,918	**18,814**	**19,754**	**20,742**	**21,779**	**22,868**	**24,012**	**25,212**	**26,473**	**27,796**	**29,186**	**30,646**	**32,178**	**33,787**	**35,476**	**37,250**	**39,112**
11,012	11,583	12,184	12,816	13,481	14,180	14,915	15,689	16,503	17,359	18,259	19,206	20,202	21,250	22,352	23,511	24,731
35,836	37,627	39,509	41,484	43,558	45,736	48,023	50,424	52,946	55,593	58,373	61,291	64,356	67,574	70,952	74,500	78,225
46,848	**49,211**	**51,693**	**54,300**	**57,039**	**59,916**	**62,939**	**66,113**	**69,448**	**72,951**	**76,631**	**80,497**	**84,558**	**88,823**	**93,304**	**98,011**	**102,955**

2050	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**
24	**25**	**26**	**27**	**28**	**29**	**30**
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
12,866.80	13,510.14	14,185.65	14,894.93	15,639.68	16,421.67	17,242.75
190.78	200.32	210.33	220.85	231.89	243.49	255.66
0.37	0.39	0.41	0.43	0.45	0.48	0.50
13	13	13	13	13	13	13
37,335	*39,201*	*41,161*	*43,219*	*45,380*	*47,649*	*50,032*
37,335	**39,201**	**41,161**	**43,219**	**45,380**	**47,649**	**50,032**
167,812	176,516	185,671	195,301	205,430	216,085	227,292
2,488	2,617	2,753	2,896	3,046	3,204	3,370
82,136	86,243	90,555	95,083	99,837	104,829	110,070
252,437	**265,376**	**278,979**	**293,279**	**308,313**	**324,117**	**340,732**
69,676	69,800	69,924	70,048	70,172	70,297	70,422
41,068	*43,121*	*45,277*	*47,541*	*49,918*	*52,414*	*55,035*
41,068	**43,121**	**45,277**	**47,541**	**49,918**	**52,414**	**55,035**
26,013	27,362	28,781	30,274	31,844	33,496	35,233
82,136	86,243	90,555	95,083	99,837	104,829	110,070
108,149	**113,605**	**119,336**	**125,357**	**131,681**	**138,325**	**145,303**

Discounted Life Cycle Costs

Calendar Year			**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Analysis Year			**0**	**0**	**0**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Discount Factor			**1**	**0.952380952**	**0.907029478**	**0.863837599**	**0.822702475**	**0.783526166**	**0.746215397**	**0.71068133**	**0.676839362**	**0.644608916**
Active Scenario	**Scenario 0**											
	Constant	Unit										
TECHNOLOGY 1: CHLORINATION AND DECHLORINATION												
CAPITAL COSTS												
Capital Cost		Nominal $	-	-	-	-	*482,250*	*459,286*	*437,415*	*416,586*	-	-
Capital Asset Replacement		Nominal $	-	-	-	-	-	-	-	-	*10,000*	*10,000*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**482,250**	**459,286**	**437,415**	**416,586**	**10,000**	**10,000**
GENERAL OPERATING EXPENSES - WASTEWATER												
Sodium Hypochlorite Cost		Nominal $	-	-	-	-	-	-	-	-	*43,458*	*43,535*
Sodium Bisulphite Cost		Nominal $	-	-	-	-	-	-	-	-	*644*	*646*
Labour Cost		Nominal $	-	-	-	-	-	-	-	-	*22,000*	*22,000*
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**66,102**	**66,181**
TECHNOLOGY 2: UV DISINFECTION												
CAPITAL COSTS												
Capital Cost		Nominal $	-	-	-	-	*796,500*	*758,571*	*722,449*	*688,047*	-	-
Capital Asset Replacement		Nominal $	-	-	-	-	-	-	-	-	*11,000*	*11,000*
Total Capital Costs		**Nominal $**	**-**	**-**	**-**	**-**	**796,500**	**758,571**	**722,449**	**688,047**	**11,000**	**11,000**
GENERAL OPERATING EXPENSES - WASTEWATER												
Energy Cost		Nominal $	-	-	-	-	-	-	-	-	*6,737*	*6,749*
Labour Cost		Nominal $	-	-	-	-	-	-	-	-	*22,000*	*22,000*
Total General Expenses - Wastewater		**Nominal $**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**28,737**	**28,749**

2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0.613913254	0.584679289	0.556837418	0.530321351	0.505067953	0.481017098	0.458111522	0.436296688	0.415520655	0.395733957	0.376889483	0.358942365	0.341849871	0.325571306	0.31006791	0.295302772	0.281240735
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10,000	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*
10,000	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
43,612	*43,690*	*43,767*	*43,845*	*43,923*	*44,001*	*44,079*	*44,158*	*44,236*	*44,315*	*44,393*	*44,472*	*44,551*	*44,630*	*44,710*	*44,789*	*44,869*
647	*648*	*649*	*650*	*651*	*652*	*654*	*655*	*656*	*657*	*658*	*659*	*661*	*662*	*663*	*664*	*665*
22,000	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*
66,259	**66,338**	**66,416**	**66,495**	**66,574**	**66,654**	**66,733**	**66,812**	**66,892**	**66,972**	**67,052**	**67,132**	**67,212**	**67,292**	**67,372**	**67,453**	**67,534**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11,000	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*
11,000	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**
6,761	*6,773*	*6,785*	*6,797*	*6,809*	*6,821*	*6,833*	*6,845*	*6,857*	*6,869*	*6,882*	*6,894*	*6,906*	*6,918*	*6,931*	*6,943*	*6,955*
22,000	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*
28,761	**28,773**	**28,785**	**28,797**	**28,809**	**28,821**	**28,833**	**28,845**	**28,857**	**28,869**	**28,882**	**28,894**	**28,906**	**28,918**	**28,931**	**28,943**	**28,955**

2050	2051	2052	2053	2054	2055	2056
24	25	26	27	28	29	30
0.267848319	0.255093637	0.242946321	0.231377449	0.220359475	0.209866167	0.19987254
-	-	-	-	-	-	-
10,000	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*
10,000	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
44,948	*45,028*	*45,108*	*45,188*	*45,268*	*45,349*	*45,429*
666	*668*	*669*	*670*	*671*	*672*	*674*
22,000	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*
67,615	**67,696**	**67,777**	**67,858**	**67,940**	**68,021**	**68,103**
-	-	-	-	-	-	-
11,000	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*	*11,000*
11,000	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**	**11,000**
6,968	*6,980*	*6,992*	*7,005*	*7,017*	*7,030*	*7,042*
22,000	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*	*22,000*
28,968	**28,980**	**28,992**	**29,005**	**29,017**	**29,030**	**29,042**

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A5

Appendix A5: Evaluation of Alternative Site Layouts Technical Memorandum

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City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Evaluation of Alternative Site Layouts Technical Memorandum

Tuesday, August 6, 2024

T001744A

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Engineering for **people**

Hamilton

Evaluation of Alternative Site Layouts

Facility Upgrade Plan for Dundas WWTP

T001744A

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1 Introduction

CIMA+ was retained by the City of Hamilton to develop a long-term plan and conceptual design to implement upgrades to the Dundas Wastewater Treatment Plant (WWTP).

As part of this study, CIMA+ completed an evaluation of alternative treatment process technologies and design concepts. The preferred design concept to upgrade the Dundas WWTP is the Membrane Bioreactor Process with UV disinfection. This technical memorandum (TM) documents the evaluation of two alternative site layouts to implement the preferred design concept.

2 Preferred Design Concept

The proposed upgrades to the Dundas WWTP are based on achieving the design criteria documented in the *Design Basis TM* (CIMA+, 2022) and confirmed in the *Effluent Criteria TM* (CIMA+, 2023). Membrane filtration is required to meet the stringent total phosphorous effluent requirements.

The *Evaluation of Alternative Design Concepts TM* (CIMA+, 2023) recommended the MBR process and UV disinfection as the preferred treatment technologies for the Dundas WWTP.

The existing Dundas WWTP has capacity limitations and is reaching the end of its service life. Therefore, the preferred design concept involves constructing new process tanks, installing new equipment, and decommissioning the existing plant. Both site layout options considered in this TM are based on providing a rated capacity of 18,200 m^3/d while meeting the design criteria documented in the *Effluent Criteria TM* (CIMA+, 2023).

3 Evaluation Methodology and Criteria

The constraints and opportunities associated with constructing the new facilities either on the current site (Site Layout A) or to the east of the existing site (Site Layout B) were examined to select the preferred site layout.

The criteria used in the evaluation of the preferred site layout are presented in **Table 3-1** below. Each site layout was evaluated against each criterion using the rating scale shown in **Table 3-2** below. Each site layout requires a specific staging and implementation plan to allow construction while maintaining the existing plant in operation. The layout option selected also impacts when the existing Public Works facilities within the site would need to be relocated.

Table 3-1: Evaluation Criteria

Criteria	Description
Environmental Considerations	
Terrestrial Environment	The potential for this alternative to impact terrestrial habitats or systems including terrestrial features, unique vegetation species, mature trees, existing park/open spaces or wildlife.
Surface Water Quality and Source Water Protection	The potential for this alternative to impact surface water quality and protect source water.
Groundwater Quality and Quantity	The potential for this alternative to impact the quality and quantity of groundwater.
Social-Cultural Considerations	
Odour, Noise and Vibration	The potential for this alternative to produce odour, noise and/or vibration.
Visual Aesthetics	The potential for this alternative to impact the scenic attributes of the community and surrounding areas.
Disruption during Construction	The potential for this alternative to impact surrounding landowners and users including disruption to traffic, parking, noise and odour generation, and park/greenspace use.
Property Acquisition and Easement	The potential requirement to purchase additional land.
Recreational Use and Users	The potential for this alternative to impact surrounding recreational uses including both land and water uses.

Criteria	Description
Archaeology/Natural Heritage	The potential for this alternative to impact any archaeological sites and/or significant natural heritage areas.
Technical Considerations	
Ease of Implementation	The relative complexity of implementing this alternative.
Geotechnical and Hydrogeology	The extent of potential geotechnical challenges and impact to hydrogeology as related to the infrastructure during and post construction.
Permits and Approvals	Ease of receiving permits and approvals.
Economic Considerations	
Capital Cost	Capital cost estimates to provide a relative comparison of the alternatives. Capital costs are derived from costing benchmarks from reference upgrade projects.

Table 3-2: Evaluation Rating Scale

Impact Description	Impact Rating
Positive or no impact	9-10
Minor impact	7-8
Moderate impact	5-6
High impact	3-4
Severe impact	1-2

4 Alternative Site Layout

4.1 Site Layout A: Build within Existing Site

In Site Layout A, the upgrades would be situated within the existing site boundaries. To fit the new infrastructure within the existing site, the existing Plant A and Tertiary Filtration facility would need to be demolished to create space for the new process facilities. The blowers supplying air to Plant B are located in Plant A. Thus, they would need to be temporarily relocated to a new blower facility to service Plant B while the new facility is being constructed. The existing garage and yard works area would also need to be demolished to provide space for staging and material stockpiling during construction.

Plant B would eventually be decommissioned or potentially converted into a wet weather equalization/emergency storage facility.

The upgrades associated with this option would include the following:

- Relocation of existing Public Works Yard and stockpile areas
- Relocation of Plant B blowers to allow demolition of Plant A
- Demolition of Plant A
- Demolition of Tertiary Filtration Facility
- Modifications to the existing diversion chamber
- New Headworks Facility complete with screening and grit removal
- New Chemical Building
- New Odour Control Facility
- New Membrane Bioreactor (MBR) trains (including aeration tanks and membrane filtration system).
- New UV disinfection system
- New sludge handling facility and storage tanks
- New Center of Excellence and Control Building

The existing King Street SPS would be upgraded as part of a separate capital project. Raw influent would be conveyed to the new headworks. The screened and degritted influent would be conveyed to the new aeration tanks and membrane filters to be constructed in the location of the demolished existing Plant A. A new disinfection facility adjacent to the MBR facility would be constructed. The treated effluent would be discharged to the existing outfall. A new chemical building and odour control facility would be located close to the new headworks. A new Center of Excellence and Control

Building and a new sludge storage facility would be constructed in the area occupied by the Public Works yard.

Figure 4-1 shows a schematic site plan of the new buildings and tankage associated with this layout option.

Additional discussion on the staging for this option is provided below.

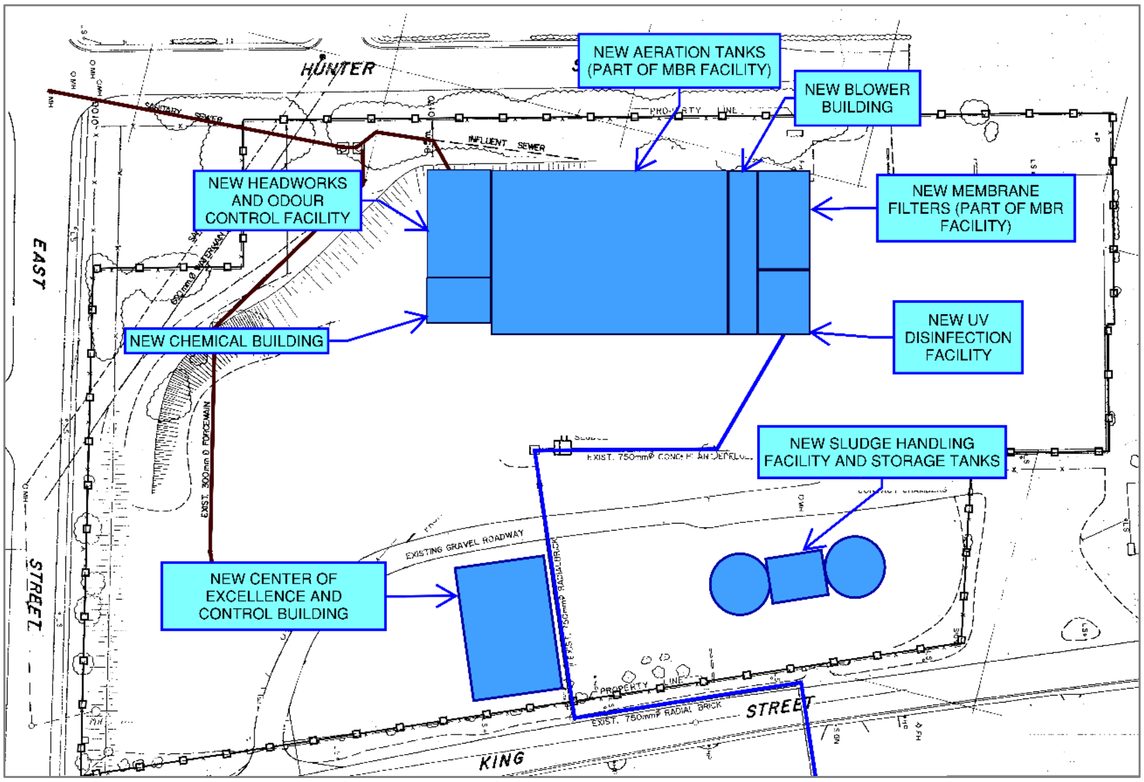

Figure 4-1: Site Layout A – Building within Existing Site

4.1.1 Implementation

Construction would be carried out as part several separate contracts. Conceptually, the project could be implemented as two main contracts.

Contract 1 would involve construction of the new sludge storage facility, relocation of the Plant B blowers, demolition/relocation of the Public Works facilities, and demolition of the existing sludge storage tanks.

Construction of the sludge storage and handling facility would be advanced due to the condition of the existing storage tanks. To create space for the sludge facilities, the existing storage garage and works yard area would need to be demolished. After the new sludge storage and handling facility is built, the existing tanks can be demolished.

The new MBR and disinfection facilities would be constructed in the area currently occupied by Plan A and the Tertiary Filtration Facility. Plant B would need to remain operational during construction so it would need to be rehabilitated prior to the decommissioning of the existing Plant A. Since the blowers supplying air to Plant B are within the Control Building in Plant A, a temporary blower facility and temporary air piping would need to be constructed to maintain aeration to Plant B during construction. Any other rehabilitation works required to ensure Plant B operates reliably during construction of the new facility would included as part of this Contract. **Figure 4-2** below shows the scope of Contract 1.

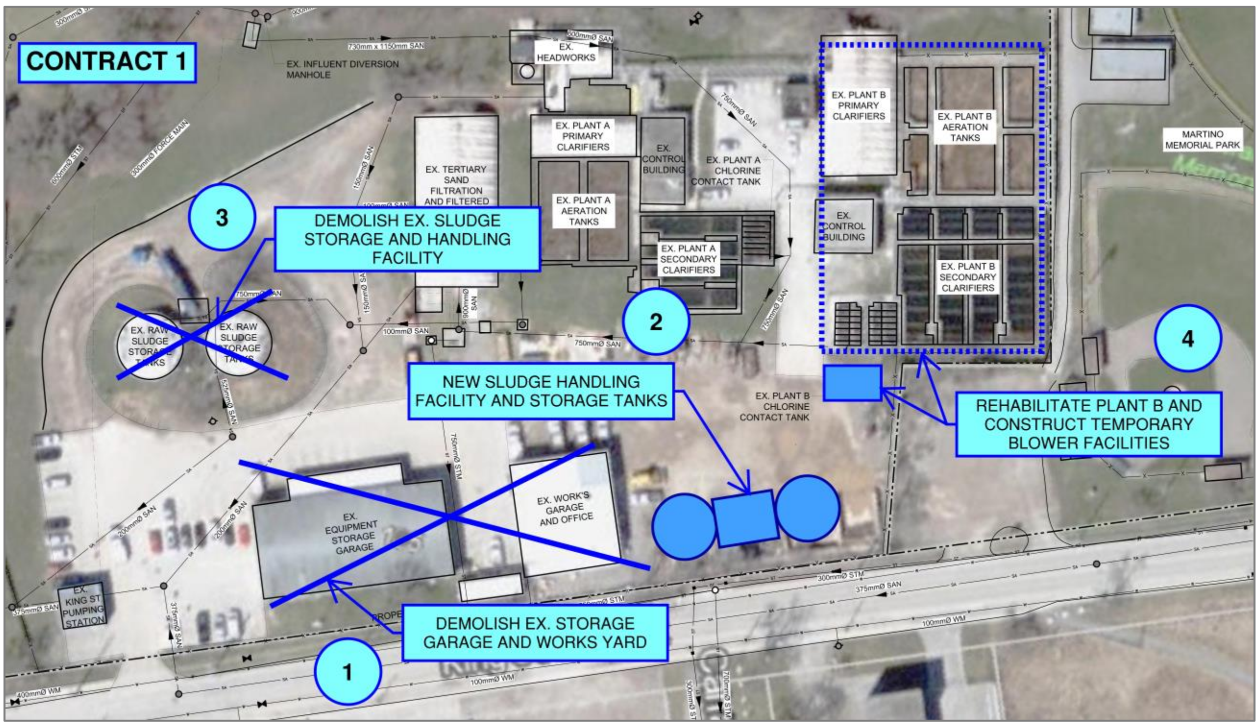

Figure 4-2: Site Layout A Implementation - Conceptual Contract 1

A second contract could be executed in three stages.

Contract 2A would involve construction of the new Headworks, Odour Control Facility, Chemical Building and Center of Excellence and Control Building would be constructed prior to the demolition of the existing headworks, chemical storage and Control Building. Following this, Plant A and the existing headworks would be demolished to make room for the new plant (see **Figure 4-3** below).

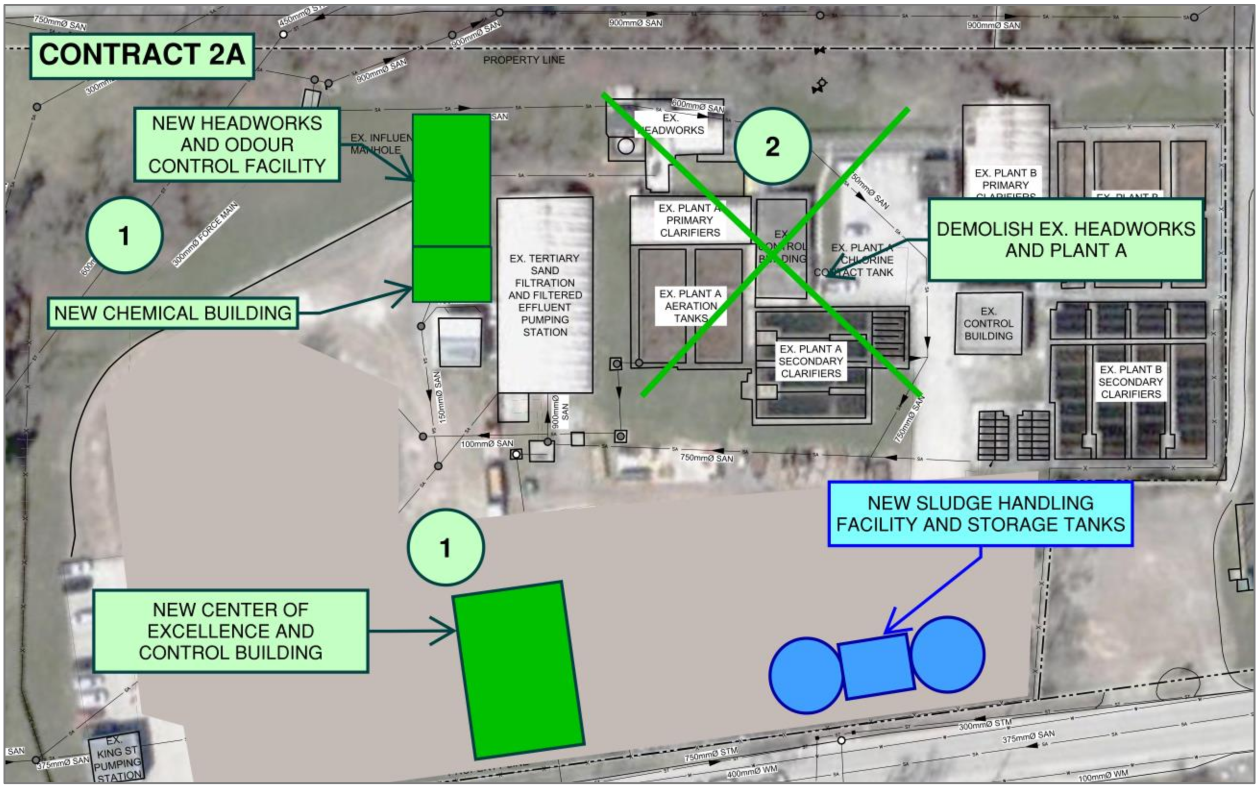

Figure 4-3: Site Layout A Implementation - Conceptual Contract 2A

Contract 2B would include construction of the new MBR facility. The new MBR facility would need to be staged into two parts to maintain tertiary filtration at the plant. The membrane filters, UV disinfection facility and Blower Building would be constructed first and commissioned. The flow from Plant B would be temporarily diverted through the new membrane and UV facility to allow the decommissioning of the existing tertiary sand filters to make room for the new aeration tanks (see **Figure 4-4** below).

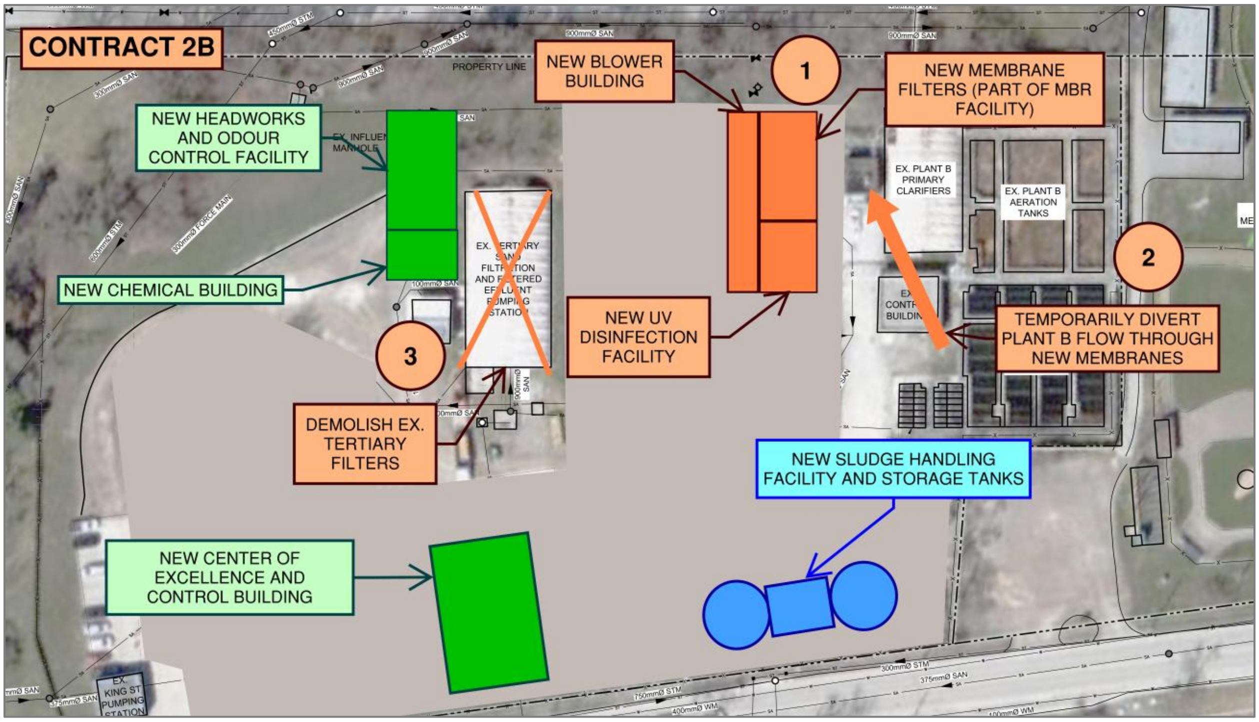

Figure 4-4: Site Layout A Implementation - Conceptual Contract 2B

Finally, as part of Contract 2C, the aeration tanks that make up part of the MBR facility would be constructed. Once the new plant is online, the existing Plant B would be decommissioned (see **Figure 4-5** below).

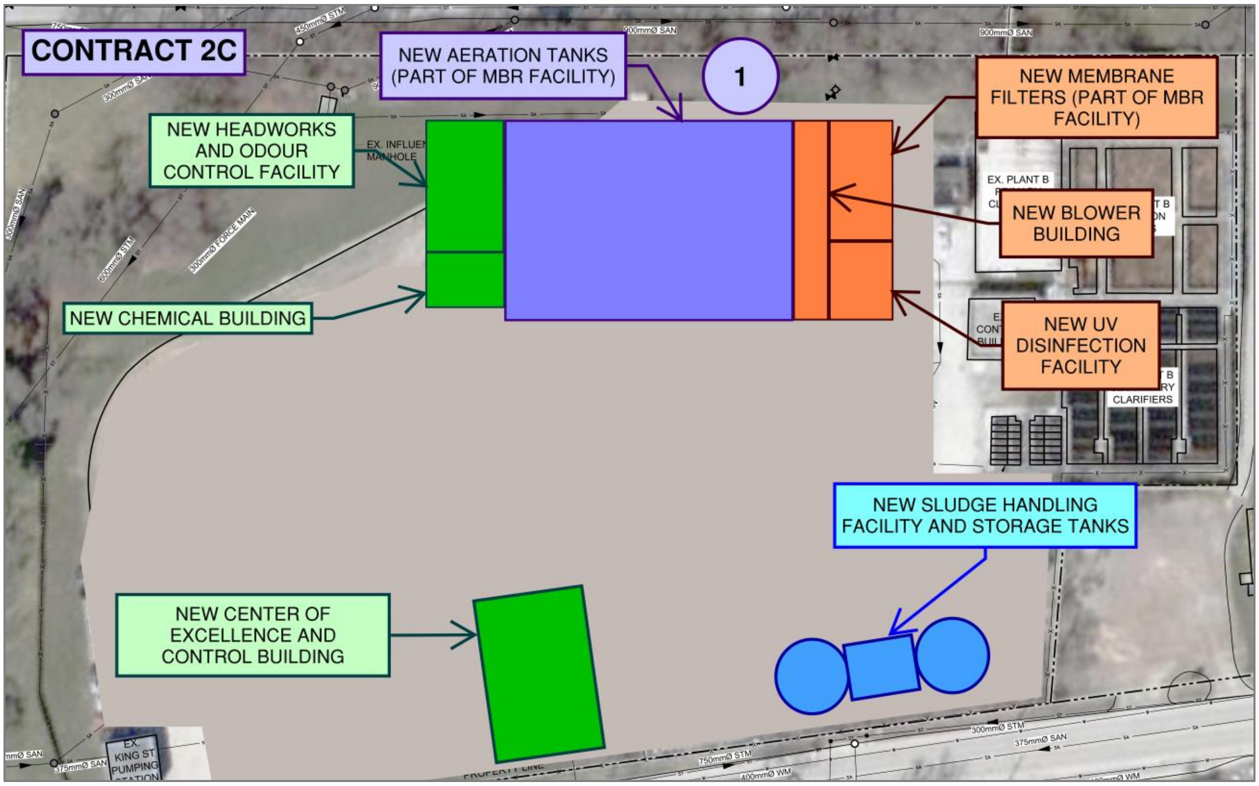

Figure 4-5: Site Layout A Implementation - Conceptual Contract 2C

4.2 Site Layout B: Build within Park East of Existing Site

In Site Layout B, the new process facilities would be constructed east of the existing plant site in the area currently occupied by baseball fields. The new treatment facilities would be constructed while the existing plant continues to operate. Once the new treatment facilities are commissioned and online, the existing King Street SPS, Plant A and Plant B can be decommissioned.

The upgrades associated with this option would include the following:

- New Sewage Pumping Station and forcemain
- Modifications to the influent conveyance piping and new diversion chamber
- New Headworks Facility complete with screening and grit removal
- New Chemical Building
- New Odour Control Facility
- New Membrane Bioreactor (MBR) trains (including aeration tanks and membrane filtration system)
- New UV disinfection system
- New sludge handling facility and storage tanks

- New Center of Excellence and Control Building

The screened and degritted influent would flow by gravity to the new MBR facility. Effluent from the MBR facility would be pumped to a new UV disinfection facility and then conveyed by gravity to the existing outfall.

A new Center of Excellence and Control Building, a new sludge handling and storage facility, a chemical building and odour control facility would also be constructed.

Following the construction of the new plant, the process facilities on the existing site would be decommissioned and the existing site may be repurposed. The existing site could potentially be repurposed to construct a new distribution yard and/or to accommodate future plant capacity expansions.

Figure 4-6 shows a schematic site plan of the new buildings and tankage associated with this layout option.

Additional discussion on the staging for this option is provided below.

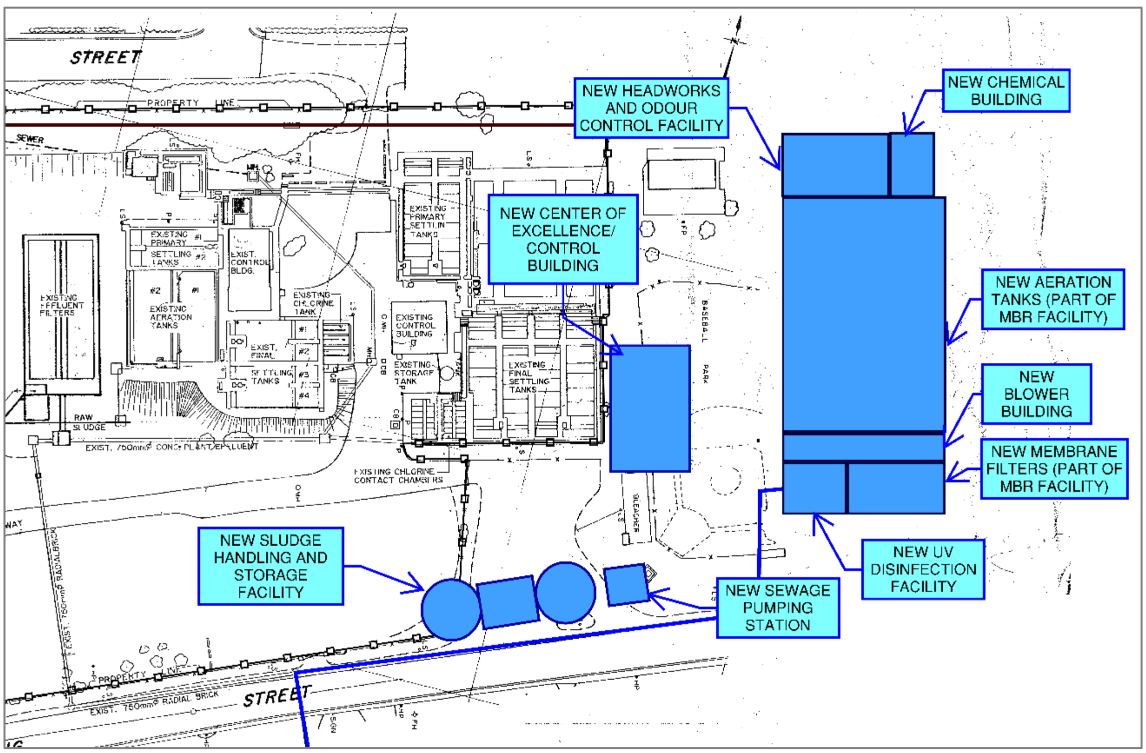

Figure 4-6: Site Layout B – Building within Park East of Existing Site

4.2.1 Implementation

The staging for Site Layout B would be more straightforward than for Site Layout A. First, to mitigate the impacts of relocating the baseball fields on the community, ideally new baseball diamonds would be constructed prior to decommissioning the existing park.

Plant A and Plant B would continue to operate while the new plant is being constructed. A contract to ensure both plants continue to operate reliably until the new plant is commissioned would be required.

As in the previous option, an initial contract would be completed to construct the new sludge storage and handling facility (see **Figure 4-7** below). The facilities and processes for the new plant can be built as part of a second contract without any complex sequencing (see **Figure 4-8** below). Once construction is complete and final tie-ins to the influent and effluent piping occur, the new plant can be brought online and the existing plant can be decommissioned.

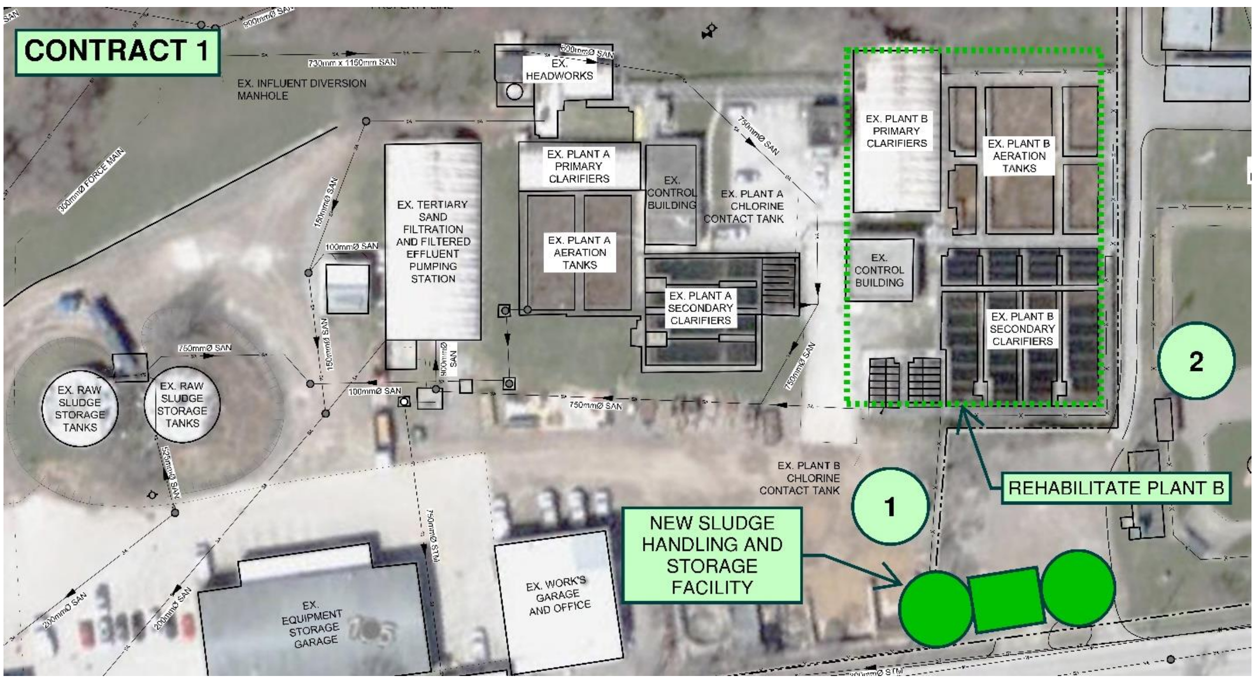

Figure 4-7: Site Layout B Implementation - Conceptual Contract 1

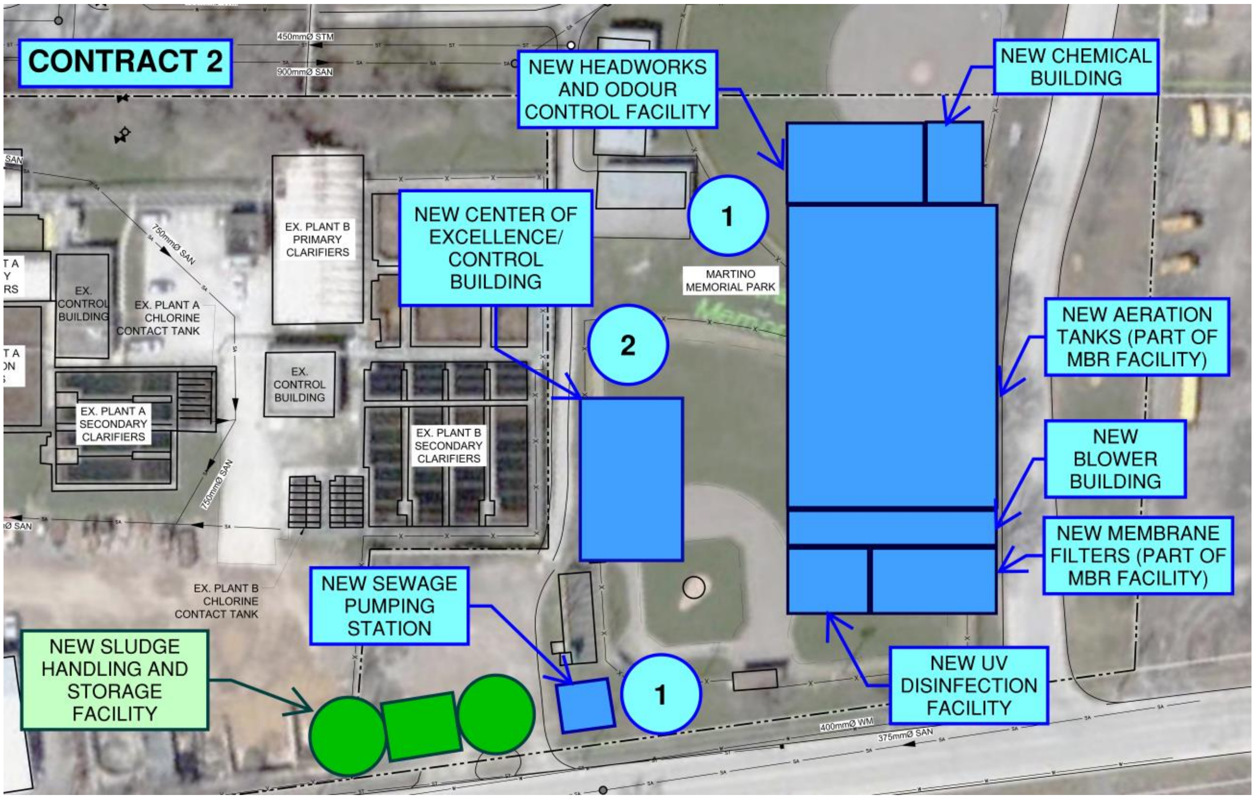

Figure 4-8: Site Layout B Implementation - Conceptual Contract 2

The facilities within the existing site can then be demolished and the existing site can be repurposed for a new Public Works Yard and future plant capacity expansions (see **Figure 4-9** below).

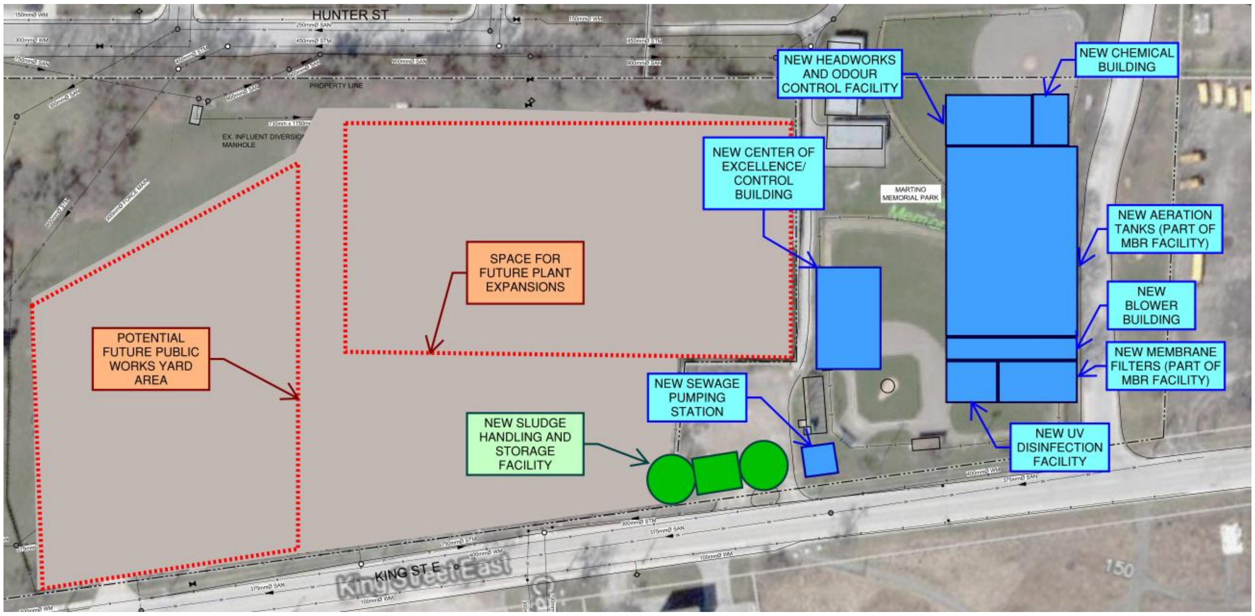

Figure 4-9: Site Layout B Implementation – Potential Future Contracts

4.3 Evaluation of Alternative Site Layouts

The following sections describe the results of the evaluation of the two site layouts with respect to the various criteria listed in **Table 3-1.** A summary of the evaluation is presented in **Section 4.3.5**.

4.3.1 Environmental Considerations

Most of the existing Dundas WWTP site has been previously disturbed. However, there are some trees concentrated along the north and west edges of the property and the northwest corner. The new buildings associated with Site Layout A would be located within the existing site boundary on lands that have been previously disturbed with minimal disturbance to the surrounding trees.

Site Layout B would be located on the property to the east of existing Plant B. This space has been mostly previously disturbed for the baseball fields, but there are small areas with trees through the middle of the area and around the north and east edges that would be impacted by the construction. The baseball fields would need to be relocated to a new property.

There are no open water sources located within or close to the existing site or the existing baseball fields that would be directly impacted by construction of the upgrades and the effluent does not discharge near any intake protection zones (IPZs). The effluent from Dundas WWTP is discharged to the West Pond of Cootes Paradise which is an environmentally sensitive marsh. Regardless of which site layout is selected, the proposed upgrades would be designed to meet stringent effluent criteria which are protective of the surface water quality of the receiver (CIMA+, 2023).

In terms of groundwater quantity and quality, the Dundas WWTP site is located approximately 1,800 m from Hamilton Harbour which flows into Lake Ontario, so it is expected that groundwater levels on site would be near or just above the water level of the lake. From boreholes completed on site in 1969, the groundwater level is shown from 1.4 to 2 m below the ground surface. Shoring during construction would likely be required. Shoring and dewatering plans would be developed during detailed design to protect groundwater resources.

Any upgrades to the Dundas WWTP would include controls to limit air emissions such that the plant would meet MECP requirements. Regardless of the site layout selected, the plant would be designed to include emission control and treatment to ensure air quality standards are met and impacts are mitigated.

4.3.2 Social-Cultural Considerations

The Dundas WWTP site is surrounded by residential areas to the north and west, the Royal Botanical Gardens to the south and east, and some commercial properties to the south. Due to proximity of the residential areas, there is some concern related to odour and noise emissions and visual aesthetics of the processes on site. The baseball diamond area is farther away from the residential areas. There is park space to the south across King Street East and northeast as well as a distribution yard to the north and bus lot to the east.

Regardless of which layout is selected, the new facilities would be designed to be aesthetically pleasing and tree screening and landscaping would be provided. The treatment processes would include odour control to meet air quality standards. Noise emission and vibrations during construction and operation would be mitigated to meet requirements of the nearest receptors. Odour and noise assessments would be completed during detailed design to confirm design details for odour and noise controls.

Site Layout A would have a longer construction duration because it requires staging, where Plant A and the tertiary filtration building would need to be demolished to provide space to construct the new treatment facility while Plant B remains operational. Construction associated with this layout would be closer to residential areas, resulting in greater short-term impact on the community due to both the extended duration of construction activities and the proximity of these activities to homes. Site Layout B would involve construction farther away from residential areas. Since construction would be done in a greenfield area, there would be less risk to existing plant operation and less staging would be required, reducing the overall project duration.

Site Layout B would impact existing recreational uses as the existing baseball fields would need to be relocated which may require property acquisition. The impacts of this relocation can be mitigated by constructing the new baseball fields prior to the decommissioning of the existing baseball diamonds.

The Desjardins Canal area south of the Dundas WWTP site is listed as a non-designated property being of cultural heritage value or interest in the City of Hamilton (City of Hamilton, 2022). However, the upgrades would have no impact on this property.

The upgrades in Site Layout A would be constructed within the existing site on previously disturbed land, so no archaeological potential is expected. Site Layout B would be constructed on land that has been previously disturbed for the existing baseball diamonds. The City is in the process of completing an Archaeological Screening Process to confirm.

4.3.3 Technical Considerations

For Site Layout A, there would be challenges with implementation due to space constraints within the existing site. The existing plant would need to remain in operation and maintain effluent quality while the new facilities are being constructed, thus demolition and construction would need to be sequenced accordingly. Plant A and the Tertiary Filtration Building would be demolished, and the new treatment train would be constructed in their place. Prior to demolishing Plant A, upgrades would be made to Plant B to maintain its operation while the new treatment train is being constructed. This includes providing temporary air piping and temporary blowers/relocation of existing blowers to maintain operations at Plant B since the blowers feeding both plants are in the control building for Plant A.

For Site Layout A, a portion of the influent flow may need to be temporarily diverted to Woodward Ave. WWTP to account for the loss of capacity resulting from Plant A being decommissioned. This would increase the risk of overflows in the Woodward Avenue WWTP catchment.

Construction of Site Layout B would be less challenging since the existing plant would remain online (without a temporary loss of capacity) during the construction of the new treatment train.

Site Layout A would require consultation with MECP and permitting to temporarily divert a portion of the flow to Woodward Ave. WWTP during construction. Both layout options would require demolition permits and ECA amendments.

Implementation of Site Layout B would give the City additional time and flexibility to determine the long-term plan for the Public Works Yard.

Neither layout would trigger the need for an Environmental Assessment (EA) under the amended Municipal Class EA process. The recent modifications to the Municipal Class EA process clarified and modified requirements for various types of projects, including sewage treatment facilities. According to the "Municipal Water and Wastewater Projects for Sewage Treatment Facilities" (MECP, 2023); projects involving the expansion, refurbishment, or upgrade of sewage treatment plants up to their existing rated capacity where no land acquisition is required are exempted from EA requirements. Since the land east of the existing site boundary is owned by the City, the construction of the new plant there would fall under this exemption.

4.3.4 Economic Considerations

Site Layout A would require demolition of the existing buildings, tanks, and equipment in Plant A and demolition of the Tertiary Filtration Facility. This option would also require a temporary blower facility for Plant B and air piping modifications since the existing Plant B blowers are in Plant A. This temporary infrastructure is essentially a "throwaway cost." The construction process would be complex and prolonged due to the sequential nature of the upgrades staging of the limited space available for construction and the need to maintain access for operations.

Site Layout B would have a simpler implementation process as the new facilities would be constructed in a greenfield area away from existing operation activities resulting in a shorter construction duration and reduced risk.

Cost estimates were developed to assess the relative difference between the two layouts. The costs differences are mainly driven by the requirements for staging, partial demolition, tie ins, etc. and overall implementation risk. Additional details related to the cost estimates including all assumptions made and information used can be found in **Appendix A**.

Table 4-1 below presents a cost comparison for the alternative site layouts.

Table 4-1: Cost Comparison of Alternative Site Layout

Parameters	Site Layout A	Site Layout B
Capital Cost	$99,520,000	$91,400,000

Parameters	Site Layout A	Site Layout B
Notes: 1. All costs are conceptual level opinions of probable costs in 2024 dollars and should be considered accurate to +/-50% 2. Costs shown only include the relative difference between the layouts. Costs for elements common to both layouts are not included.		

4.3.5 Summary of the Evaluation of Alternative Site Layouts

Table 4-2 below summarizes the evaluation and scoring of the two site layouts using the criteria and rating scale as described in **Table 3-1** and **Table 3-2,** respectively.

Table 4-2: Evaluation of Alternative Site Layouts

Sub-Criteria	Site Layout A	Site Layout B
Environmental Considerations		
Terrestrial System	The footprint of Site Layout A would be located within the existing site boundary on lands that have been previously disturbed with minimal disturbance of the surrounding natural areas. Site Layout B would be located on the property to the east of existing Plant B that has been mostly previously disturbed for the baseball fields, but there are small areas with trees through the middle of the area and around the north and east edges that would be impacted by the construction.	
	8	7
Surface Water Quality and Source Water Protection	The effluent discharges to the West Pond of Cootes Paradise which is an environmentally sensitive marsh. Proposed upgrades would be designed to meet the proposed effluent criteria which is protective of the receiver regardless of which site layout is selected. The effluent does not discharge near any IPZs and there are no open water sources located within or close to the existing site or existing baseball field that would be directly impacted by construction of the upgrades.	
	6	6
Groundwater Water Quality and Quantity	Groundwater would be near or just above the level of Lake Ontario/Hamilton Harbour. Shoring and dewatering plans would be developed during detailed design to protect groundwater resources.	
	6	6
Total Score (Out of 30)	20	19
Weight	25	25
Normalized Score (Out of 25)	**16.7**	**15.8**
Social – Cultural Considerations		
Odour/Noise/Vibrations	Neighboring residential areas have a potential to be impacted. However, Site Layout A would have more of a negative impact compared to Site Layout B due to proximity to residential area since Site Layout B is situated further away from residential areas. Both Site Layouts would include odour control and treatment such that all air quality standards are met, and impacts mitigated. Neighboring residential areas have a potential to be impacted by noise. Both Site Layouts would be designed to mitigate noise/vibrations to meet requirements at the nearest receptors. However, Site Layout B is situated further away from residential areas, so Site Layout B would impact less than Site Layout A.	
	6	7
Visual Aesthetics	Regardless of which layout is selected, the new facilities would be designed to be aesthetically pleasing and tree screening and landscaping would be provided.	

Sub-Criteria	Site Layout A	Site Layout B
	8	8
Disruption During Construction	Both layouts would create disruption during construction and have the potential to impact the neighboring residential and recreational areas. Site Layout B anticipates a shorter construction duration compared to Site Layout A, and it is situated further away from residential areas, Thereby, reducing the disruption experienced by nearby residents.	
	5	8
Property Acquisition and Easement	Site Layout B would require relocation of the baseball fields which would require potential land acquisition for a new property to construct new baseball fields.	
	10	7
Recreational Use and Users	Both layouts have potential to impact recreational users of the surrounding parks during construction from traffic, dust, noise and odour. These are short-term impacts, and they can be mitigated. Site Layout B would impact recreational use as the existing baseball field would need to be relocated.	
	7	6
Archaeology/Cultural Heritage	The Desjardins Canal area south of Dundas WWTP is listed as a non-designated property being of cultural heritage value/interest. However, these upgrades would have no impact on this property. Site Layout A would be constructed within the existing site on previously disturbed land, so no archaeological potential is expected. Site Layout B will be constructed on land that has been previously disturbed for baseball fields. The City is in the process of undergoing an Archaeological Screening Process to confirm.	
	8	8
Total Score (Out of 60)	44	44
Weight	25	25
Normalized Score (Out of 25)	**18.3**	**18.3**
Technical Considerations		
Ease of Operation	Site Layout A which involves construction within the existing site boundaries, brings about increased risk to operations during construction. A portion of flow would need to be temporarily diverted to Woodward Ave. WWTP increasing the risk of uncontrolled overflows in the collection system. The plant would be operating only with Plant B limiting the redundancy available. Plant B would also require upgrades to maintain its operation during construction due to required repairs and aging infrastructure. There will also be challenges with maintaining aeration to Plant B with temporary facilities. For Site Layout B, the existing plant can remain in operation until the new plant is online.	
	4	7
Ease of Implementation	For Site Layout A, there would be challenges due to space constraints within the existing site and the need to demolish Plant A, the Tertiary Filtration Building and the Public Works Yard to facilitate construction. A temporary blower facility and piping modification would be required to support continued operation of Plant B since the blowers feeding Plant B are located in Plant A. The flow from Plant B would need to be temporarily diverted through the new membrane facility after the existing tertiary filters are demolished to build the new aeration tanks.	

Sub-Criteria	Site Layout A	Site Layout B
	Site Layout B would simplify the implementation process resulting in a shorter construction duration given that the new facilities would be constructed in a green field area. Plant A and Plant B would only need to be demolished once the new facility is constructed.	
	3	7
Geotechnical and Hydrogeology	Both layouts would be designed according to on-site geotechnical and hydrogeological conditions.	
	7	7
Permits and Approvals	Site Layout A would require MECP approvals to temporarily divert a portion of the flow to Woodward Ave. WWTP during construction. Both layouts would require demolition permits.	
	6	7
Total Score (Out of 40)	20	28
Weight	25	25
Normalized Score (Out of 25)	**12.5**	**17.5**
Economic Considerations		
Capital Cost	Site Layout A would require more complex staging increasing the construction duration as well as more extensive demolition. It would also require some temporary facilities to maintain operation of Plant B. It is expected that this layout would result in higher capital costs overall. Site Layout B would have a more straightforward implementation process, resulting in a shorter construction duration. The relative cost difference between the complex staging, demolition and temporary facilities required for Site Layout A in comparison to the property purchase and landscaping of baseball fields required in this layout, it is expected that this layout would result in lower capital costs.	
	6	8
Total Score (Out of 10)	6	9
Weight	25	25
Normalized Score (Out of 25)	15.0	20.0
Total Score (Sum of Normalized Scores for all Criteria)	**62.5%**	**71.7%**

A sensitivity analysis of the evaluation scoring was completed using the weighting changes presented in **Table 4-3** below. This analysis was done to assess whether the final score is sensitive to the relative importance assigned of the criteria categories. As seen below, regardless of the weight of the categories, Site Layout B still produced the highest score.

This is particularly clear when applying weights of 15% to Natural Environment and 15% for Social-Cultural criteria, and weights of 35% for Technical and 35% for Economic Considerations. Given that both options would have similar expected environmental and social impacts, the key differences lie in the technical and economic aspects. Using these weights, it becomes obvious that Site Layout B is preferred.

Table 4-3: Alternative Site Layout Evaluation Sensitivity Analysis

Criteria Category	Weighting (base)	Sensitivity Analysis			
Natural Environment	25%	30%	35%	30%	15%
Social - Cultural Environment	25%	30%	35%	30%	15%
Technical Considerations	25%	20%	15%	30%	35%
Economic Considerations	25%	20%	15%	10%	35%
Score For Site Layout A	**62.5%**	**64.0%**	**65.5%**	**63.0%**	**59.5%**
Score For Site Layout B	**71.3%**	**70.5%**	**69.8%**	**69.5%**	**73.0%**

4.3.6 Preferred Site Layout

Based on the evaluation and scoring in **Table 4-2** and **Table 4-3** above, Site Layout B would simplify the implementation process resulting in a shorter construction duration, reduced capital cost and overall project risk. Overall, there would be less impact on residents in the area with Site Layout B since the construction of the new plant would be further away from residential areas and the duration of the disruption would be shorter. This layout, however, would require the relocation of the existing baseball diamonds. The impacts of this relocation could be mitigated by constructing new baseball diamonds before decommissioning the existing park.

4.4 Summary and Next Steps

This TM documents the evaluation of two alternative site layouts to implement the preferred design concept. The constraints and opportunities associated with constructing the new facilities either on the current site (Site Layout A) or in the area east of the existing site (Site Layout B) were examined to select a preferred site layout. The two layouts were evaluated based on a set of criteria and a rating scale. A sensitivity analysis was conducted by modifying the weights/relative importance of the evaluation criteria on the scoring of the site layouts.

Table 4-4: Comparison between the Two Site Layouts

Site Layout A		Site Layout B	
Requires demolition of Plant A to accommodate construction of new facility.	☒	Requires relocation of the existing baseball diamonds in Martino Park.	☒
Require careful sequencing and demolition to accommodate construction of the new facility.	☒	This layout would allow the new facility to be constructed in Martino Park.	☑
Higher capital costs and increased construction risks.	☒	Reduced construction risks, a more straightforward implementation process, shorter construction duration and lower capital cost.	☑

Site Layout A		Site Layout B	
Requires a portion of flows to be diverted to the Woodward Avenue WWTP during construction and increasing risk of overflows in the Woodward Avenue WWTP catchment.	☒	This layout would allow the existing plant to remain operational (at full capacity) throughout the construction phase.	☑

Based on the above, Site Layout B is recommended.

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A

Appendix A: Opinion of Probable Cost

Engineering
for **people**

Project Title:	**Facility Upgrade Plan for Dundas WWTP**		
Client:	City of Hamilton		
Project No.:	T001744A		
Task:	Opinion of Probable Cost		
Prepared By:	Maria Bovtenko	**Date:**	28-Feb-24

Site Layout A - Build within Existing Site

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
Site Works	1	L.S.	$15,582,000	1	$15,580,000	Total estimated site works assuming new facilities are constructed within the existing site. Assumes demolition of sludge storage, headworks, tertiary filtration building, Plant A and yard works area. Note: demolition costs can vary greatly.
Raw Sewage Pumping Station Rehabilitation	1	L.S.	$655,000	1	$660,000	Total estimate of repairs based on capital improvements recommended in the DC008 King St. WW Pumping Station Condition Assessment Report from immediate to long term improvements.
Plant B Rehabilitation	1	L.S.	$250,000	1	$250,000	Aeration system repairs to restore full functionality to Plant B.
Headworks	1	L.S.	$5,224,000	1	$5,220,000	Assuming replacement of headworks sized for 42.2 MLD PIF, housing 2 mm screens with 1 duty, 1 standby. Unit rate based on reference project cost estimate.
Temporary Blower Facility	1	L.S.	$915,000	1	$920,000	Relocation of existing blowers for use in temporary facility.
Membrane Bioreactor Facility	1	L.S.	$27,315,000	1	$27,320,000	Assuming new treatment train sized for 18.2 MLD ADF replacing both Plant A and B with no primary treatment. Total estimate for membrane bioreactor facility (including aeration tanks, membrane filters and process building). Process equipment costs from vendor. Concrete quantities were estimated. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
UV Disinfection Facility	1	L.S.	$2,078,000	1	$2,080,000	Assuming replacement of disinfection sized for 36.4 MLD PHF. Estimate of UV channels, lamps, and associated equipment. Process equipment costs from vendor. Concrete quantities were estimated. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
Sludge Handling Facility and Storage	1	L.S.	$4,671,000	1	$4,670,000	Assuming replacement of existing sludge handling facility and storage with the same size facility. Total estimate of sludge storage tanks, process building, mixing equipment and dewatering equipment. Process equipment costs are from vendors and reference projects. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
Center of Excellence	500	m^2	$11,000	1	$5,500,000	Total estimated building surface area. Unit cost based on reference project cost estimates.
Subtotal Capital Cost (2024$)					**$62,200,000**	
Engineering (15%)			15%		$9,330,000	
Contingency & Estimating Allowance (30%)			30%		$18,660,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$9,330,000	
Total Project Capital Cost (2024$ - Excluding HST)					**$99,520,000**	

Project Title:	**Facility Upgrade Plan for Dundas WWTP**
Client:	City of Hamilton
Project No.:	T001744A
Task:	Opinion of Probable Cost
Prepared By:	Maria Bovtenko **Date:** 28-Feb-24

Site Layout B - Build within Park East of Existing Site

Opinion of Probable Cost

Item	Quantity	Unit	Unit Cost	Installation Factor	Subtotal Cost	Comments
Site Works	1	L.S.	$7,096,000	1	$7,100,000	Total estimated site works assuming new facilities are constructed on the baseball diamonds east of the existing site. Assumes demolition of the existing buildings beside the baseball diamond. Note: demolition costs can vary greatly.
Plant B Rehabilitation	1	L.S.	$250,000	1	$250,000	Aeration system repairs to restore full functionality to Plant B.
Raw Sewage Pumping Station	1	L.S.	$4,302,500	1	$4,300,000	Assumes replacement of existing King St. Pumping Station with pumps of the same capacity. Concrete quantities were estimated. Structural/architectural components based on unit rate per m2. Process equipment costs based on reference projects. I&C/Electrical/Mechanical components assumed as % of process costs.
Headworks	300	m^2	$13,000	1	$3,900,000	Assuming replacement of headworks sized for 42.2 MLD PIF, housing 2 mm screens with 1 duty, 1 standby. Unit rate based on reference project cost estimate.
Membrane Bioreactor Facility	1	L.S.	$27,315,000	1	$27,320,000	Assuming new treatment train sized for 18.2 MLD ADF replacing both Plant A and B with no primary treatment. Total estimate for membrane bioreactor facility (including aeration tanks, membrane filters and process building). Process equipment costs from vendor. Concrete quantities were estimated. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
UV Disinfection Facility	1	L.S.	$2,078,000	1	$2,080,000	Assuming replacement of disinfection sized for 36.4 MLD PHF. Estimate of UV channels, lamps, and associated equipment. Process equipment costs from vendor. Concrete quantities were estimated. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
Sludge Handling Facility and Storage	1	L.S.	$4,671,000	1	$4,670,000	Assuming replacement of existing sludge handling facility and storage with the same size facility. Total estimate of sludge storage tanks, process building, mixing equipment and dewatering equipment. Process equipment costs are from vendors and reference projects. Structural/architectural components based on unit rate m2. I&C/Electrical/Mechanical assumed as % of process costs.
Center of Excellence	500	m^2	$11,000	1	$5,500,000	Total estimated building surface area. Unit cost based on reference project cost estimates.
Baseball Fields	1	L.S.	$2,000,000	1	$2,000,000	
Subtotal Capital Cost (2024$)					**$57,120,000**	
Engineering (15%)			15%		$8,570,000	
Contingency & Estimating Allowance (30%)			30%		$17,140,000	
General Contractor's Overhead & Profit, Mob.,bond (15%)			15%		$8,570,000	
Total Project Capital Cost (2024$ - Excluding HST)					**$91,400,000**	

A6

Appendix A6: Denitrification Technical Memorandum

Engineering
for **people**

City of Hamilton

Facility Upgrade Plan for Dundas Wastewater Treatment Plant (WWTP)

Denitrification Evaluation Technical Memorandum

Tuesday, August 6, 2024

T001744A

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Engineering for **people**

Hamilton

Denitrification Evaluation Technical Memorandum

Facility Upgrade Plan for Dundas WWTP

T001744A

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1 Introduction

CIMA+ was retained by the City of Hamilton (City) to develop a long-term plan and conceptual design to implement upgrades to the Dundas Wastewater Treatment Plant (WWTP). As previously identified in the *Evaluation of Alternative Design Concepts Technical Memorandum* (CIMA+, 2024), the preferred design concept is to upgrade the Dundas WWTP with a Membrane Bioreactor (MBR) Process with UV disinfection.

The design concept is based on the effluent requirements described in the *Effluent Criteria Technical Memorandum* (CIMA+, 2023). These criteria were developed in consultation with the Hamilton Harbour Remedial Action Plan (HHRAP) Cootes-Grindstone Water Quality Targets Sub-Committee. The effluent criteria include stringent design objectives for ammonia and total phosphorus, requiring for full nitrification and filtration, respectively. The criteria considered do not include total nitrogen (TN) or nitrate (NO_3) effluent objectives. However, the MBR design could be adapted to provide denitrification. In addition to reducing nitrate discharges to the receiving body, denitrification reduces oxygen requirements for biological treatment and mitigates the formation of nitrous oxide (a potent greenhouse gas).

The purpose of this technical memorandum (TM) is to evaluate the required MBR design modifications to achieve denitrification at the Dundas WWTP.

2 BioWIN Modelling

A BioWIN model for the proposed Dundas WWTP was developed. The model was first set up to reflect a baseline configuration based on the design criteria defined in the *Evaluation of Alternative Design Concepts Technical Memorandum* (CIMA+, 2024). Other model configurations were also considered incorporating modifications to the baseline design to achieve denitrification.

Each configuration was modelled under steady state conditions based on annual averages flows and annual average effluent concentrations, as well as maximum month flow (MMF) conditions. Each configuration is described below.

2.1 Baseline Scenario

The BioWIN model was initially setup per the design outlined in the *Evaluation of Alternative Design Concepts* TM (CIMA+, 2024). This design was based on three bioreactors with an anoxic zone sized at 25% of the aerobic volume. The three proposed aeration tanks and four MBR tanks were represented in the model as a single treatment train with multiple anoxic and aerobic zones. The anoxic zones of each aeration tank were represented as multiple anoxic zones in series to simulate the presence of residual oxygen in the first part of the anoxic zone. Other elements of the treatment process (e.g., screening, disinfection) were omitted for simplicity. The BioWIN model is shown in Figure 1.

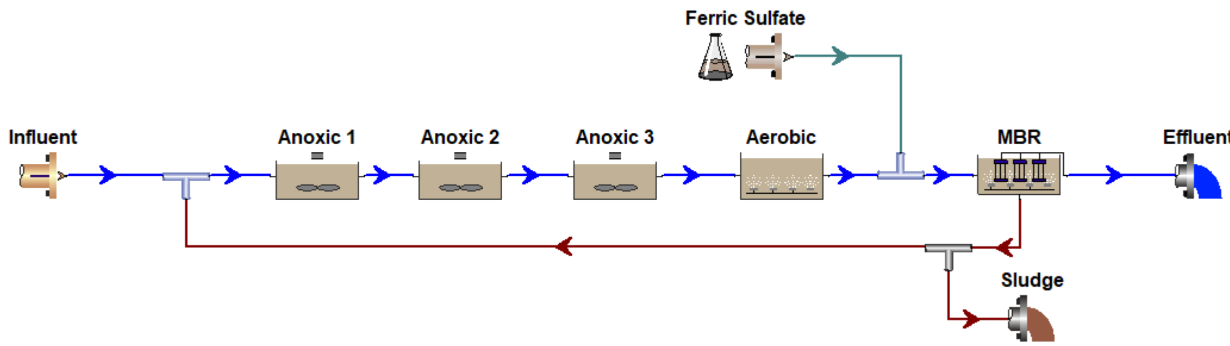


Figure 1: Baseline Scenario BioWIN Model

The key design parameters for the baseline model are summarized in **Table 1.**

Table 1: Baseline Scenario Model Design Parameters

Parameter	Design Value (Average Day Flow)
Wastewater Influent Note 1	
Design Flow (m^3/d)	18,200
Carbonaceous Biological Oxygen Demand (cBOD5) (mg/L)	158
Total Suspended Solids (TSS) (mg/L)	224
Total Phosphorus (TP) (mg/L)	5.0
Total Kjeldahl Nitrogen (TKN) (mg/L)	34
Temperature (°C)	20
Alkalinity (mmol/L) Note 1	6
Treatment Units Note 2	
Anoxic Zone Volume (m^3)	1,800 Split into three zones of equal volume (600 m^3 each)
Anoxic Zone Water Depth (m)	6
Aerobic Zone Volume (m^3)	7,200
Aerobic Zone Water Depth (m)	6

Parameter	Design Value (Average Day Flow)
MBR Tank Volume (m^3) Note 3	645.12
MBR Tank Water Depth (m)	4
MBR Number of Cassettes Note 4	28
Operating Values	
Ferric Sulfate Flow (L/d) Note 5	656.7
Return Activated Sludge (RAS) Flow (m^3/d) Note 6	71,071
Waste Activated Sludge (WAS) Flow (m^3/d) Note 7	433
Solids Retention Time (SRT) (days) Note 7	18.01

Notes:

1) There is no data available on raw wastewater alkalinity. Alkalinity was assumed to be 6 mmol/L (approximately 300 mg/L as $CACO_3$).
2) Wastewater influent flow/characteristics and treatment unit designs are based on the average day flow (ADF) design basis outlined in *Evaluation of Alternative Design Concepts* TM (CIMA+, 2024).
3) MBR tank volume is the sum of the volume in four tanks each with dimensions of 16.8 m (length) by 2.4 m (width) by 4 m (water depth).
4) MBR cassette quantity per vendor proposal included in *Evaluation of Alternative Design Concepts* TM (CIMA+, 2024).
5) Ferric sulfate flow based on a dosage of 7 mg Fe/L and a concentration of 194,000 mg Fe/L.
6) Total underflow (RAS+WAS) set as four times the influent flow for steady state analysis, consistent with vendor proposal.
7) WAS flow adjusted to maintain design SRT of 18 days.

The wastewater influent characteristics for the MMF conditions are summarized in **Table 2.**

Table 2: MMF Scenario Wastewater Characteristics

Parameter	MMF Design Value
Wastewater Influent Note 1	
Design Flow (m^3/d)	22,750
Carbonaceous Biological Oxygen Demand (cBOD5) (mg/L)	182

Parameter	MMF Design Value
Total Suspended Solids (TSS) (mg/L)	301
Total Phosphorus (TP) (mg/L)	6.2
Total Kjeldahl Nitrogen (TKN) (mg/L)	42

Notes:

1) Wastewater influent flow/characteristics MMF conditions outlined in the vendor proposal included in TM-3 (CIMA+, 2024)

The steady state model was evaluated and compared with the operating values outlined in the design concept in TM-3 (CIMA+, 2024). **Table 3** below summarizes the outputs from the baseline model compared with the design concept and expected effluent limits and objectives. Other final effluent parameters, such as Total Suspended Solids (TSS) and Total Phosphorus (TP) are mainly removed through filtration and are thus not significantly affected by the biological process design. Therefore, they are not discussed below.

Table 3: Baseline Scenario Model Outputs

Parameter	Design Value	Model Output
Hydraulic Retention Time (HRT)		
Anoxic HRT (total) (hrs)	N/A	*ADF:* 2.37 *MMF:* 1.90
Aerobic HRT (including MBR) (hrs)	N/A	*ADF:* 10.3 *MMF:* 8.28
Total HRT (hrs)	N/A	*ADF:* 12.7 *MMF:* 10.2
Final Effluent		
Flow (m^3/d)	N/A	*ADF:* 17,768 *MMF:* 22,318
BOD (mg/L)	3.0	*ADF:* 0.89 *MMF:* 0.91
Total Ammonia Nitrogen (TAN) (mg N/L)	0.3	*ADF:* 0.12 *MMF:* 0.11
Nitrate (NO_3) (mg N/L)	N/A	*ADF:* 12.61 *MMF:* 16.92
Nitrite (NO_2) (mg N/L)	N/A	*ADF:* 0.03

Parameter	Design Value	Model Output
		MMF: 0.03
Total Nitrogen (TN) (mg N/L) Note 2	N/A	*ADF:* 14.03 *MMF:* 18.50

Notes:

1) Per MBR vendor proposal design parameters.
2) Final Effluent TN includes TAN, NO_3, NO_2, and TKN. Default model kinetic parameters were left unchanged for this analysis.

Based on the output values from the baseline model, the conceptual MBR Dundas WWTP would be able to meet its anticipated treatment objectives for BOD and TAN. Under ADF conditions, the model predicted effluent nitrate and TN concentrations of 12.61 mg N/L and 14.03 mg N/L, respectively. Under MMF conditions, the model predicted effluent nitrate and TN concentrations of 16.92 mg N/L and 18.50 mg N/L, respectively. These correspond to loadings of 224 kg NO_3-N/d and 249 kg TN/d at the design ADF and 413 kg NO_3-N/d and 378 kg TN/d at the MMF, respectively.

Under MMF conditions, the raw influent TN loading is 956 kg N/d. The baseline scenario predicts an effluent TN loading of 413 kg N/d, corresponding to an overall nitrogen removal of 56.8%. As shown in **Table 3,** most of the nitrogen in the effluent is in the form of nitrate (NO_3). Nitrate is not typically regulated in wastewater effluent in Ontario.

See **Appendix A** for additional details on the BioWIN model.

2.2 Denitrification Modelling Scenarios

Denitrification is the process by which nitrate (NO_3) and nitrite (NO_2) are biologically reduced to nitrogen gas (N_2). The N_2 produced is off gassed from the aeration tanks into the atmosphere, thus removing the nitrogen from the wastewater. This process occurs in an anoxic environment and uses the BOD in the wastewater as a carbon source for the denitrifying bacteria. A system which utilizes a pre-anoxic zone for denitrification is called a Modified Ludzack-Ettinger (MLE) process. MLE processes rely on an increased underflow rate to return nitrate to the pre-anoxic tank.

If this BOD is the sole source of carbon for the denitrification process, the extent of Total Nitrogen removal (i.e., the reactor's denitrification potential) is typically limited by the size of the pre-anoxic zone, the availability of readily biodegradable carbon, the fraction of soluble non-biodegradable nitrogen, and the nitrate recycle rate.

Depending on these factors and local kinetic parameters, a maximum TN removal can theoretically be reached. To further remove TN, a second post-anoxic denitrification stage with the addition of a concentrated BOD source such as methanol to act as a carbon source would be required (Tchobanoglous, 2014).

Two design configurations are described below: one involving a typical MBR process with a pre-anoxic zone followed by an aerobic zone, and one with a second post-anoxic zone with supplemental carbon addition.

2.2.1 MBR Process with Enlarged Pre-Anoxic Zone

In a denitrifying MLE MBR process, there is only one underflow loop, i.e., the nitrate recycle loop is the same as the RAS loop, pumping mixed liquor from the MBR tanks to the head of the pre-anoxic tanks (Tchobanoglous, 2014).

Since the MBR mixed liquor return flow (RAS) can contain a significant DO concentration, the pre-anoxic zone was modelled as multiple tanks in series to simulate the presence of oxygen in the first portion of the anoxic tank and to simulate the consumption of oxygen as flow progresses through the anoxic zones. The baseline model was modified to include four pre-anoxic tanks in series, each with a volume of 500 m^3, followed by a fifth pre-anoxic tank. The volume of the fifth pre-anoxic tank was modified to conduct a sensitivity analysis on the effect of pre-anoxic volume on denitrification performance.

The model was used to simulate the effect of different RAS flowrates. The RAS flowrate was varied as 4, 5, and 6 times the permeate (effluent) flow (referred to as 4Q, 5Q or 6Q). An underflow rate of 6 times the permeate flow is a typical literature value for a denitrifying MBR process (Tchobanoglous, 2014).

The WAS flowrate remained unchanged from the baseline scenario.

Figure 2 shows the revised model configuration. See **Appendix A** for additional details on the BioWIN model.

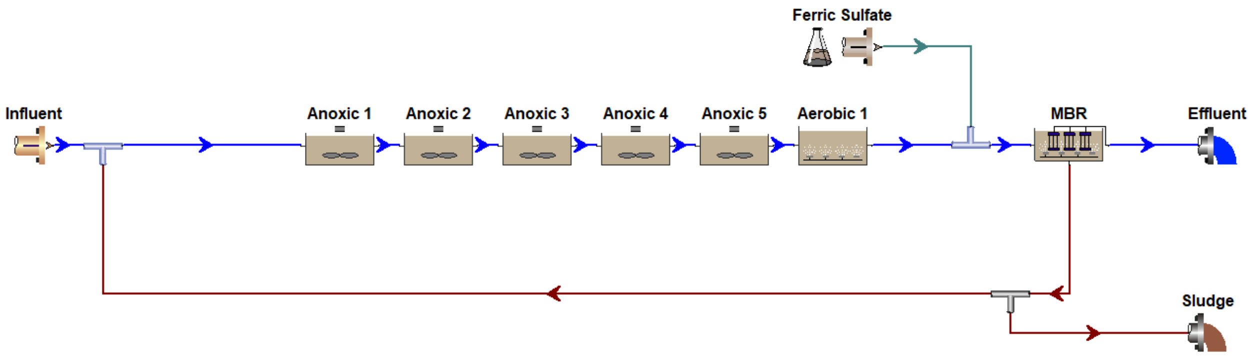


Figure 2: Image of BioWIN Model used for Denitrification Scenario Evaluation

Figure 3 and **Figure 4** below show the final effluent nitrate and TN concentrations, respectively, for the various modelled scenarios under ADF conditions. As shown in the figures, the relationship between increased pre-anoxic volume and effluent nitrogen concentration is asymptotic, i.e., effluent nitrogen concentration is reduced with increased pre-anoxic volume up to a certain value. This limitation means that increased pre-anoxic volume beyond an inflection point does not yield significant increased nitrogen removal.

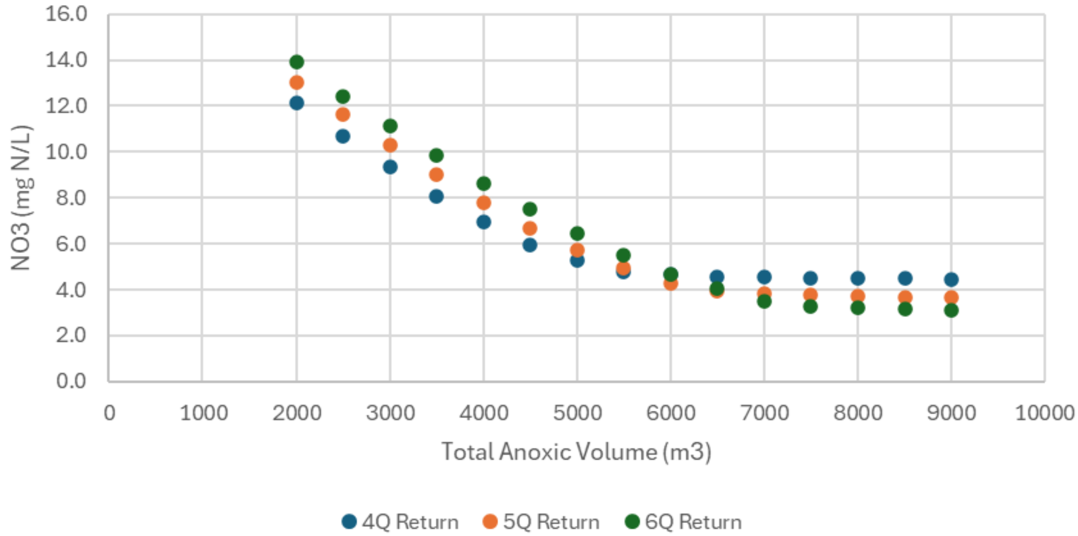


Figure 3: Modelled Final Effluent Nitrate Concentrations at ADF

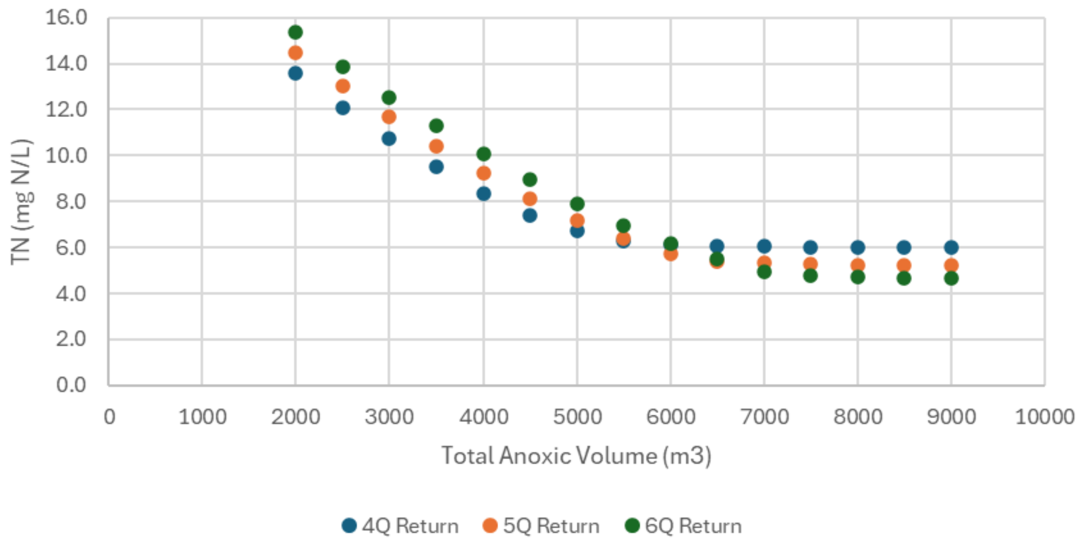


Figure 4: Modelled Final Effluent TN Concentrations at ADF

Figure 5 shows the final effluent TN concentrations of the modelled pre-anoxic volume scenarios under MMF conditions.

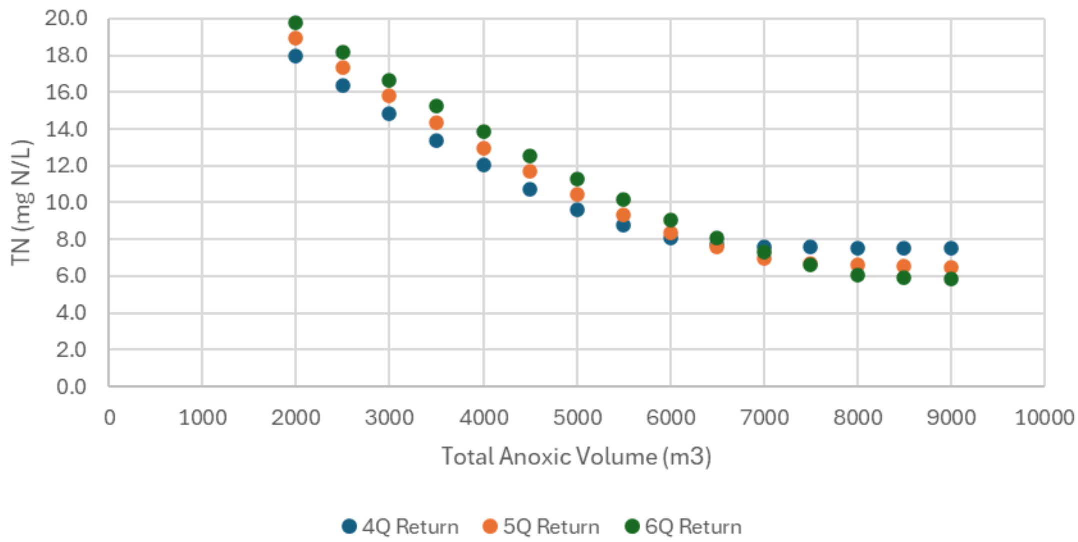


Figure 5: Modelled Final Effluent TN Concentrations at MMF

As shown in the above figures, regardless of the underflow rate, the inflection point at which increases in pre-anoxic volume do not significantly increase total nitrogen in the effluent is approximately 6,000 to 6,500 m^3 at approximately 6 mg TN/L and 8 mg TN/L at ADF and MMF, respectively. For comparison purposes, the baseline scenario discussed in Section 2.1, was based on a pre-anoxic volume of 1,800 m^3 and achieved effluent 14.0 mg TN/L and 18.5 mg TN/L under ADF and MMF conditions, respectively.

2.2.2 MBR Process with Supplemental Carbon Dosing

The process was restructured to provide an anoxic-aerobic-anoxic-aerobic configuration as shown in **Figure 6** below. In this configuration, methanol would be dosed upstream of the post-anoxic (i.e., the anoxic zone after the first aerobic zone). This arrangement more efficiently utilizes supplemental carbon in the denitrification process.

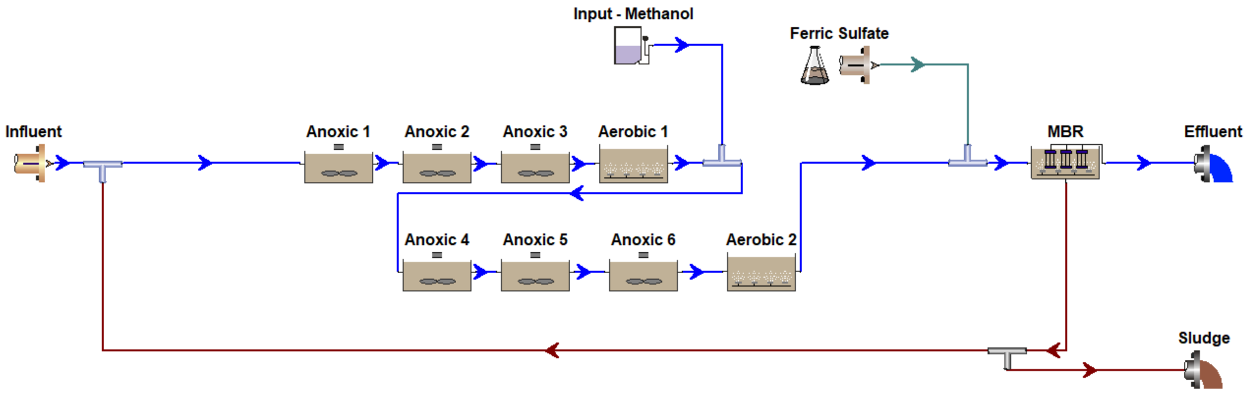


Figure 6: BioWIN Model used for Supplemental Carbon Dosing Scenario Evaluation

The model was used to assess the effect of varying methanol dosage rates with total anoxic volumes of 5,000, 6,000, and 7,000 m^3. All analyses were completed under ADF conditions with a total underflow rate of 5 times the permeate flow. **Figure 7** shows the modelled effluent TN concentration for modelled scenarios as a function of methanol dosage.

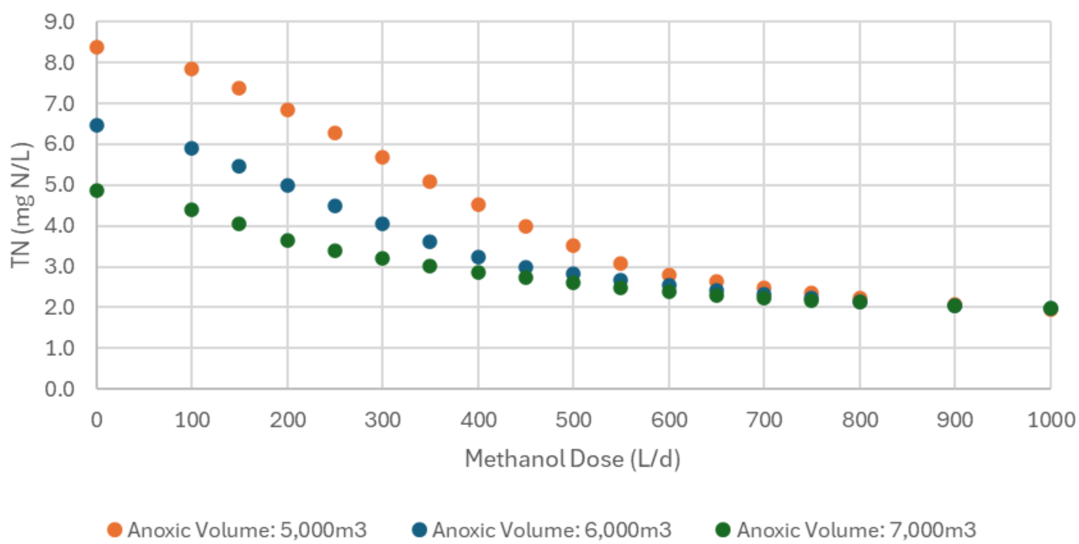


Figure 7: Modelled Final Effluent TN Concentrations as a Function of Methanol Dose

As shown above, to achieve TN effluent concentrations below 6 mg TN/L (the concentration achievable with an MBR configuration with a pre-anoxic zone) doses greater than 300 L/d of methanol would be required. This configuration would be able to achieve concentrations as low as 2 mg TN/L.

Given that the proposed effluent criteria do not include objectives for TN or NO_3 reduction, it is assumed that any design modifications to denitrify at the Dundas WWTP would be limited to those achievable without the need for a supplementary carbon source and those that would be achievable within the proposed conceptual site footprint shown in the *Evaluation of Alternative Site Layouts* TM (CIMA+, 2024).

Therefore, this configuration is not considered further given that it is more complex, requires significant chemical addition and requires significant increases in volume and footprint.

3 Cost Sensitivity Analysis of Increasing Denitrification Capacity at the Dundas WWTP

3.1 Capital Costs

The capital cost associated with an MBR process designed for denitrification was estimated (Class D or planning level estimates). The recirculation pumps included in the baseline scenario MBR vendor quote were assumed to be sufficient for all scenarios (i.e., they have the capacities in excess of 6Q). Therefore, the key factors driving the capital cost of the various scenarios are the anoxic volume required and the need for additional mixers.

The baseline scenario has an estimated capital cost for the MBR facility of $28,155,000, as outlined in the *Evaluation of Alternative Design Concepts* TM (CIMA+, 2024). **Appendix B** includes a breakdown of the capital cost estimates for the denitrification MBR.

Since TN removal targets/concentration objectives have not been defined, a cost sensitivity analysis was conducted to assess the cost related to increasing TN removal under ADF conditions relative to the baseline design.

TN removals were calculated as the difference between the final effluent TN loadings (in kg N/d) in the baseline scenario and in the denitrifying MBR Process.

Table 4 below shows the additional capital costs per kg N/d removed ($/kg N/d) as a function of pre-anoxic volume and underflow rate compared to the baseline design.

Table 4: Additional Capital Costs per kg TN/d Removed for Increased Pre-Anoxic Zone Volume ($/kg N/d)

Total Pre-Anoxic Volume (m^3)	Increase in Anoxic Volume (m^3)	4Q Underflow	5Q Underflow	6Q Underflow
2,500	700	$35,300	*Omitted*	*Omitted*
3,000	1,200	$27,300	$38,300	*Omitted*
3,500	1,700	$25,300	$31,800	$41,600

Total Pre-Anoxic Volume (m^3)	Increase in Anoxic Volume (m^3)	4Q Underflow	5Q Underflow	6Q Underflow
4,000	2,200	$23,600	$28,000	$33,900
4,500	2,700	$24,200	$27,200	$31,600
5,000	3,200	$24,500	$26,200	$29,300
5,500	3,700	$26,400	$26,800	$29,100
6,000	4,200	$28,500	$27,100	$28,600
6,500	4,700	$30,600	$28,300	$28,600
7,000	5,200	$32,700	$29,900	$28,800
7,500	5,700	$36,200	$33,000	$31,400
8,000	6,200	$38,400	$35,000	$33,100
8,500	6,700	$40,600	$36,900	$34,800
9,000	7,200	$42,900	$38,900	$36,600

Based on **Table 4**, the most capital cost-effective option to maximize TN removal without the need for methanol addition is an MBR process with a total pre-anoxic volume of 4,000 m^3 (providing an additional 2,200 m^3 of anoxic volume compared with the baseline scenario) and an underflow rate of 4 times the permeate. The estimated additional capital cost (relative to the baseline option) to implement a pre-anoxic tank upstream of the aeration tanks is $2,370,000. Based on model results, this configuration would result in a final effluent TN concentration of 8.37 mg/L (149 kg N/d) at ADF and 12.02 mg/L (214 kg N/d) at MMF. Relative to the baseline scenario, this corresponds to reductions in TN loadings of only 40.3% at ADF and 48.3% at MMF.

3.2 Operation and Maintenance Costs

Operational costs associated with a denitrifying MBR are greater than those for the baseline MBR WWTP. A denitrifying MBR would have increased energy costs due to potential higher underflow rates and increased mixing requirements in the anoxic zone. These energy increases would be partially offset by reduced air demands in the aerobic zone, reducing the power consumption of the blowers. There would also be increased maintenance requirements associated with the increased underflow pump flow rate and the increased number of anoxic mixers.

To properly estimate energy costs, a dynamic BioWIN model would need to be developed. Thus, this analysis is outside the scope of this assignment.

4 Other Considerations

4.1 Available Space on Site and Construction Staging

The proposed site plan for the Baseline Scenario, as outlined in the *Evaluation of Alternative Site Layouts TM* (CIMA+, 2024), is shown below in **Figure 8.** This site plan shows three aeration tanks, each with a 600 m[3] of anoxic volume and 2,400 m[3] of aerobic volume.

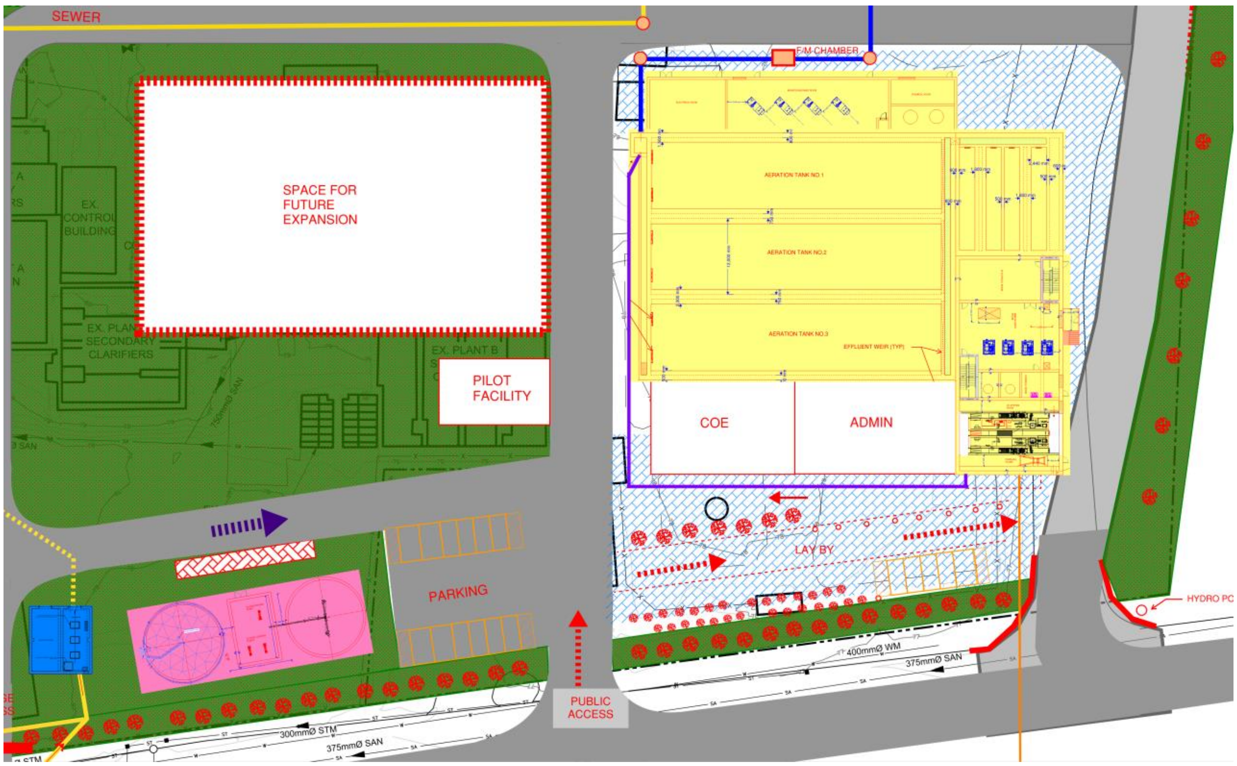


Figure 8: Baseline Scenario Conceptual Site Layout per *Alternative Site Layouts TM* (CIMA+, 2024)

Available site area is limited, being bounded by the access road to the City's Fleet Building to the east, by King Street to the south and by Plant B to the west. Given site constraints, to provide additional denitrification capacity, additional pre-anoxic tankage would need to be constructed in the area currently occupied by Plant B. This additional pre-anoxic volume would have to be commissioned after demolition of the existing plant.

Figure 9 shows a schematic layout which adds an additional 1,200 m[3] pre-anoxic tank upstream of the proposed aeration tanks, increasing the total anoxic volume from 1,800 m[3] to 3,000 m[3]. Similarly, **Figure 10** and **Figure 11** show schematic layouts for upstream pre-anoxic tanks with volumes of 2,700 m[3] and 4,700 m[3], respectively. These correspond to total pre-anoxic volumes of 4,500 m[3] and 6,500 m[3], respectively.

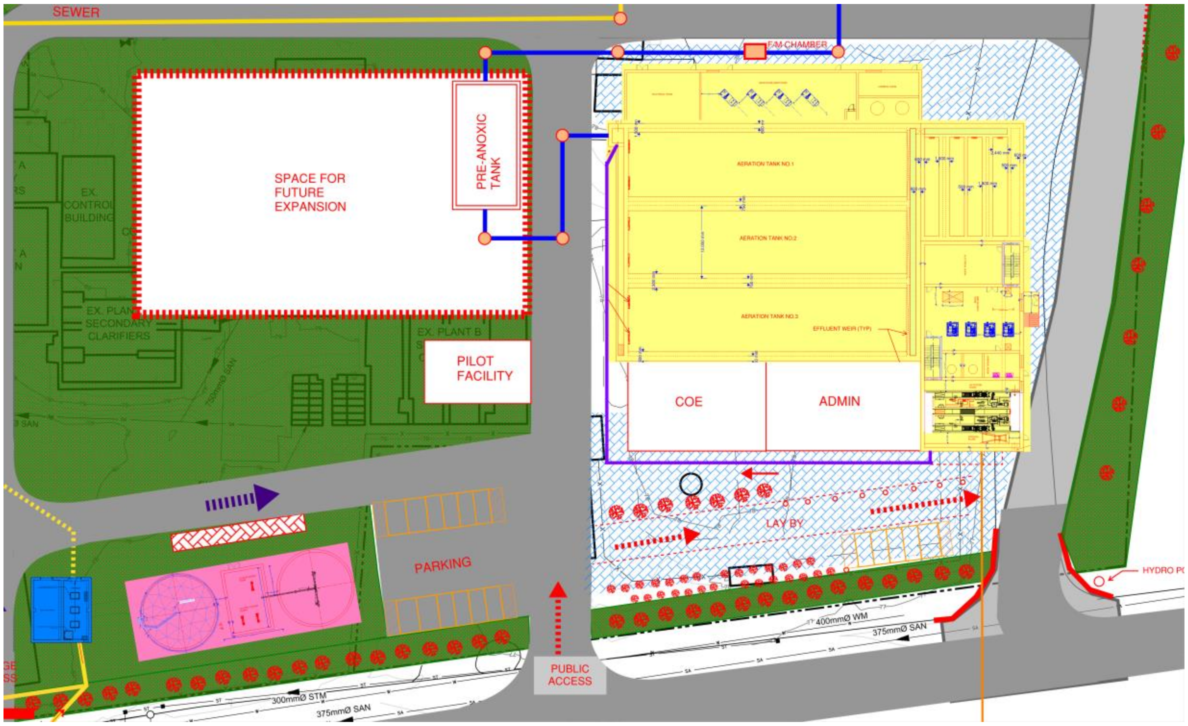


Figure 9: Conceptual Site Layout for 1,200 m^3 of Additional Pre-Anoxic Volume (Total Anoxic Volume of 3,000 m^3)

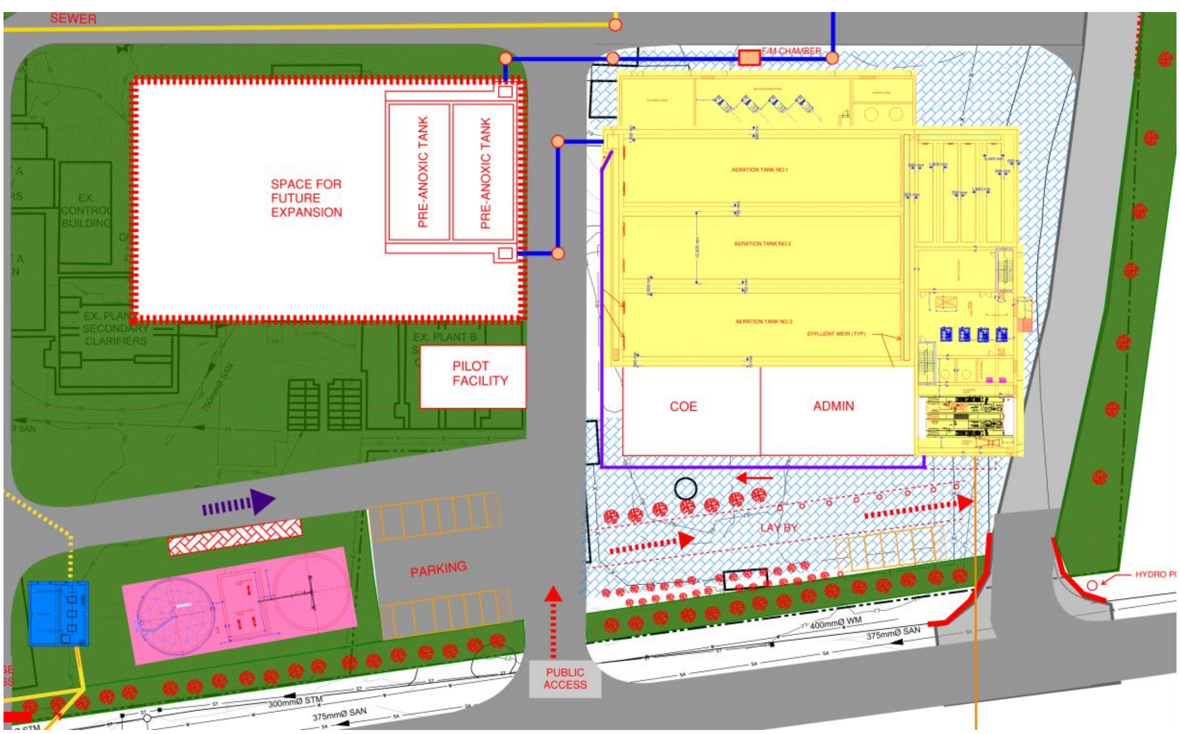


Figure 10: Conceptual Site Layout for 2,700 m^3 of Additional Pre-Anoxic Volume (Total Anoxic Volume of 4,500 m^3)

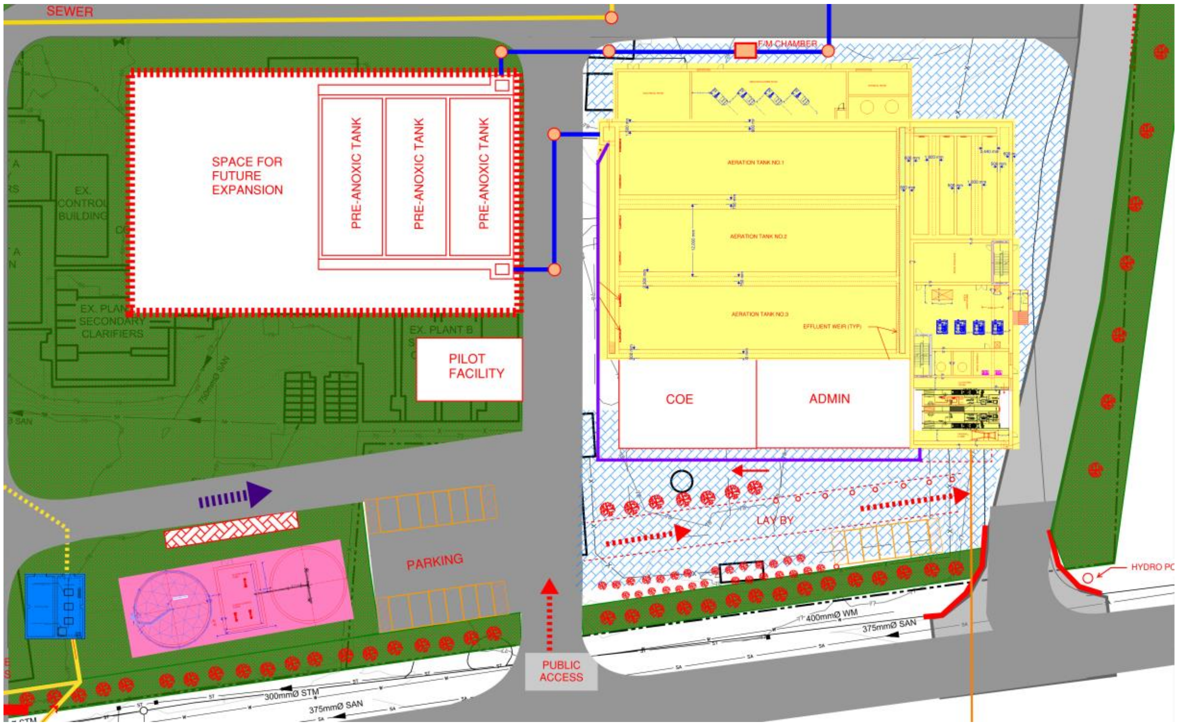


Figure 11: Conceptual Site Layout for 4,700 m^3 of Additional Pre-Anoxic Volume (Total Anoxic Volume of 6,500 m^3)

4.2 Anoxic Zone Mixing

The increased pre-anoxic volume increases the complexity of maintaining effective mixing in them. Based on CIMA+'s experience, it is recommended to employ hyperbolic mixers to maintain mixing in large volumes while minimizing energy consumption. These mixers function effectively in deep water depths and in wide tanks. Accordingly, the cost estimates in this TM were developed by assuming the additional pre-anoxic volumes compared to baseline would be provided in dedicated tankage upstream of the aeration tanks. This was conceptualized as follows:

- A single pre-anoxic tank for volumes up to 3,500 m^3.
  - Anoxic volume in baseline plant tankage: 1,800 m^3.
  - Additional anoxic volume in separate tank (as shown in **Figure 9**): up to 1,700 m^3.
- Two parallel pre-anoxic tanks for volumes up to 5,500 m^3.
  - Anoxic volume in baseline plant tankage: 1,800 m^3.
  - Additional anoxic volume in two parallel upstream tanks (as shown in **Figure 10**): up to 3,700 m^3.

- Three parallel pre-anoxic tanks for volumes greater than 5,500 m^3.
  - Anoxic volume in baseline plant tankage: 1,800 m^3.
  - Additional anoxic volume in three parallel upstream tanks (as shown in **Figure 11**)

Regardless of the arrangement, the pre-anoxic tanks would have a SWD of 6 m and a total width of 10 m, similar to the aeration tanks, with a length dependent on the total anoxic volume required. The length also determined the number of hyperbolic mixers required per anoxic tank, with each mixer functioning most effectively in a square area of tankage.

5 Conclusions and Recommendations

The purpose of this TM is to evaluate the conceptual design for the Dundas WWTP and determine what the requirements would be for it to maximize denitrification.

Denitrification capacity is dependent on the influent wastewater characteristics, the nitrification rate (the amount of nitrate produced), the underflow ratio and the anoxic volume.

The baseline design considered in *Evaluation of Alternative Design Concepts Technical Memorandum* (CIMA+, 2024) was used as the starting point for the evaluation. The baseline design includes a pre-anoxic volume of 1,800 m^3, and thus provides some denitrification. Using a steady state BioWIN model, the predicted effluent TN concentration achievable by the baseline design is 14.0 mg TN/L and 18.5 mg TN/L at ADF and MMF, respectively.

Using BioWIN, a sensitivity analysis was conducted to assess the effect of modifying the baseline design by increasing both underflow rates and pre-anoxic volumes on the TN effluent concentrations. The model shows that for pre-anoxic volumes beyond 6,000 m^3 to 6,500 m^3, there are no significant reductions in effluent TN concentration at underflow rates ranging from 4 to 6 times the permeate flowrate. The expected effluent concentrations for this pre-anoxic tank volume range, regardless of underflow rate, are approximately 6 mg TN/L and 8 mg TN/L at ADF and MMF, respectively.

Further reductions are possible by considering a process with supplemental carbon (methanol) addition. The BioWIN model was set up to assess such a configuration. However, given that there are no established objectives for TN or NO_3 reduction, it is assumed that any design modifications to denitrify at the Dundas WWTP would be limited to those achievable without the need for a supplementary carbon source. Furthermore, the design of additional pre-anoxic tankage was assumed to be located within the current footprint of Plant B, shown as space for future expansion in the *Evaluation of Alternative Site Layouts* TM (CIMA+, 2024).

A capital cost sensitivity analysis was conducted to assess the relative capital cost increase associated with varying pre-anoxic tank volumes. **Table 5** below summarizes the final effluent TN concentrations achievable with different combinations of pre-anoxic volume and underflow rate based on MMF conditions at the Dundas WWTP. It should be noted that the values below are based on a steady state BioWIN model and that cost estimates are at a Class D level of accuracy. The costs include additional structural, excavation and equipment associated with the various configurations.

Table 5: Summary of Recommended Dundas WWTP Arrangements based on Final Effluent TN Concentrations

Final Eff. TN Obj. (mg N/L)	Recommended Pre-Anoxic Zone Volume (m^3)	Recommended Total Underflow (Multiple of Permeate)	Additional Capital Cost ($) Note 3	Reference
<19	1,800 Note 1	4Q Underflow	$0	Baseline Scenario
<15	3,000 Note 2	4Q Underflow	$1,590,000	See **Figure 9** for conceptual layout
<11	4,500 Note 2	4Q Underflow	$2,840,000	See **Figure 10** for conceptual layout
<8	6,500 Note 2	4Q Underflow	$4,320,000	See **Figure 11** for conceptual layout

Notes:

1) The baseline scenario includes a total pre-anoxic zone volume of 1,800 m^3 and was modelled to be able to achieve a final effluent TN concentration of 18.5 mg N/L under MMF conditions.
2) Pre-anoxic zone volumes greater than the baseline scenario (1,800 m^3) would require the demolition of Plant B to be constructed.
3) Estimated additional capital costs are relative to the baseline scenario cost.

A pre-anoxic volume in the range of 6,000 to 6,500 m^3 was found to provide the "biggest bank for the buck" in terms of reductions in effluent TN concentrations per dollar of construction cost.

The analysis documented in this TM was completed using a steady state, uncalibrated BioWIN model. The model is based on assumptions regarding biological reaction rates and other kinetic parameters. Notably, BioWIN's default values for the fraction of recalcitrant nitrogen (or the fraction of TKN that will not hydrolyze to ammonia), and fraction of readily biodegradable chemical oxygen demand (RBCOD) were used.

Variations in these parameters significantly impact the analysis results. It is recommended that an in-depth raw wastewater characterization program be undertaken during predesign to calibrate the biological model.

The steady state nature of the model also does not allow for the modelling of variable influent conditions, including flows and loadings. Therefore, it is recommended that a calibrated dynamic model be utilized during predesign to confirm the sizing of the various processes at the Dundas WWTP. The dynamic model can then be utilized to obtain more accurate estimates of the operations and maintenance costs for the upgraded plant.

6 Bibliography

Tchobanoglous, G., Stensel, H., Tsuchihashi, R., Burton, F. (2014). *Wastewater Engineering: Treatment and Resource Recovery, Fifth Edition.* New York: McGraw-Hill Education.

A

Appendix A: BioWIN Model Summaries

Engineering
for **people**

BASELINE SCENARIO

BioWin user and configuration data

Project details

Project name: T001744A Project ref.: Project ref.

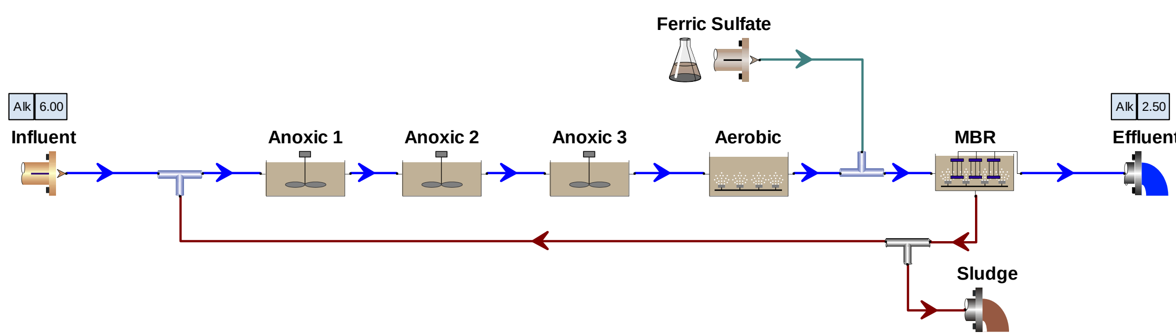
Plant name: Dundas WWTP User name: jordan.gerber

Created: 2024-05-15 Saved: 2024-06-21

SRT: ** days**

Temperature: 20.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers
Anoxic 1	600.0000	100.0000	6.000	Un-aerated
Aerobic	7,200.0000	1,200.0000	6.000	2927
Anoxic 2	600.0000	100.0000	6.000	Un-aerated
Anoxic 3	600.0000	100.0000	6.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic 1	0
Aerobic	2.0
Anoxic 2	0
Anoxic 3	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Anoxic 1	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Aerobic	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 2	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 3	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers	# of cassettes	Displaced volume / cassette [m3/cassette]	Membrane area / cassette [m2/cassette]	Total displaced volume [m3]	Membrane surface area [m2]
MBR	645.1200	161.2800	4.000	323	28.00	1.690	1,516.18	47.32	42,453.04

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR	6.0

Element name	Split method	Average Split specification
MBR	Ratio	4.00

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
MBR	0.0500	0.3800	1.0000	0.0500	0.2500	2.0000	50.0000	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulenc e factor [-]
MBR	0.0400	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	22750
BOD - Total Carbonaceous mgBOD/L	182.00
Volatile suspended solids mg/L	180.00
Total suspended solids mg/L	301.00
N - Total Kjeldahl Nitrogen mgN/L	42.00
P - Total P mgP/L	6.20
S - Total S mgS/L	10.00
N - Nitrate mgN/L	0
pH	7.30
Alkalinity mmol/L	6.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9790
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300

Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0.1500
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000

Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000

Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000
Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.1500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000

H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.6327
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.0983	39.0983

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220

Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400

Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Methylotrophic

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0400	0.0400
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [m2]	0.0410	0.0410
Diffuser mounting height [m]	0.2500	0.2500
Min. air flow rate per diffuser m3/hr (20C, 1 atm)	0.5000	0.5000
Max. air flow rate per diffuser m3/hr (20C, 1 atm)	10.0000	10.0000
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [kPa]	3.0000	3.0000
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))^2]	0	0

PRE-ANOXIC DENITRIFICATION SCENARIOS

BioWin user and configuration data

Project details

Project name: T001744A Project ref.: Project ref.

Plant name: Dundas WWTP **User name: jordan.gerber**

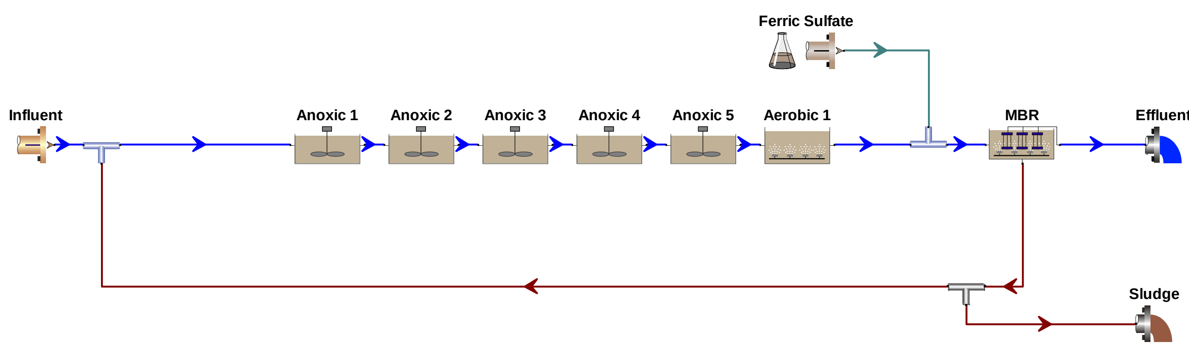
Created: 2024-05-15 **Saved: 2024-06-05**

Steady state solution

SRT #1: 26.80 days

Temperature: 20.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers
Aerobic 1	7,200.0000	1,200.0000	6.000	2927
Anoxic 1	500.0000	83.3333	6.000	Un-aerated
Anoxic 2	500.0000	83.3333	6.000	Un-aerated
Anoxic 3	500.0000	83.3333	6.000	Un-aerated
Anoxic 4	500.0000	83.3333	6.000	Un-aerated
Anoxic 5	4,000.0000	666.6667	6.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic 1	2.0
Anoxic 1	0
Anoxic 2	0
Anoxic 3	0
Anoxic 4	0
Anoxic 5	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mountin g height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Di ff) + C*(Qa/Di ff)^2	'B' in diffuser pressure drop = A + B*(Qa/Di ff) + C*(Qa/Di ff)^2	'C' in diffuser pressure drop = A + B*(Qa/Di ff) + C*(Qa/Di ff)^2
Aerobic 1	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 1	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 2	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 3	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 4	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0

Anoxic 5	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers	# of cassettes	Displaced volume / cassette [m3/cassette]	Membrane area / cassette [m2/cassette]	Total displaced volume [m3]	Membrane surface area [m2]
MBR	645.1200	161.2800	4.000	323	28.00	1.690	1,516.18	47.32	42,453.04

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR	6.0

Element name	Split method	Average Split specification
MBR	Ratio	5.00

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2

MBR	0.0500	0.3800	1.0000	0.0500	0.2500	2.0000	50.0000	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulence factor [-]
MBR	0.0400	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	22750
BOD - Total Carbonaceous mgBOD/L	182.00
Volatile suspended solids mg/L	180.00
Total suspended solids mg/L	301.00
N - Total Kjeldahl Nitrogen mgN/L	42.00
P - Total P mgP/L	6.20
S - Total S mgS/L	10.00
N - Nitrate mgN/L	0
pH	7.30
Alkalinity mmol/L	6.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9790
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0.1500
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600

Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000
Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000

Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.1500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.6327
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.0983	39.0983

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000

Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Methylotrophic

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0400	0.0400

Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [m2]	0.0410	0.0410
Diffuser mounting height [m]	0.2500	0.2500
Min. air flow rate per diffuser m3/hr (20C, 1 atm)	0.5000	0.5000
Max. air flow rate per diffuser m3/hr (20C, 1 atm)	10.0000	10.0000
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [kPa]	3.0000	3.0000
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))^2]	0	0

PRE- & POST-ANOXIC DENITRIFICATION SCENARIOS

BioWin user and configuration data

Project details

Project name: T001744A Project ref.: Project ref.

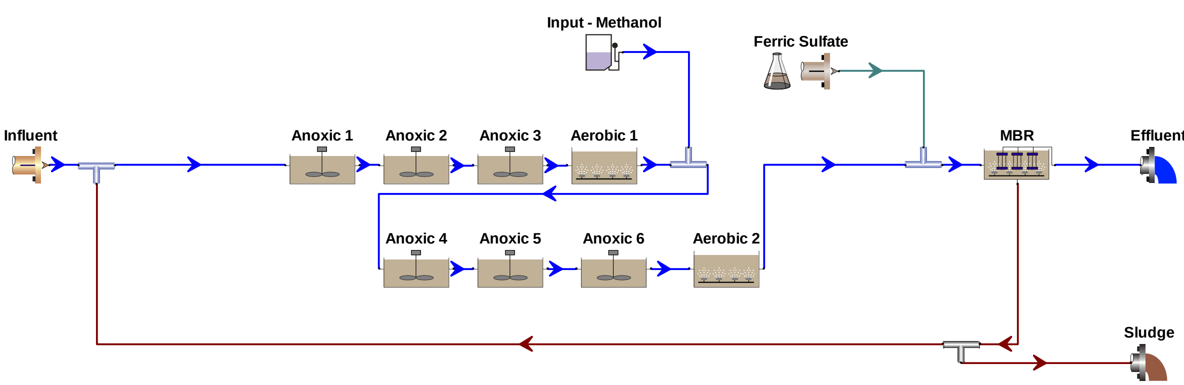
Plant name: Dundas WWTP **User name: jordan.gerber**

Created: 2024-05-15 **Saved: 2024-06-05**

SRT: ** days**

Temperature: 20.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers
Aerobic 2	3,600.0000	600.0000	6.000	1463
Anoxic 1	500.0000	83.3333	6.000	Un-aerated
Anoxic 2	500.0000	83.3333	6.000	Un-aerated
Anoxic 3	2,000.0000	333.3333	6.000	Un-aerated
Aerobic 1	3,600.0000	600.0000	6.000	1463
Anoxic 4	500.0000	83.3333	6.000	Un-aerated
Anoxic 5	500.0000	83.3333	6.000	Un-aerated
Anoxic 6	2,000.0000	333.3333	6.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic 2	2.0
Anoxic 1	0
Anoxic 2	0
Anoxic 3	0
Aerobic 1	2.0
Anoxic 4	0
Anoxic 5	0
Anoxic 6	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Aerobic 2	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0

Anoxic 1	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 2	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 3	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Aerobic 1	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 4	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 5	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0
Anoxic 6	1.2400	0.8960	0.8880	0.0410	0.2500	0.5000	10.0000	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [m3]	Area [m2]	Depth [m]	# of diffusers	# of cassettes	Displaced volume / cassette [m3/cassette]	Membrane area / cassette [m2/cassette]	Total displaced volume [m3]	Membrane surface area [m2]
MBR	645.1200	161.2800	4.000	323	28.00	1.690	1,516.18	47.32	42,453.04

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR	6.0

Element name	Split method	Average Split specification
MBR	Ratio	5.00

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser m3/hr (20C, 1 atm)	Max. air flow rate per diffuser m3/hr (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
MBR	0.0500	0.3800	1.0000	0.0500	0.2500	2.0000	50.0000	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulence factor [-]
MBR	0.0400	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	18200
BOD - Total Carbonaceous mgBOD/L	158.00
Volatile suspended solids mg/L	150.00
Total suspended solids mg/L	224.00
N - Total Kjeldahl Nitrogen mgN/L	34.00
P - Total P mgP/L	5.00
S - Total S mgS/L	10.00
N - Nitrate mgN/L	0

pH	7.30
Alkalinity mmol/L	6.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9293
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0.1500
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Input - Methanol units

Operating data Average (flow/time weighted as required)

Element name	Input - Methanol
Biomass - Ordinary heterotrophic [mgCOD/L]	0
Biomass - Methylotrophic [mgCOD/L]	0
Biomass - Ammonia oxidizing [mgCOD/L]	0
Biomass - Nitrite oxidizing [mgCOD/L]	0
Biomass - Anaerobic ammonia oxidizing [mgCOD/L]	0
Biomass - Phosphorus accumulating [mgCOD/L]	0
Biomass - Propionic acetogenic [mgCOD/L]	0
Biomass - Acetoclastic methanogenic [mgCOD/L]	0
Biomass - Hydrogenotrophic methanogenic [mgCOD/L]	0
Biomass - Endogenous products [mgCOD/L]	0
CODp - Slowly degradable particulate [mgCOD/L]	0
CODp - Slowly degradable colloidal [mgCOD/L]	0
CODp - Degradable external organics [mgCOD/L]	0
CODp - Undegradable non-cellulose [mgCOD/L]	0
CODp - Undegradable cellulose [mgCOD/L]	0
N - Particulate degradable organic [mgN/L]	0
P - Particulate degradable organic [mgP/L]	0
N - Particulate degradable external organics [mgN/L]	0
P - Particulate degradable external organics [mgP/L]	0
N - Particulate undegradable [mgN/L]	0
P - Particulate undegradable [mgP/L]	0
CODp - Stored PHA [mgCOD/L]	0
P - Releasable stored polyP [mgP/L]	0
P - Unreleasable stored polyP [mgP/L]	0
CODs - Complex readily degradable [mgCOD/L]	0
CODs - Acetate [mgCOD/L]	0
CODs - Propionate [mgCOD/L]	0

CODs - Methanol [mgCOD/L]	1,188,000.00
Gas - Dissolved hydrogen [mgCOD/L]	0
Gas - Dissolved methane [mg/L]	0
N - Ammonia [mgN/L]	0
N - Soluble degradable organic [mgN/L]	0
Gas - Dissolved nitrous oxide [mgN/L]	0
N - Nitrite [mgN/L]	0
N - Nitrate [mgN/L]	0
Gas - Dissolved nitrogen [mgN/L]	0
P - Soluble phosphate [mgP/L]	0
CODs - Undegradable [mgCOD/L]	0
N - Soluble undegradable organic [mgN/L]	0
Influent inorganic suspended solids [mgISS/L]	0
Precipitate - Struvite [mgISS/L]	0
Precipitate - Brushite [mgISS/L]	0
Precipitate - Hydroxy - apatite [mgISS/L]	0
Precipitate - Vivianite [mgISS/L]	0
HFO - High surface [mg/L]	0
HFO - Low surface [mg/L]	0
HFO - High with H2PO4- adsorbed [mg/L]	0
HFO - Low with H2PO4- adsorbed [mg/L]	0
HFO - Aged [mg/L]	0
HFO - Low with H+ adsorbed [mg/L]	0
HFO - High with H+ adsorbed [mg/L]	0
HAO - High surface [mg/L]	0
HAO - Low surface [mg/L]	0
HAO - High with H2PO4- adsorbed [mg/L]	0
HAO - Low with H2PO4- adsorbed [mg/L]	0
HAO - Aged [mg/L]	0
P - Bound on aged HMO [mgP/L]	0
Metal soluble - Magnesium [mg/L]	0
Metal soluble - Calcium [mg/L]	0
Metal soluble - Ferric [mg/L]	0
Metal soluble - Ferrous [mg/L]	0
Metal soluble - Aluminum [mg/L]	0

Other Cations (strong bases) [meq/L]	0
Other Anions (strong acids) [meq/L]	0
Gas - Dissolved total CO2 [mmol/L]	0
User defined - UD1 [mg/L]	0
User defined - UD2 [mg/L]	0
User defined - UD3 [mgVSS/L]	0
User defined - UD4 [mgISS/L]	0
Biomass - Sulfur oxidizing [mgCOD/L]	0
Biomass - Sulfur reducing propionic acetogenic [mgCOD/L]	0
Biomass - Sulfur reducing acetotrophic [mgCOD/L]	0
Biomass - Sulfur reducing hydrogenotrophic [mgCOD/L]	0
Gas - Dissolved total sulfides [mgS/L]	0
S - Soluble sulfate [mgS/L]	0
S - Particulate elemental sulfur [mgS/L]	0
Precipitate - Ferrous sulfide [mgISS/L]	0
CODp - Adsorbed hydrocarbon [mgCOD/L]	0
CODs - Degradable volatile ind. #1 [mgCOD/L]	0
CODs - Degradable volatile ind. #2 [mgCOD/L]	0
CODs - Degradable volatile ind. #3 [mgCOD/L]	0
CODs - Soluble hydrocarbon [mgCOD/L]	0
Gas - Dissolved oxygen [mg/L]	0
Flow	0.75

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000

Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000

Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000
Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.1500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000

H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.6327
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.0983	39.0983

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220

Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400

Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Methylotrophic

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0400	0.0400
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [m2]	0.0410	0.0410
Diffuser mounting height [m]	0.2500	0.2500
Min. air flow rate per diffuser m3/hr (20C, 1 atm)	0.5000	0.5000
Max. air flow rate per diffuser m3/hr (20C, 1 atm)	10.0000	10.0000
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [kPa]	3.0000	3.0000
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[kPa/(m3/hr (20C, 1 atm))^2]	0	0

B

Appendix B: Capital Cost Estimates

Engineering
for **people**

Conceptual Cost Estimate

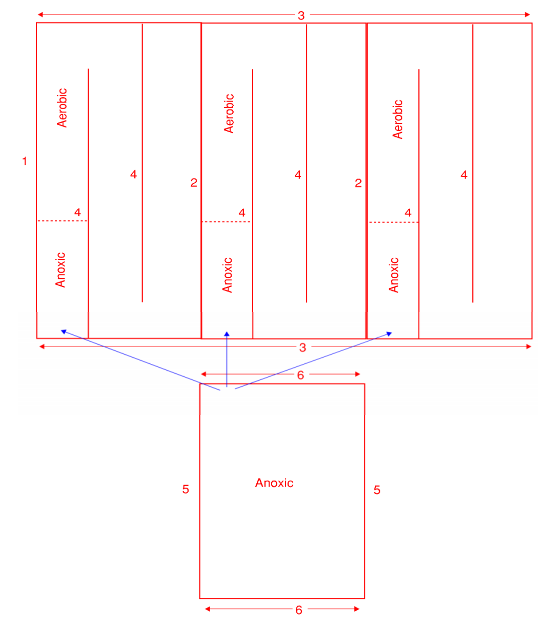
PROJECT: Facility Upgrade Plan for Dundas WWTP
PROJ. NO.: T001744A
PREPARED BY: Maria Bovtenko, Jordan Gerber
DATE: June 24, 2024
SUBJECT: Aeration Tanks - *Modified to increase concrete wall height to 6.6m (aeration tanks) and 4.6m (MBR tanks) to allow for 0.6m of freeboard*

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 2 SITE WORKS									
	Excavation/Backfill	12030	m^3	$ 40	$ 480,000	-	-	Incl.	$ 480,000.00	$ 480,000.00
					$ -	-	-	Incl.	$ -	$ -
								TOTAL ESTIMATE FOR DIVISION 2 - SITE WORKS	$ 480,000.00	**$ 480,000.00**
	DIVISION 3 CONCRETE									
	Mud Slab		m^3	$ 1,100	$ -	-	-	Incl.	$ -	$ -
	Base Slab	1359	m^3	$ 1,900	$ 2,580,000	-	-	Incl.	$ 2,580,000.00	$ 2,580,000.00
	Suspended Slabs	63	m^3	$ 2,000	$ 130,000	-	-	Incl.	$ 130,000.00	$ 130,000.00
	Walls	2439	m^3	$ 2,000	$ 4,880,000	-	-	Incl.	$ 4,880,000.00	$ 4,880,000.00
	Beams and columns		m^3	$ 2,000	$ -	-	-	Incl.	$ -	$ -
	Misc. Structures		m^3	$ 1,500	$ -	-	-	Incl.	$ -	$ -
								TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE	**$ 7,590,000.00**	**$ 7,590,000.00**
	DIVISION 5 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Structural steel and architectural finishes	410	m^2	$ 2,500	$ 1,025,000	-	-	Incl.	$ 1,025,000.00	$ 1,025,000.00
								TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL	**$ 1,025,000.00**	**$ 1,025,000.00**
	DIVISION 11 - PROCESS									
	Bioreactor and membrane filtration equipment	1	L.S.	$ 7,450,000	$ 7,450,000	45%	-	$ 3,350,000.00	$ 10,800,000.00	$ 10,800,000.00
	Gates	1	L.S.	$ 120,000	$ 120,000	45%	-	$ 50,000.00	$ 170,000.00	$ 170,000.00
	Channel Mixing	1	L.S.	$ 580,000	$ 580,000	45%	-	$ 260,000.00	$ 840,000.00	$ 840,000.00
	WAS Pumps	1	L.S.	$ 70,000	$ 70,000	45%		$ 30,000.00	$ 100,000.00	$ 100,000.00
								TOTAL ESTIMATE FOR DIVISION 11 - PROCESS	**$ 11,910,000.00**	**$ 11,910,000.00**
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Lump Sum	1	L.S.	$ 1,790,000	$ 1,790,000	-	-	Incl.	$ 1,790,000.00	$ 1,790,000.00
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$ 1,790,000.00**	**$ 1,790,000.00**
	DIVISION 14 - HOISTING SYSTEMS									
			units		$ -	-	-	Incl.	$ -	$ -
								TOTAL ESTIMATE FOR DIVISION 14 - HOISTING SYSTEMS	**$ -**	**$ -**
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$ 1,790,000	$ 1,790,000	-	-	Incl.	$ 1,790,000.00	$ 1,790,000.00
								TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL	**$ 1,790,000.00**	**$ 1,790,000.00**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$ 3,570,000	$ 3,570,000	-	-	Incl.	$ 3,570,000.00	$ 3,570,000.00
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$ 3,570,000.00**	**$ 3,570,000.00**
								TOTAL ESTIMATE FOR DIVISION 3-16	**$ 28,155,000.00**	**$ 28,155,000.00**

PRE-ANOXIC - 1 TANK UPSTREAM - FUTURE

Number of Anoxic Tanks	1	
Tank Width (m)	10	
SWD (m)	6	
Tank Exterior/Separation Wall Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Freeboard (m)	0.6	
No. Exterior Length Walls	2	*Consistent with Ref Baseline Calculation*
Exterior Walls Additional Length (m)	3	*Consistent with Ref Baseline Calculation*
No. Exterior Width Walls (Anoxic)	2	
Exterior Walls Additional Width (m)	5	*Consistent with Ref Baseline Calculation*
Base Slab Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Excavation/Backfill Unit Price ($/m3)	$40	
Base Slab Unit Price ($/m3)	$1,900	
Walls Unit Price ($/m3)	$2,000	
Waterloo WWTP Anoxic Zone Mixer Quote	$134,680	*Cost based on quote for 4x 2500mm Invent mixers. Each mixer sized for basin volume of 757 m3 with length/width 11.7m and water depth 5.6 m*
Napanee Post-EQ Mixer Quote	$100,800	*Cost for 2x 2500mm Invent mixers to fully mix 28m long tank (7m width, variable depth)*
Cost per 2500mm Invent Mixer	$50,442	*Assumed average cost per Invent Mixer, sufficient to mix a tank 6m deep, 10x10 in dimension. Per dicsussion with Amy, Invent mixers perform best in square volumes, and operate in series when tank is rectagular (i.e. anoxic volume of 10m wide by XXm long). Added 20% for buffer*

	TOTAL VOLUME	**Pre-Train Anoxic Tank**		**WALL CONCRETE VOLUMES (SEE BELOW)**								
	Anoxic Zone	Anoxic Tank	Anoxic Zone Le	5	6	Wall Vol.	**Wall Cost**	Anoxic Base Slab Vol.	**Base Slab Cost**	Anoxic Excavation/Backfill	**Excavation/Backfill Cost**	**Mechanical Mixers**
	m3	m3	m	m3, total	m3, total	m3	$	m3	$	m3	$	$
Baseline	1800	0	0.0	0	0	0	**$0**	0	**$0**	0	**$0**	**$0**
	2000	200	3.3	50	119	169	**$340,000**	57	**$110,000**	630	**$30,000**	**$60,000**
	2500	700	11.7	116	119	235	**$470,000**	132	**$260,000**	1530	**$70,000**	**$110,000**
	3000	1200	20.0	182	119	301	**$610,000**	207	**$400,000**	2430	**$100,000**	**$110,000**
Max Feasible Per Length	3500	1700	28.3	248	119	367	**$740,000**	282	**$540,000**	3330	**$140,000**	**$160,000**
	4000	2200	36.7	314	119	433	**$870,000**	357	**$680,000**	4230	**$170,000**	**$210,000**
	4500	2700	45.0	380	119	499	**$1,000,000**	432	**$830,000**	5130	**$210,000**	**$260,000**
	5000	3200	53.3	446	119	565	**$1,130,000**	507	**$970,000**	6030	**$250,000**	**$310,000**
	5500	3700	61.7	512	119	631	**$1,270,000**	582	**$1,110,000**	6930	**$280,000**	**$360,000**
	6000	4200	70.0	578	119	697	**$1,400,000**	657	**$1,250,000**	7830	**$320,000**	**$360,000**
	6500	4700	78.3	644	119	763	**$1,530,000**	732	**$1,400,000**	8730	**$350,000**	**$410,000**
	7000	5200	86.7	710	119	829	**$1,660,000**	807	**$1,540,000**	9630	**$390,000**	**$460,000**
	7500	5700	95.0	776	119	895	**$1,790,000**	882	**$1,680,000**	10530	**$430,000**	**$510,000**
	8000	6200	103.3	842	119	961	**$1,930,000**	957	**$1,820,000**	11430	**$460,000**	**$560,000**
	8500	6700	111.7	908	119	1027	**$2,060,000**	1032	**$1,970,000**	12330	**$500,000**	**$610,000**
	9000	7200	120.0	974	119	1093	**$2,190,000**	1107	**$2,110,000**	13230	**$530,000**	**$610,000**



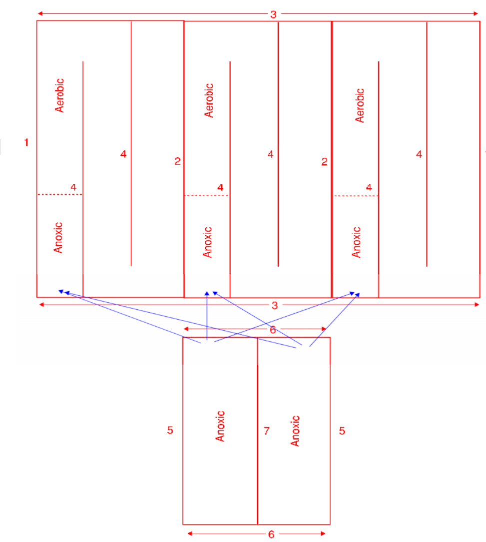
MBR System Cost

	Total Anoxic Volur	Extra Anoxic Zone Volu	Div 2		Div 3		Div 11	Div 16	Estimate Contingency	**TOTAL**		
	m3	m3	Excavation/Bac	Allowance for Pip	Walls	Base Slab	Additional Mixers	Adder for Mixers	20%		**Adder Compared to Baseline**	**% of Baseline**
Baseline	1800	0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	0%
	2000	200	$30,000	$75,000	$340,000	$110,000	$60,000	$12,000	$125,400	**$760,000**	$760,000	3%
	2500	700	$70,000	$75,000	$470,000	$260,000	$110,000	$22,000	$201,400	**$1,210,000**	$1,210,000	4%
	3000	1200	$100,000	$75,000	$610,000	$400,000	$110,000	$22,000	$263,400	**$1,590,000**	$1,590,000	6%
Max Feasible Per Length	3500	1700	$140,000	$75,000	$740,000	$540,000	$160,000	$32,000	$337,400	**$2,030,000**	$2,030,000	7%
	4000	2200	$170,000	$75,000	$870,000	$680,000	$210,000	$42,000	$409,400	**$2,460,000**	$2,460,000	9%
	4500	2700	$210,000	$75,000	$1,000,000	$830,000	$260,000	$52,000	$485,400	**$2,920,000**	$2,920,000	10%
	5000	3200	$250,000	$75,000	$1,130,000	$970,000	$310,000	$62,000	$559,400	**$3,360,000**	$3,360,000	12%
	5500	3700	$280,000	$75,000	$1,270,000	$1,110,000	$360,000	$72,000	$633,400	**$3,810,000**	$3,810,000	14%
	6000	4200	$320,000	$75,000	$1,400,000	$1,250,000	$360,000	$72,000	$695,400	**$4,180,000**	$4,180,000	15%
	6500	4700	$350,000	$75,000	$1,530,000	$1,400,000	$410,000	$82,000	$769,400	**$4,620,000**	$4,620,000	16%
	7000	5200	$390,000	$75,000	$1,660,000	$1,540,000	$460,000	$92,000	$843,400	**$5,070,000**	$5,070,000	18%
	7500	5700	$430,000	$75,000	$1,790,000	$1,680,000	$510,000	$102,000	$917,400	**$5,510,000**	$5,510,000	20%
	8000	6200	$460,000	$75,000	$1,930,000	$1,820,000	$560,000	$112,000	$991,400	**$5,950,000**	$5,950,000	21%
	8500	6700	$500,000	$75,000	$2,060,000	$1,970,000	$610,000	$122,000	$1,067,400	**$6,410,000**	$6,410,000	23%
	9000	7200	$530,000	$75,000	$2,190,000	$2,110,000	$610,000	$122,000	$1,127,400	**$6,770,000**	$6,770,000	24%

PRE-ANOXIC - 2 TANKS UPSTREAM - FUTURE

Number of Anoxic Tanks	2	
Tank Width (m)	10	
SWD (m)	6	
Tank Exterior/Separation Wall Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Freeboard (m)	0.6	
No. Exterior Length Walls	2	*Consistent with Ref Baseline Calculation*
Exterior Walls Additional Length (m)	3	*Consistent with Ref Baseline Calculation*
No. Exterior Width Walls (Anoxic)	2	
Exterior Walls Additional Width (m)	5	*Consistent with Ref Baseline Calculation*
Base Slab Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Excavation/Backfill Unit Price ($/m3)	$40	
Base Slab Unit Price ($/m3)	$1,900	
Walls Unit Price ($/m3)	$2,000	
Waterloo WWTP Anoxic Zone Mixer Quote	$134,680	*Cost based on quote for 4x 2500mm Invent mixers. Each mixer sized for basin volume of 757 m3 with length/width 11.7m and water depth 5.6 m*
Napanee Post-EQ Mixer Quote	$100,800	*Cost for 2x 2500mm Invent mixers to fully mix 28m long tank (7m width, variable depth)*
Cost per 2500mm Invent Mixer	$50,442	*Assumed average cost per Invent Mixer, sufficient to mix a tank 6m deep, 10x10 in dimension. Per dicsussion with Amy, Invent mixers perform best in square volumes, and operate in series when tank is rectagular (i.e. anoxic volume of 10m wide by XXm long). Added 20% for buffer*

	TOTAL VOLUME	**Pre-Train Anoxic Tank**		**WALL CONCRETE VOLUMES (SEE BELOW)**									
	Anoxic Zone	Anoxic Tank	Anoxic Zone Le	5	6	7	Wall Vol.	**Wall Cost**	Anoxic Base Slab Vol.	**Base Slab Cost**	Anoxic Excavation/Backfill	**Excavation/Backfill Cost**	**Mechanical Mixers**
	m3	m3	m	m3, total	m3, total	m3, total	m3	$	m3	$	m3	$	$
Baseline	1800	0	0.0	0	0	0	0	**$0**	0	**$0**	0	**$0**	**$0**
	2000	200	1.7	37	119	7	162	**$330,000**	84	**$160,000**	600	**$30,000**	**$110,000**
	2500	700	5.8	70	119	23	212	**$430,000**	159	**$310,000**	1425	**$60,000**	**$110,000**
	3000	1200	10.0	103	119	40	261	**$530,000**	234	**$450,000**	2250	**$90,000**	**$110,000**
	3500	1700	14.2	136	119	56	311	**$630,000**	309	**$590,000**	3075	**$130,000**	**$210,000**
	4000	2200	18.3	169	119	73	360	**$730,000**	384	**$730,000**	3900	**$160,000**	**$210,000**
	4500	2700	22.5	202	119	89	410	**$820,000**	459	**$880,000**	4725	**$190,000**	**$310,000**
	5000	3200	26.7	235	119	106	459	**$920,000**	534	**$1,020,000**	5550	**$230,000**	**$310,000**
Max Feasible Per Length	5500	3700	30.8	268	119	122	509	**$1,020,000**	609	**$1,160,000**	6375	**$260,000**	**$410,000**
	6000	4200	35.0	301	119	139	558	**$1,120,000**	684	**$1,300,000**	7200	**$290,000**	**$410,000**
	6500	4700	39.2	334	119	155	608	**$1,220,000**	759	**$1,450,000**	8025	**$330,000**	**$410,000**
	7000	5200	43.3	367	119	172	657	**$1,320,000**	834	**$1,590,000**	8850	**$360,000**	**$510,000**
	7500	5700	47.5	400	119	188	707	**$1,420,000**	909	**$1,730,000**	9675	**$390,000**	**$510,000**
	8000	6200	51.7	433	119	205	756	**$1,520,000**	984	**$1,870,000**	10500	**$420,000**	**$610,000**
	8500	6700	55.8	466	119	221	806	**$1,620,000**	1059	**$2,020,000**	11325	**$460,000**	**$610,000**
	9000	7200	60.0	499	119	238	855	**$1,720,000**	1134	**$2,160,000**	12150	**$490,000**	**$610,000**



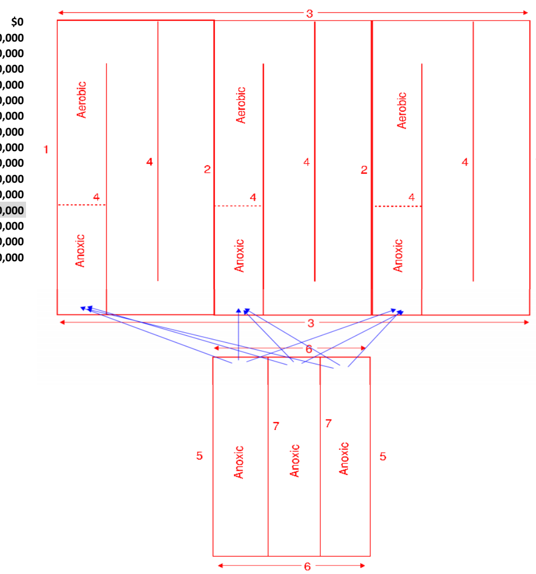
MBR System Cost

	Total Anoxic Volu	Extra Anoxic Zone Volu	Div 2		Div 3		Div 11	Div 16	Estimate Contingency	**TOTAL**		
	m3	m3	Excavation/Bac	Allowance for Pip	Walls	Base Slab	Additional Mixers	Adder for Mixers	20%		**Adder Compared to Baseline**	**% of Baseline**
Baseline	1800	0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	0%
	2000	200	$30,000	$100,000	$330,000	$160,000	$110,000	$22,000	$150,400	**$910,000**	$910,000	3%
	2500	700	$60,000	$100,000	$430,000	$310,000	$110,000	$22,000	$206,400	**$1,240,000**	$1,240,000	4%
	3000	1200	$90,000	$100,000	$530,000	$450,000	$110,000	$22,000	$260,400	**$1,570,000**	$1,570,000	6%
	3500	1700	$130,000	$100,000	$630,000	$590,000	$210,000	$42,000	$340,400	**$2,050,000**	$2,050,000	7%
	4000	2200	$160,000	$100,000	$730,000	$730,000	$210,000	$42,000	$394,400	**$2,370,000**	$2,370,000	8%
	4500	2700	$190,000	$100,000	$820,000	$880,000	$310,000	$62,000	$472,400	**$2,840,000**	$2,840,000	10%
	5000	3200	$230,000	$100,000	$920,000	$1,020,000	$310,000	$62,000	$528,400	**$3,180,000**	$3,180,000	11%
Max Feasible Per Length	5500	3700	$260,000	$100,000	$1,020,000	$1,160,000	$410,000	$82,000	$606,400	**$3,640,000**	$3,640,000	13%
	6000	4200	$290,000	$100,000	$1,120,000	$1,300,000	$410,000	$82,000	$660,400	**$3,970,000**	$3,970,000	14%
	6500	4700	$330,000	$100,000	$1,220,000	$1,450,000	$410,000	$82,000	$718,400	**$4,320,000**	$4,320,000	15%
	7000	5200	$360,000	$100,000	$1,320,000	$1,590,000	$510,000	$102,000	$796,400	**$4,780,000**	$4,780,000	17%
	7500	5700	$390,000	$100,000	$1,420,000	$1,730,000	$510,000	$102,000	$850,400	**$5,110,000**	$5,110,000	18%
	8000	6200	$420,000	$100,000	$1,520,000	$1,870,000	$610,000	$122,000	$928,400	**$5,580,000**	$5,580,000	20%
	8500	6700	$460,000	$100,000	$1,620,000	$2,020,000	$610,000	$122,000	$986,400	**$5,920,000**	$5,920,000	21%
	9000	7200	$490,000	$100,000	$1,720,000	$2,160,000	$610,000	$122,000	$1,040,400	**$6,250,000**	$6,250,000	22%

PRE-ANOXIC - 3 TANKS UPSTREAM - FUTURE

Number of Anoxic Tanks	3	
Tank Width (m)	10	
SWD (m)	6	
Tank Exterior/Separation Wall Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Freeboard (m)	0.6	
No. Exterior Length Walls	2	*Consistent with Ref Baseline Calculation*
Exterior Walls Additional Length (m)	3	*Consistent with Ref Baseline Calculation*
No. Exterior Width Walls (Anoxic)	2	
Exterior Walls Additional Width (m)	5	*Consistent with Ref Baseline Calculation*
Base Slab Thickness (m)	0.6	*Consistent with Ref Baseline Calculation*
Excavation/Backfill Unit Price ($/m3)	$40	
Base Slab Unit Price ($/m3)	$1,900	
Walls Unit Price ($/m3)	$2,000	
Waterloo WWTP Anoxic Zone Mixer Quote	$134,680	*Cost based on quote for 4x 2500mm Invent mixers. Each mixer sized for basin volume of 757 m3 with length/width 11.7m and water depth 5.6 m*
Napanee Post-EQ Mixer Quote	$100,800	*Cost for 2x 2500mm Invent mixers to fully mix 28m long tank (7m width, variable depth)*
Cost per 2500mm Invent Mixer	$50,442	*Assumed average cost per Invent Mixer, sufficient to mix a tank 6m deep, 10x10 in dimension. Per dicsussion with Amy, Invent mixers perform best in square volumes, and operate in series when tank is rectagular (i.e. anoxic volume of 10m wide by XXm long). Added 20% for buffer*

	TOTAL VOLUME	**Pre-Train Anoxic Tank**		**WALL CONCRETE VOLUMES (SEE BELOW)**									
	Anoxic Zone	Anoxic Tank	Anoxic Zone Le	5	6	7	Wall Vol.	**Wall Cost**	Anoxic Base Slab Vol.	**Base Slab Cost**	Anoxic Excavation/Backfill	**Excavation/Backfill Cost**	**Mechanical Mixers**
	m3	m3	m	m3, total	m3, total	m3, total	m3	**$**	m3	**$**	m3	**$**	**$**
Baseline	1800	0	0.0	0	0	0	0	**$0**	0	**$0**	0	**$0**	**$0**
	2000	200	1.1	33	119	9	160	**$330,000**	111	**$220,000**	590	**$30,000**	**$160,000**
	2500	700	3.9	55	119	31	204	**$410,000**	186	**$360,000**	1390	**$60,000**	**$160,000**
	3000	1200	6.7	77	119	53	248	**$500,000**	261	**$500,000**	2190	**$90,000**	**$160,000**
	3500	1700	9.4	99	119	75	292	**$590,000**	336	**$640,000**	2990	**$120,000**	**$160,000**
	4000	2200	12.2	121	119	97	336	**$680,000**	411	**$790,000**	3790	**$160,000**	**$310,000**
	4500	2700	15.0	143	119	119	380	**$770,000**	486	**$930,000**	4590	**$190,000**	**$310,000**
	5000	3200	17.8	165	119	141	424	**$850,000**	561	**$1,070,000**	5390	**$220,000**	**$310,000**
	5500	3700	20.6	187	119	163	468	**$940,000**	636	**$1,210,000**	6190	**$250,000**	**$460,000**
	6000	4200	23.3	209	119	185	512	**$1,030,000**	711	**$1,360,000**	6990	**$280,000**	**$460,000**
	6500	4700	26.1	231	119	207	556	**$1,120,000**	786	**$1,500,000**	7790	**$320,000**	**$460,000**
	7000	5200	28.9	253	119	229	600	**$1,210,000**	861	**$1,640,000**	8590	**$350,000**	**$460,000**
Max Feasible Per Length	7500	5700	31.7	275	119	251	644	**$1,290,000**	936	**$1,780,000**	9390	**$380,000**	**$610,000**
	8000	6200	34.4	297	119	273	688	**$1,380,000**	1011	**$1,930,000**	10190	**$410,000**	**$610,000**
	8500	6700	37.2	319	119	295	732	**$1,470,000**	1086	**$2,070,000**	10990	**$440,000**	**$610,000**
	9000	7200	40.0	341	119	317	776	**$1,560,000**	1161	**$2,210,000**	11790	**$480,000**	**$610,000**



MBR System Cost

	Total Anoxic Volu	Extra Anoxic Zone Vol	Div 2		Div 3		Div 11	Div 16	Estimate Contingency	**TOTAL**		
	m3	m3	Excavation/Bac	Allowance for Pip	Walls	Base Slab	Additional Mixers	Adder for Mixers	20%		**Adder Compared to Baseline**	**% of Baseline**
Baseline	1800	0	$0	$0	$0	$0	$0	$0	$0	**$0**	$0	0%
	2000	200	$30,000	$100,000	$330,000	$220,000	$160,000	$32,000	$174,400	**$1,050,000**	$1,050,000	4%
	2500	700	$60,000	$100,000	$410,000	$360,000	$160,000	$32,000	$224,400	**$1,350,000**	$1,350,000	5%
	3000	1200	$90,000	$100,000	$500,000	$500,000	$160,000	$32,000	$276,400	**$1,660,000**	$1,660,000	6%
	3500	1700	$120,000	$100,000	$590,000	$640,000	$160,000	$32,000	$328,400	**$1,980,000**	$1,980,000	7%
	4000	2200	$160,000	$100,000	$680,000	$790,000	$310,000	$62,000	$420,400	**$2,530,000**	$2,530,000	9%
	4500	2700	$190,000	$100,000	$770,000	$930,000	$310,000	$62,000	$472,400	**$2,840,000**	$2,840,000	10%
	5000	3200	$220,000	$100,000	$850,000	$1,070,000	$310,000	$62,000	$522,400	**$3,140,000**	$3,140,000	11%
	5500	3700	$250,000	$100,000	$940,000	$1,210,000	$460,000	$92,000	$610,400	**$3,670,000**	$3,670,000	13%
	6000	4200	$280,000	$100,000	$1,030,000	$1,360,000	$460,000	$92,000	$664,400	**$3,990,000**	$3,990,000	14%
	6500	4700	$320,000	$100,000	$1,120,000	$1,500,000	$460,000	$92,000	$718,400	**$4,320,000**	$4,320,000	15%
	7000	5200	$350,000	$100,000	$1,210,000	$1,640,000	$460,000	$92,000	$770,400	**$4,630,000**	$4,630,000	16%
Max Feasible Per Length	7500	5700	$380,000	$100,000	$1,290,000	$1,780,000	$610,000	$122,000	$856,400	**$5,140,000**	$5,140,000	18%
	8000	6200	$410,000	$100,000	$1,380,000	$1,930,000	$610,000	$122,000	$910,400	**$5,470,000**	$5,470,000	19%
	8500	6700	$440,000	$100,000	$1,470,000	$2,070,000	$610,000	$122,000	$962,400	**$5,780,000**	$5,780,000	21%
	9000	7200	$480,000	$100,000	$1,560,000	$2,210,000	$610,000	$122,000	$1,016,400	**$6,100,000**	$6,100,000	22%

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for **people**

B

Appendix B: Conceptual Design Drawings

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Hamilton

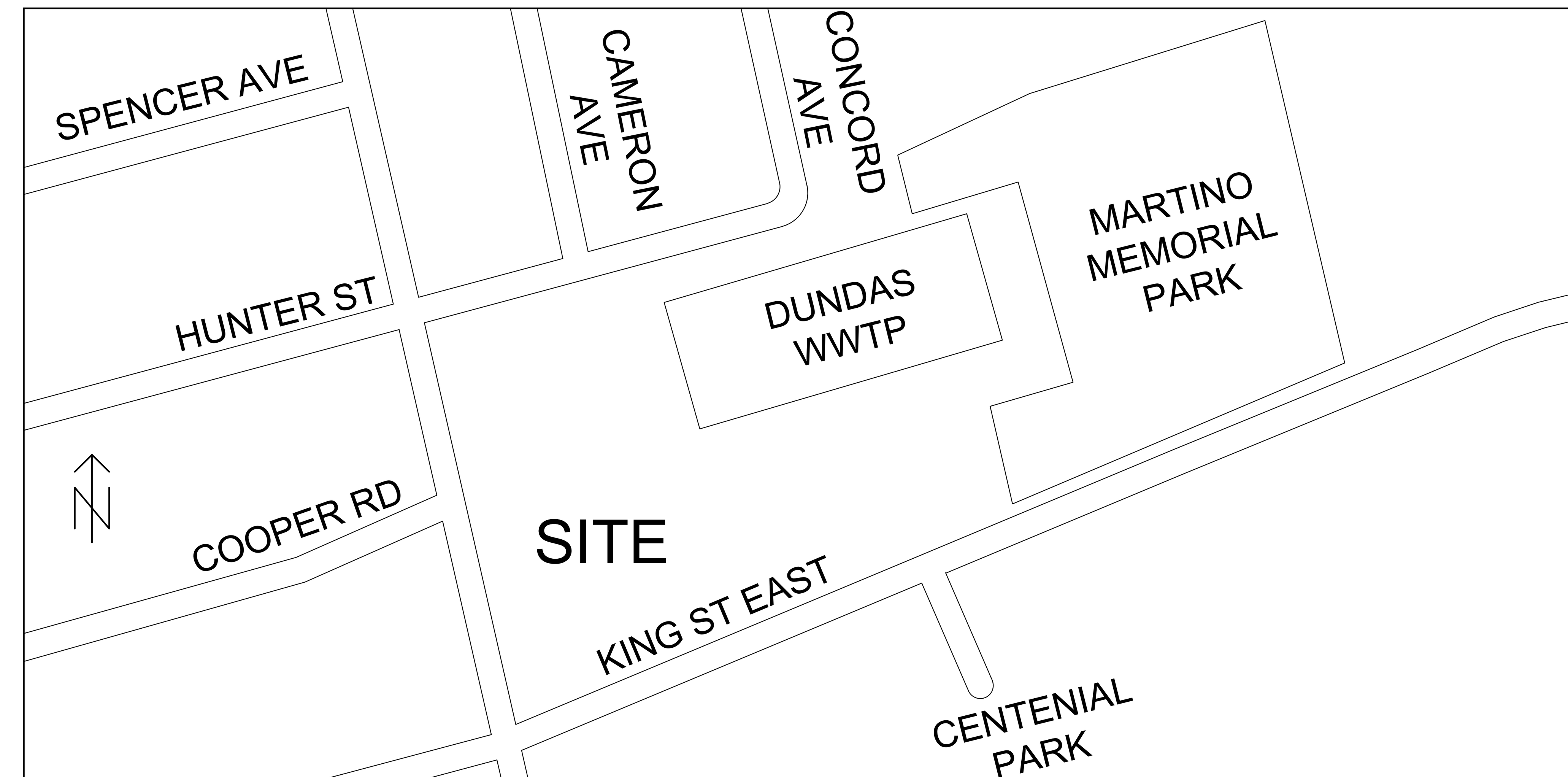
PUBLIC WORKS DEPARTMENT

General Manager, Gerry Davis, CMA

ISSUED FOR CONCEPTUAL DESIGN

Hunter St. , East St. N and King St. E

Facility Upgrade Plan for the Dundas Wastewater Treatment Plant



KEY PLAN

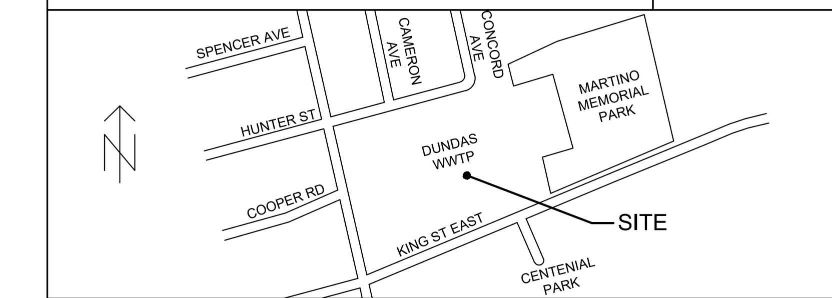
NTS

Issued for :
☒ Conceptual Design

City of Hamilton

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–G001.DWG
SHEET No. G001 OF 16



KEY PLAN
N.T.S.

DRAWING INDEX	
SHEET NO.	DESCRIPTION
GENERAL	
G000	COVER PAGE
G001	DRAWING INDEX 1
CIVIL	
C100	EXISTING SITE PLAN AND CONTRACTOR LIMITS
C101	SITE PLAN
ARCHITECTURAL	
A101	GROUND FLOOR PLAN
A201	BUILDING ELEVATIONS
A901	3D VIEWS
PROCESS	
D001	HYDRAULIC PROFILE
D002	PROCESS FLOW DIAGRAM
D111	INFLUENT SEWAGE PUMPING STATION - GROUND FLOOR WET WELL AND VALVE CHAMBER PLANS
D211	HEADWORKS BUILDING - GROUND AND BASEMENT FLOOR PLANS
D311	BLOWER BUILDING - GROUND FLOOR PLAN
D411	AERATION TANKS - PLAN & SECTIONS
D511	MEMBRANE EQUIPMENT AND UV BUILDING - BASEMENT FLOOR PLAN
D512	MEMBRANE EQUIPMENT AND UV BUILDING - GROUND FLOOR PLAN
D811	SLUDGE LOADING SYSTEM - GROUND PLAN

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: A.E DATE: 21–06–2024
CHECKED BY: G.A. DATE: 21–06–2024
APPROVED BY: G.A. DATE: 21–06–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
NTS

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DRAWING INDEX

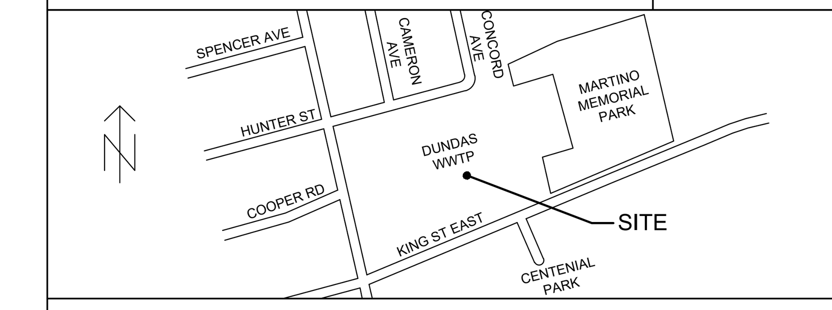
FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN METERS UNLESS OTHERWISE NOTED

DRAWING No. T001774A	SHEET No. C100
FILE No. T001774A-C001.DWG	OF 16

LEGEND:

— · · —	PROPERTY LIMIT	●	EXISTING SANITARY MANHOLE
—X—	EXISTING CHAIN LINK FENCE	○	EXISTING STORM MANHOLE
—W—	EXISTING WATER	VC	EXISTING VALVE CHAMBER
—SA—	EXISTING SANITARY	VB	EXISTING WATER VALVE BOX
—ST—	EXISTING STORM	HYD	EXISTING HYDRANT
—FM—	EXISTING FORCE MAIN	CB	EXISTING CATCH BASIN
—GM—	EXISTING GAS		
—H—	EXISTING HYDRO		
—OH—	EXISTING OVERHEAD WIRES		



KEY PLAN
N.T.S.

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY:	C.C.	DATE:	10-06-2024
CHECKED BY:	G.A.	DATE:	10-06-2024
APPROVED BY:	G.A.	DATE:	10-06-2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
V: NTS
H: 1:500

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EXISTING SITE PLAN AND CONTRACTOR LIMITS

FACILITY UPGRADE PLAN
DUNDAS WWTP

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: C.C. DATE: 10-06-2024
CHECKED BY: G.A. DATE: 10-06-2024
APPROVED BY: G.A. DATE: 10-06-2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
V: NTS
H: 1:500

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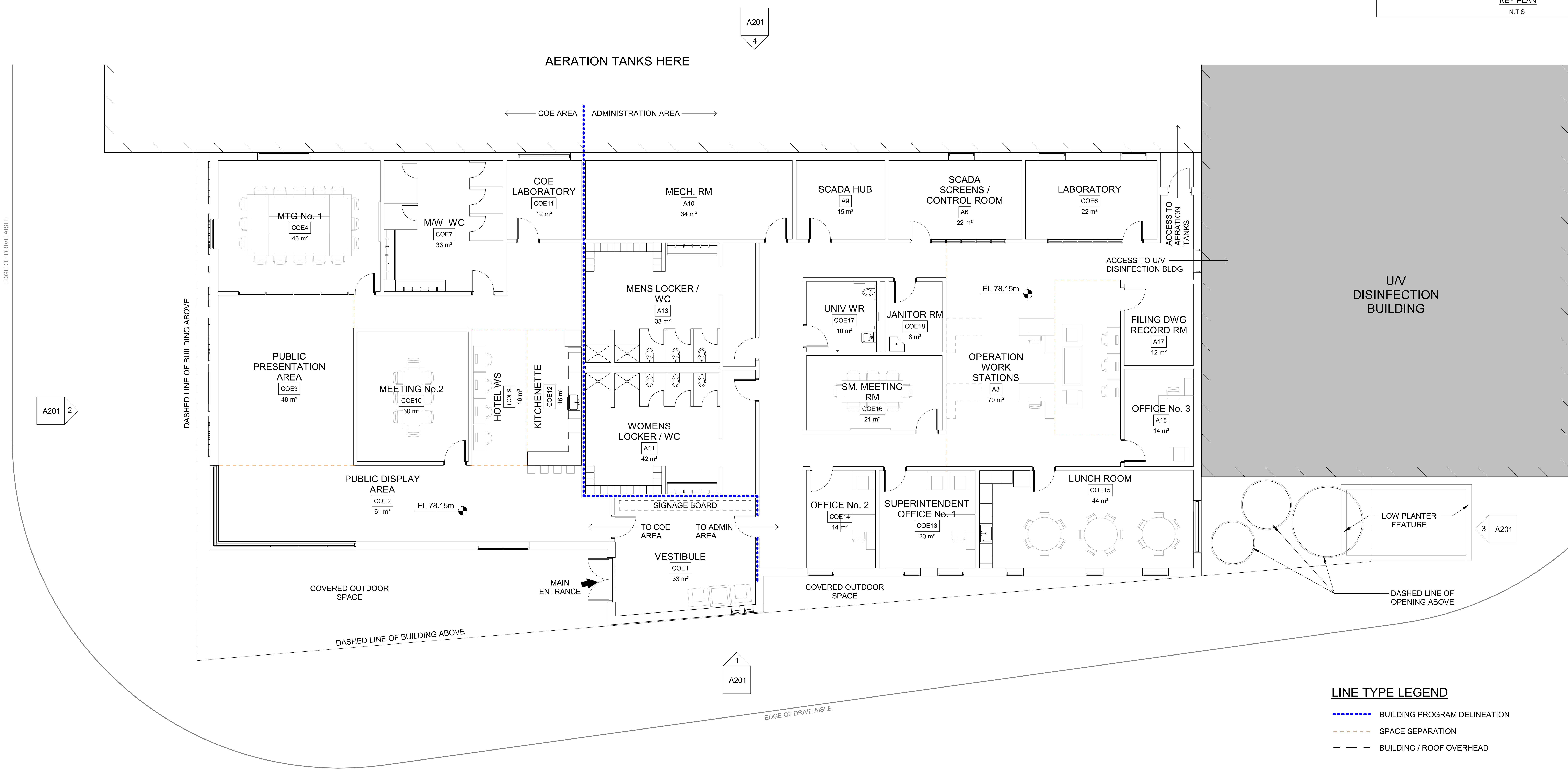
SITE PLAN

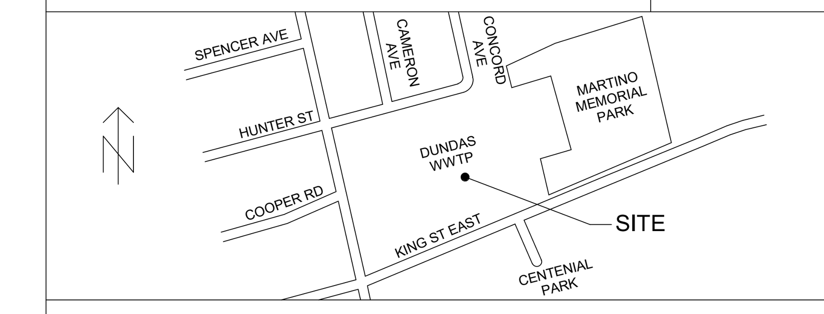
FACILITY UPGRADE PLAN
DUNDAS WWTP

DRAWING No. T001744A
SHEET No. C101
XX OF
FILE No. T001744A-C002.DWG

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. Facility Upgrade Plan Dundas WWTP
SHEET No. A101 ## OF ##





KEY PLAN
N.T.S.

LINE TYPE LEGEND

- BUILDING PROGRAM DELINEATION
- SPACE SEPARATION
- BUILDING / ROOF OVERHEAD

1 GROUND FLOOR PLAN

SCALE: 1 : 100

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SHEET No. A101

DRAWING No. T001744A

NO.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	W.H.	JUNE 2024

DRAWN BY: D.D DATE: 10-06-2024
CHECKED BY: W.H. DATE: 10-06-2024
APPROVED BY: W.H. DATE: 10-06-2024

Geodetic Bench Mark Index No. BM 100-16
Elevation= 211.614m

SCALE
H: 1 : 100

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GROUND FLOOR PLAN

FACILITY UPGRADE PLAN DUNDAS WWTP

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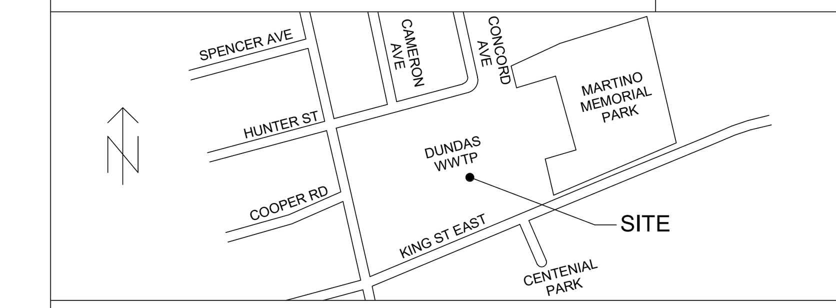
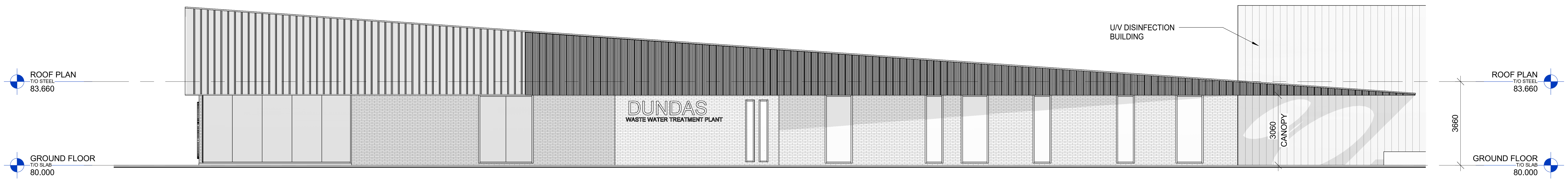
DRAWING No. T001744A
FILE No. Facility Upgrade Plan Dundas WWTP
SHEET No. A201 OF



KEY PLAN
N.T.S.



1 SOUTH ELEVATION
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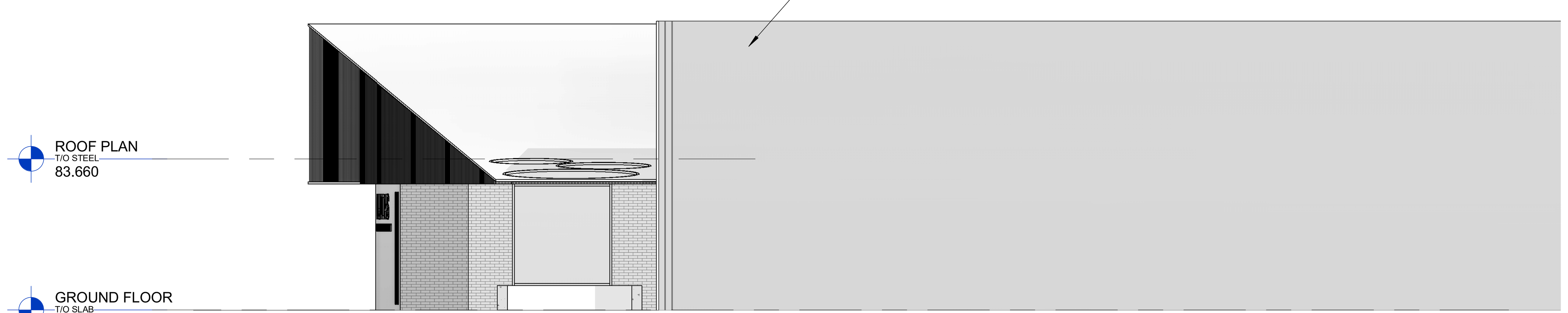

3 EAST ELEVATION
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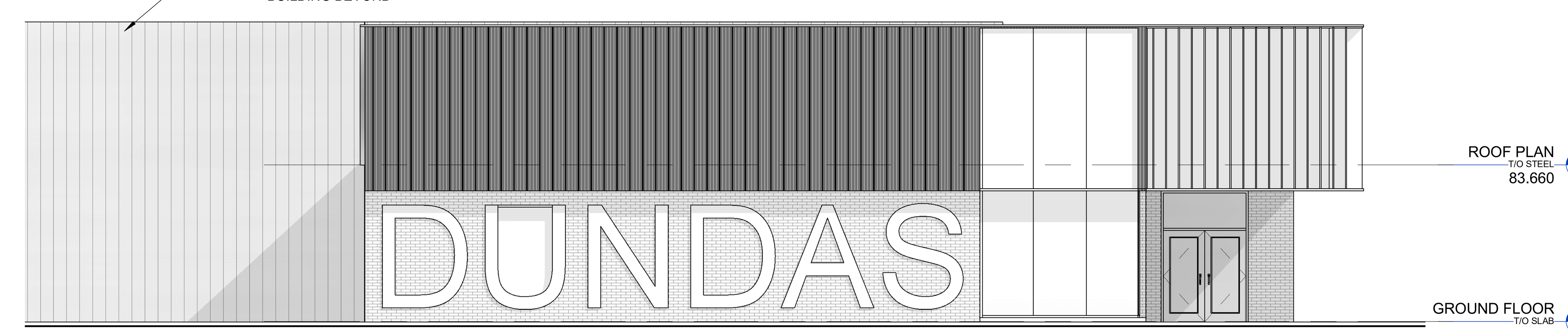

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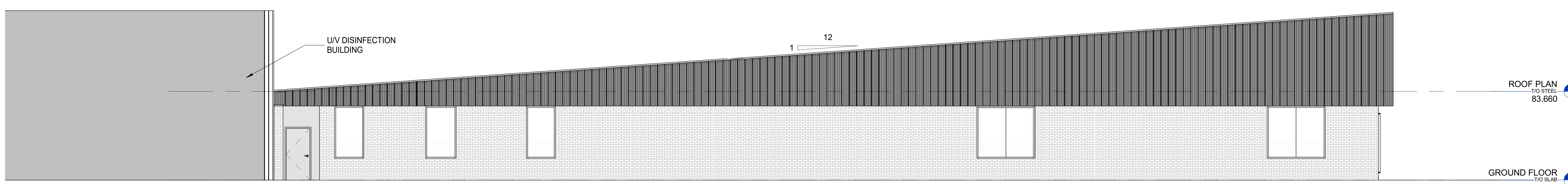

4 NORTH ELEVATION
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SHEET No. A201
DRAWING No. T001744A

NO.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	W.H.	JUNE 2024

DRAWN BY: D.D DATE: 10-06-2024
CHECKED BY: W.H. DATE: 10-06-2024
APPROVED BY: W.H. DATE: 10-06-2024

Geodetic Bench Mark Index No. BM 100-16
Elevation= 211.614m

SCALE
H: 1 : 100

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Public Works Department

BUILDING ELEVATIONS

FACILITY UPGRADE PLAN
DUNDAS WWTP

2024-07-03 4:28:08 PM

FILE NAME: Autodesk Docs://Facility Upgrade Plan Dundas WWTP (Hamilton)/T001744A-A.rvt

SHEET No. A901

DRAWING No. T001744A

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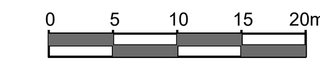
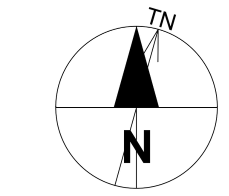
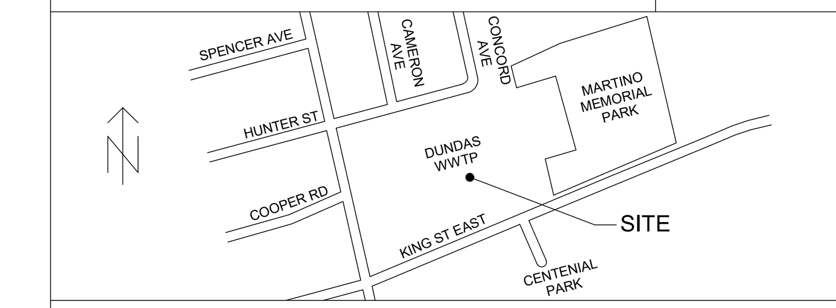
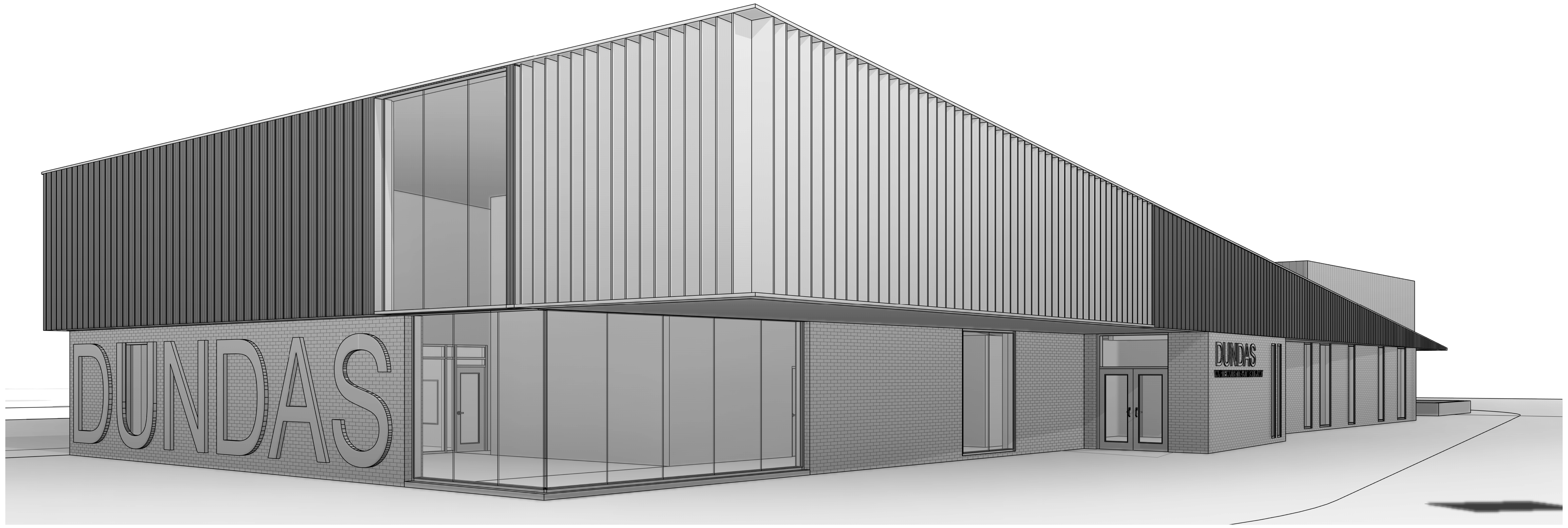






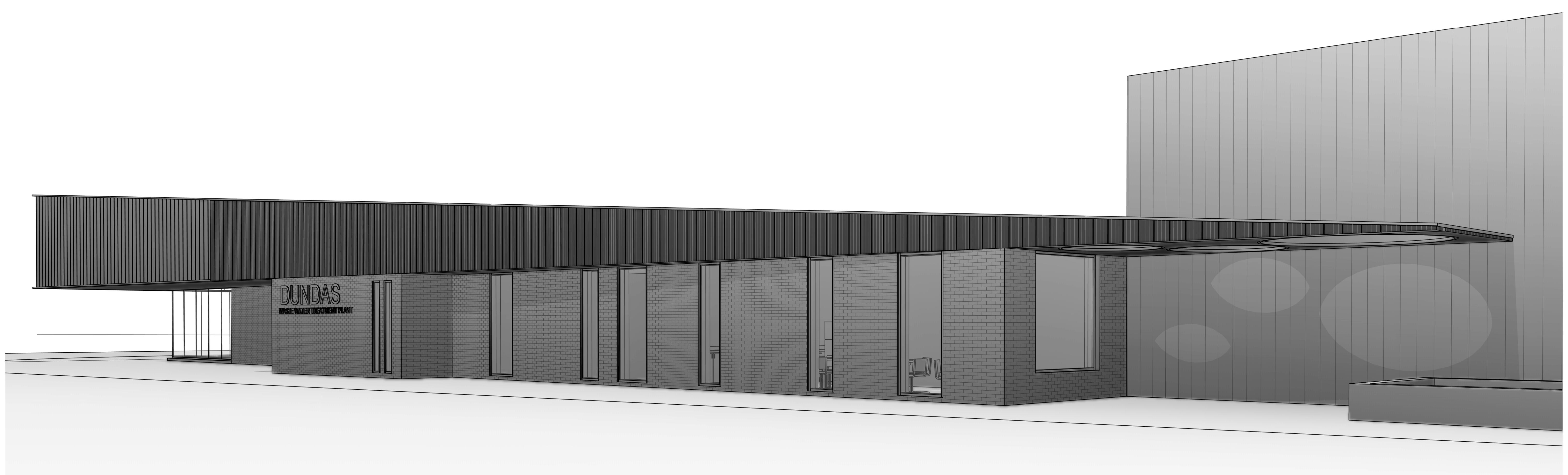
KEY PLAN

N.T.S.

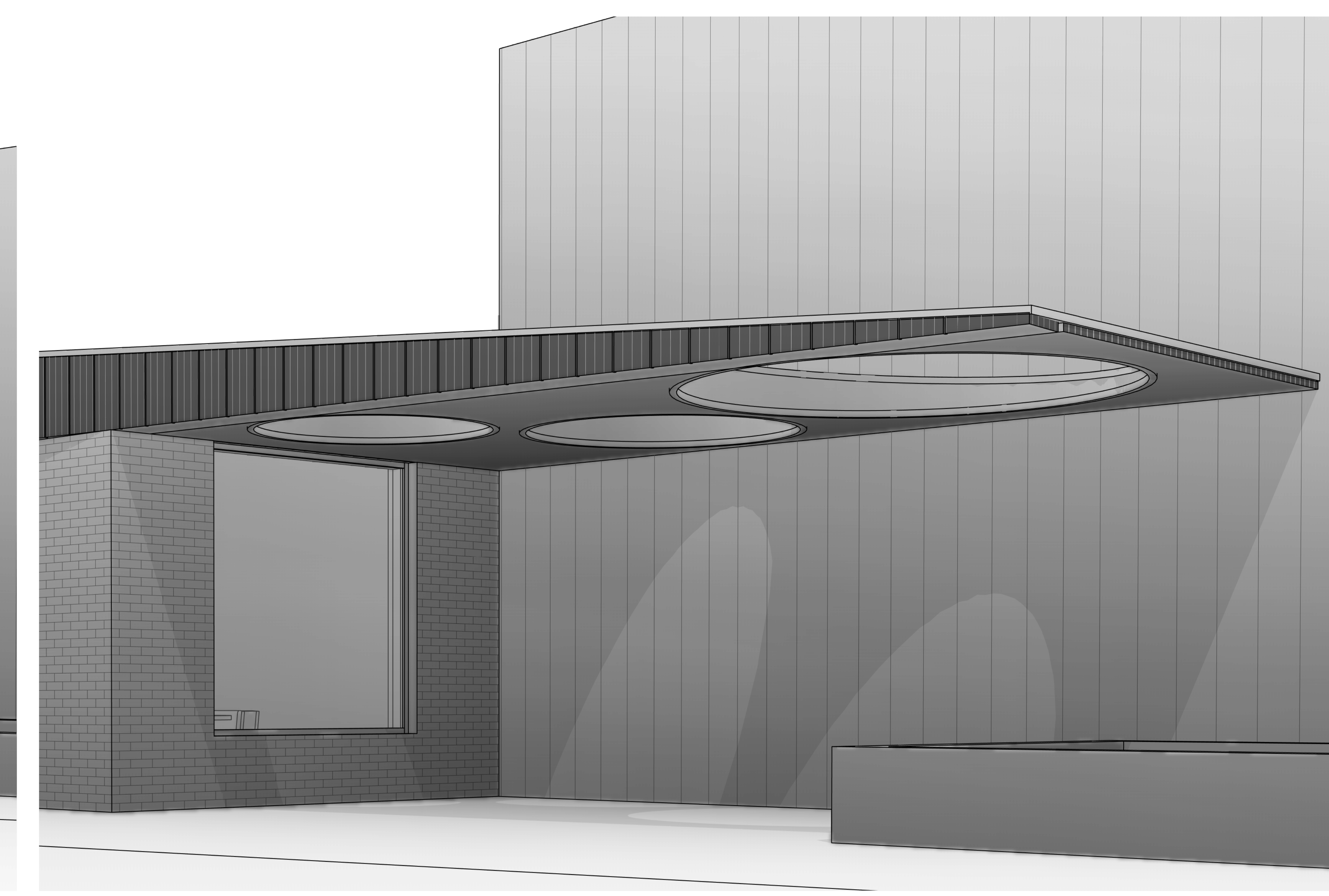


1 3D PERSPECTIVE - SOUTH WEST

4 3D PERSPECTIVE - ENTRANCE



2 3D PERSPECTIVE - SOUTH EAST



3 3D PERSPECTIVE - CANOPY OPENINGS

NO.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	W.H.	JUNE 2024

DRAWN BY: D.D.	DATE: 10-06-2024
CHECKED BY: W.H.	DATE: 10-06-2024
APPROVED BY: W.H.	DATE: 10-06-2024
Geodetic Bench Mark Index No. Elevation=	BM 100-16 211.614m

SCALE

H:

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3D VIEWS

FACILITY UPGRADE PLAN DUNDAS WWTP

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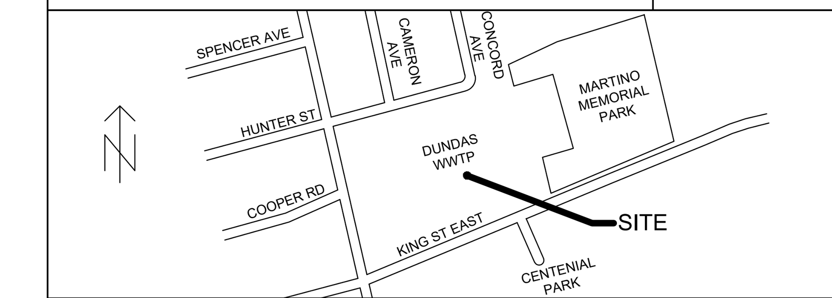
DRAWING No.	SHEET No.
T001744A	D001
FILE No. T001744A–D001.DWG	XX OF



KEY PLAN
N.T.S.

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: N.G. DATE: 29–05–2024
CHECKED BY: K.Y.K. DATE: 29–05–2024
APPROVED BY: G.A. DATE: 29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
V: 1:100
H: NTS

Hamilton

CIMA+
500-5935 AIRPORT ROAD MISSISSAUGA, ON L4V 1W5
T 905.695.1005 F 905.695.0525
www.cima.ca

CITY OF HAMILTON
Public Works Department

HYDRAULIC PROFILE

FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A

FILE No. T001744A–D002.DWG

SHEET No. D002

XX OF

KEY PLAN

N.T.S.

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: D.C. DATE: 29–05–2024
CHECKED BY: K.Y.K. DATE: 29–05–2024
APPROVED BY: G.A. DATE: 29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE

NTS

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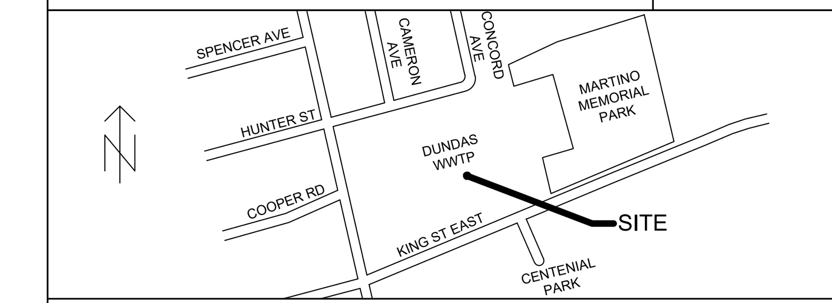
Public Works Department

PROCESS FLOW DIAGRAM

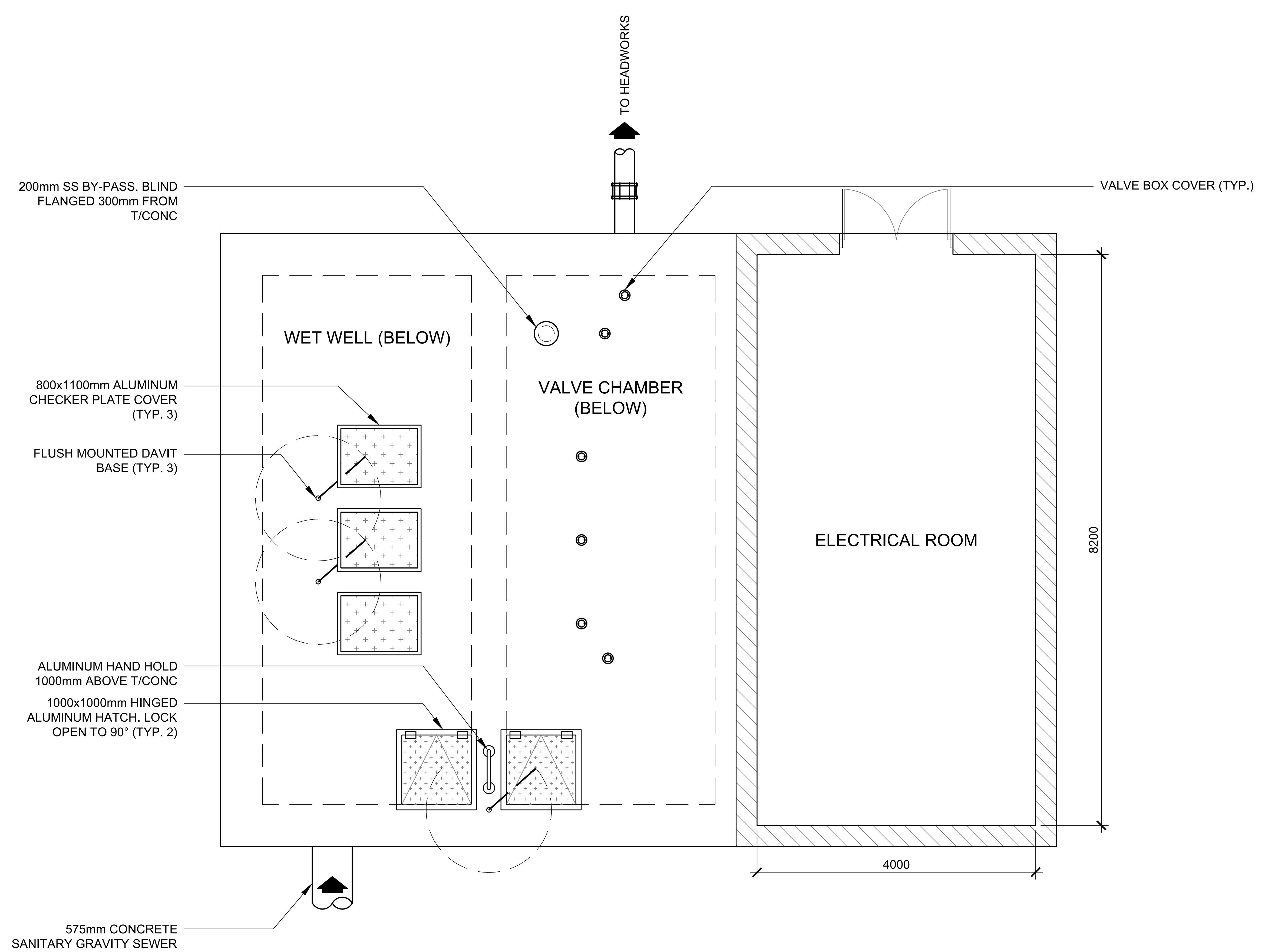
FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

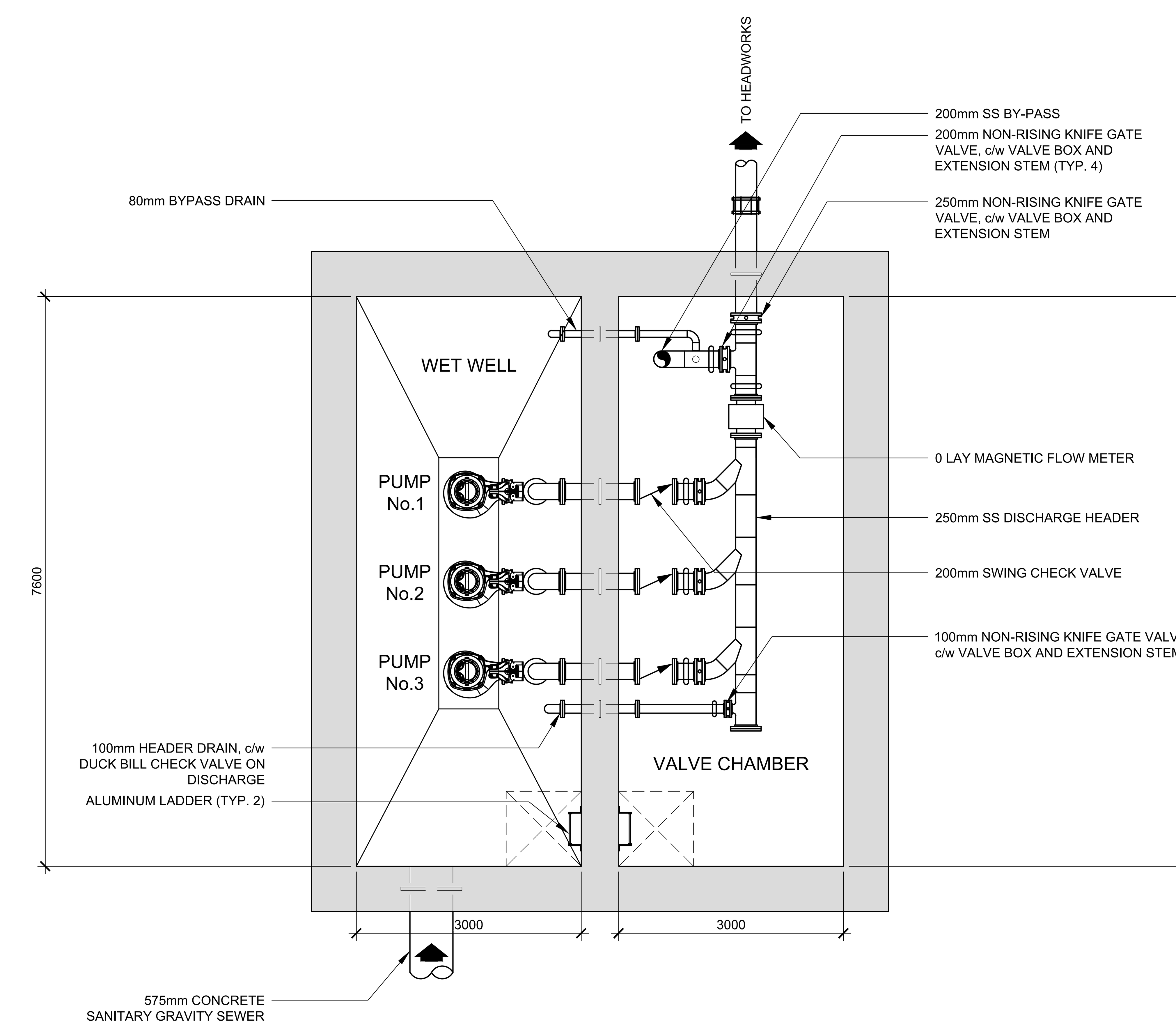
DRAWING No. T001744A
FILE No. T001744A–D111.DWG
SHEET No. D111
XX OF



KEY PLAN
N.T.S.



1 GROUND FLOOR
SCALE: 1:50



2 WET WELL AND VALVE CHAMBER
SCALE: 1:50

-1000 0 1000 2000
1:50

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: N.G. DATE: 29–05–2024
CHECKED BY: K.Y.K. DATE: 29–05–2024
APPROVED BY: G.A. DATE: 29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE 1:50

Hamilton

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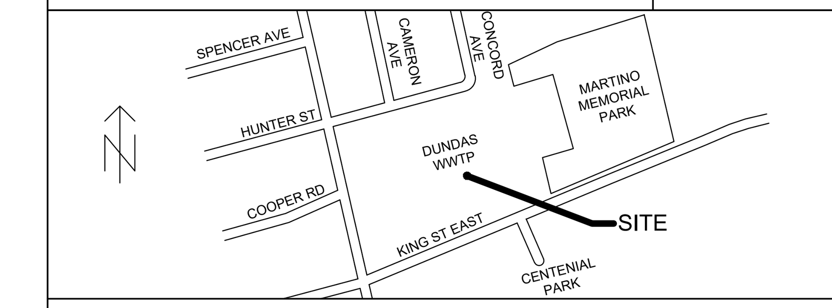
CITY OF HAMILTON
Public Works Department

INFLUENT SEWAGE PUMPING STATION
GROUND FLOOR WET WELL AND VALVE CHAMBER PLANS

FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–D211.DWG
SHEET No. D211
XX OF



KEY PLAN
N.T.S.

1 GROUND FLOOR
SCALE: 1:75

2 BASEMENT FLOOR
SCALE: 1:75

NOTES:

1. CHECKERED PLATES OR GRATING COVERS OVER SCREEN CHANNELS ARE NOT SHOWN FOR CLARITY.
2. CHANNEL MIXING DIFFUSER SYSTEM IS NOT SHOWN FOR CLARITY.
3. MECHANICAL PIPING NOT SHOWN FOR CLARITY.

1:75 -1500 0 1500 3000

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: E.M. DATE: 29-05-2024
CHECKED BY: K.Y.K. DATE: 29-05-2024
APPROVED BY: G.A. DATE: 29-05-2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
1:75

Hamilton

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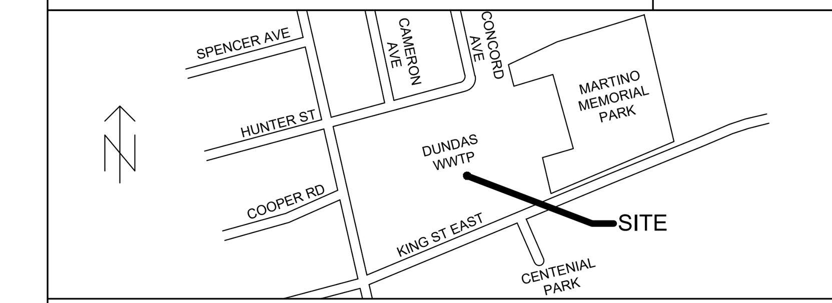
CITY OF HAMILTON
Public Works Department

HEADWORKS BUILDING
GROUND AND BASEMENT FLOOR PLANS

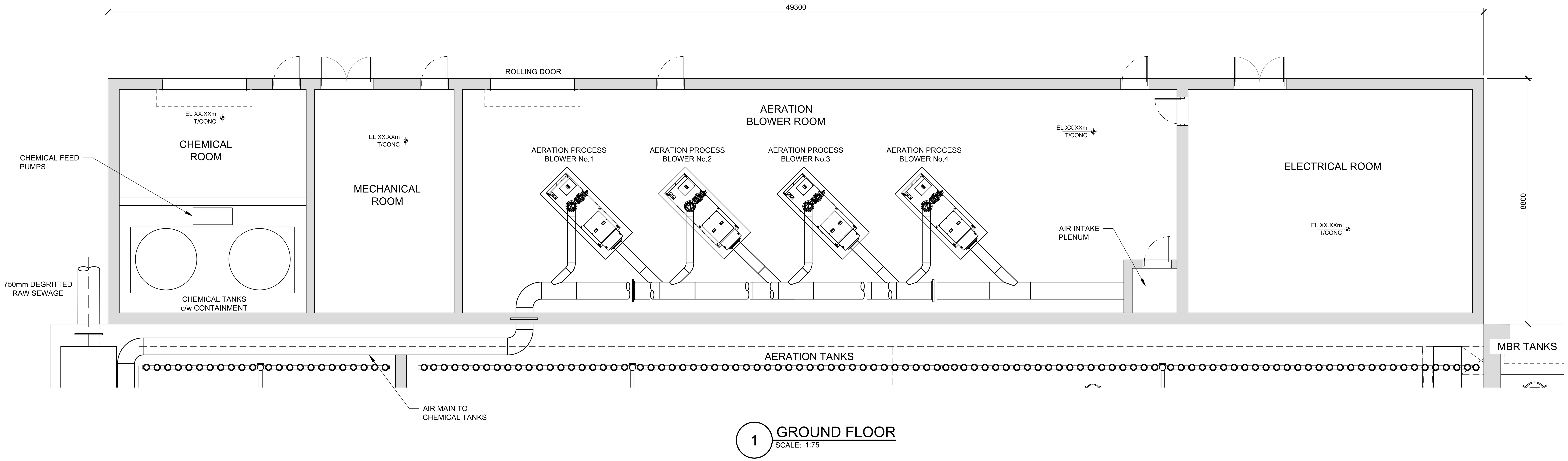
FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–D311.DWG
SHEET No. D311
XX OF



KEY PLAN
N.T.S.



1 GROUND FLOOR
SCALE: 1:75

NOTE:

1. NOT ALL PROCESS PIPING SHOWN FOR CLARITY. REFER TO D111.

-1500 0 1500 3000
1:75

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: E.M. DATE: 29–05–2024
CHECKED BY: K.Y.K. DATE: 29–05–2024
APPROVED BY: G.A. DATE: 29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE 1:75

Hamilton

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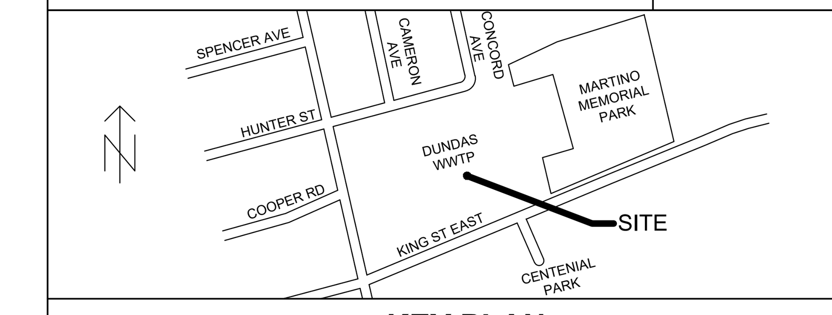
CITY OF HAMILTON
Public Works Department

BLOWER BUILDING
GROUND FLOOR PLAN

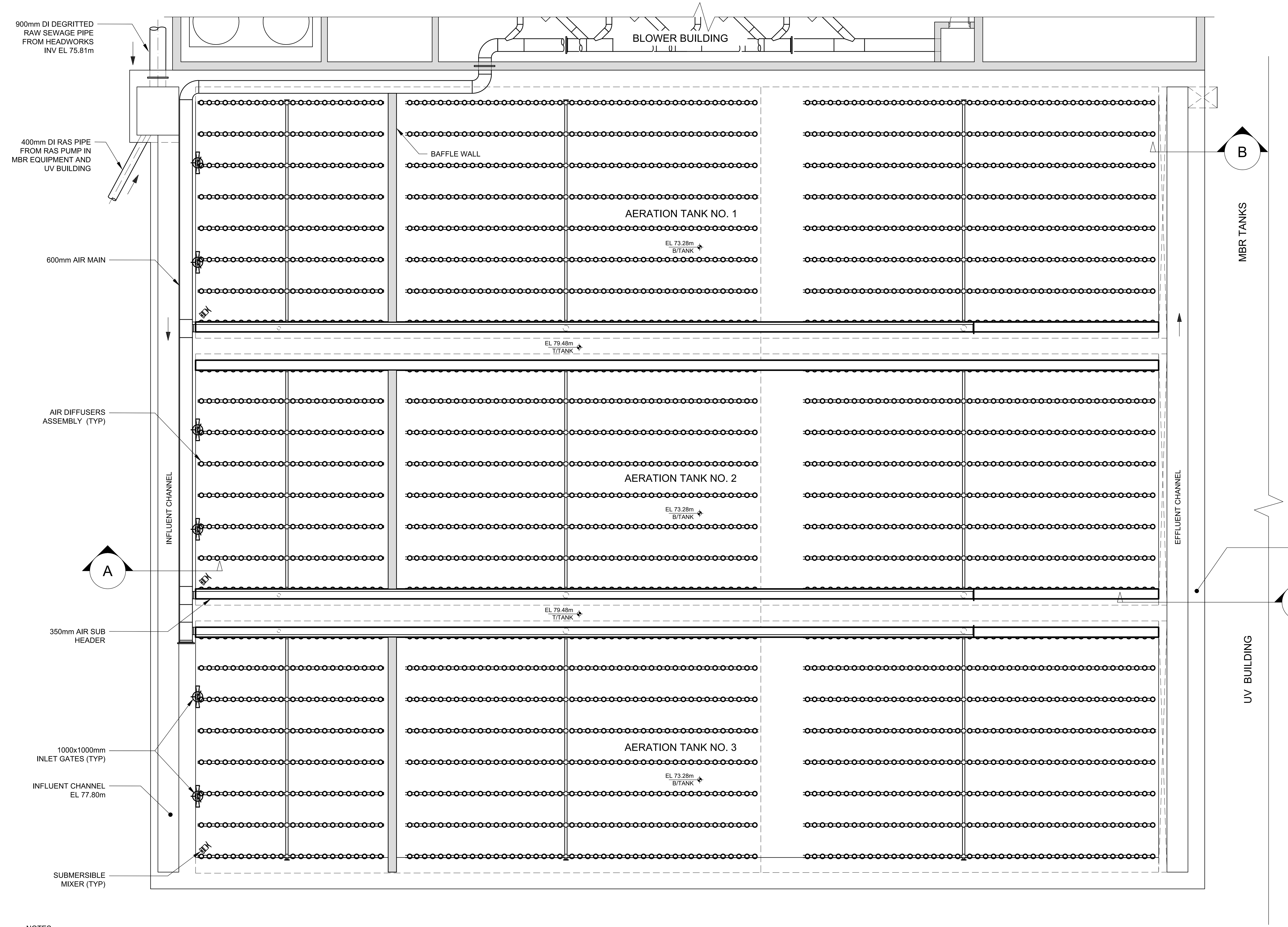
FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

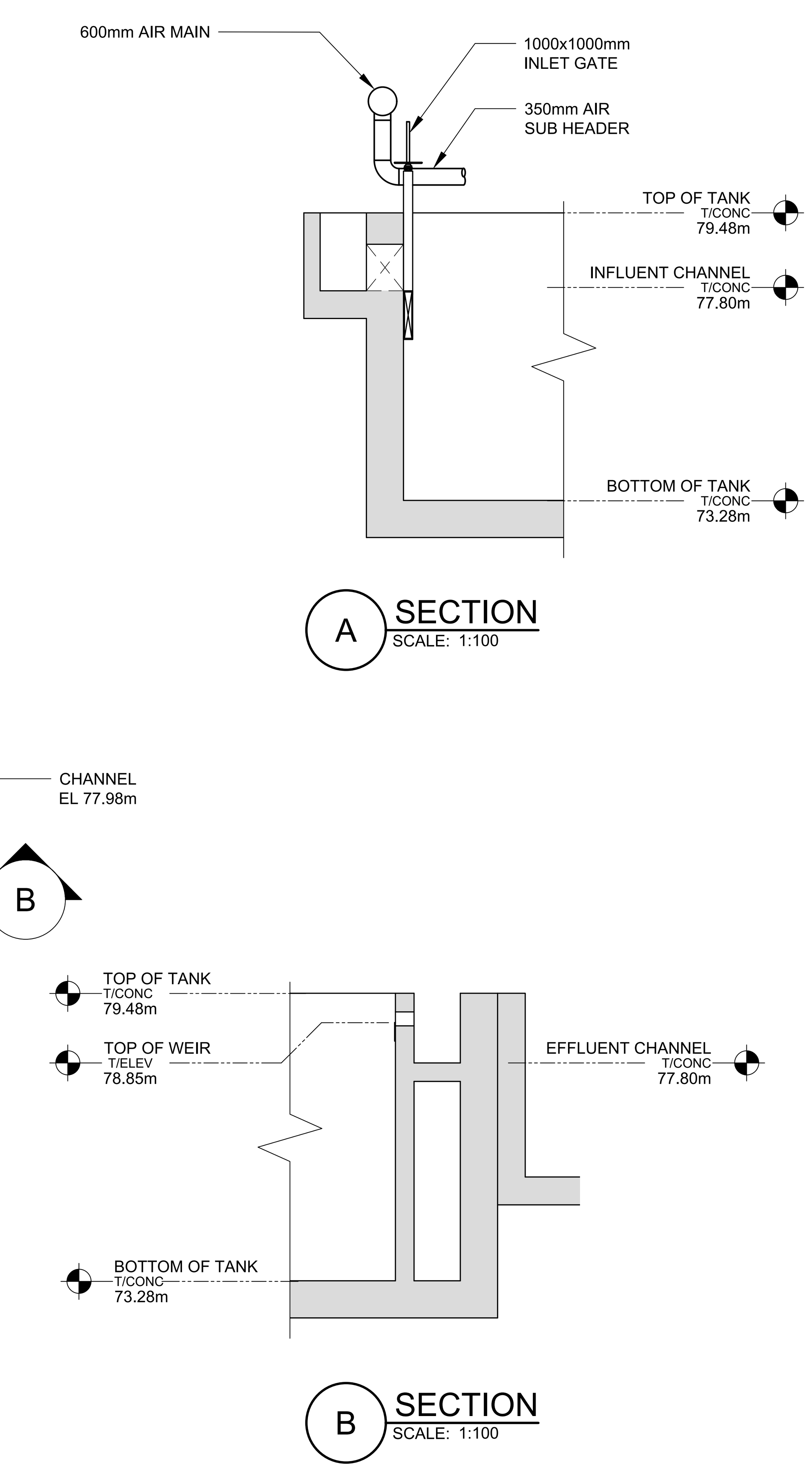
DRAWING No. T001744A
FILE No. T001744A–D411.DWG
SHEET No. D411
XX OF



KEY PLAN
N.T.S.



1 GROUND FLOOR
SCALE: 1:100



NOTES:

1. CHECKERED PLATES OR GRATING COVERS OVER INFLUENT CHANNEL, EFFLUENT CHANNEL AND MEMBRANE TANKS ARE NOT SHOWN FOR CLARITY.
2. ANOXIC ZONE MIXERS NOT SHOWN FOR CLARITY.
3. CHANNEL MIXING DIFFUSER SYSTEM NOT SHOWN FOR CLARITY.

1:100 -1000 0 2000 4000

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: E.M. DATE: 29-05-2024
CHECKED BY: K.Y.K. DATE: 29-05-2024
APPROVED BY: G.A. DATE: 29-05-2024

Geodetic Bench Mark Index No.
Elevation=

SCALE 1:100

Hamilton

CIMA+

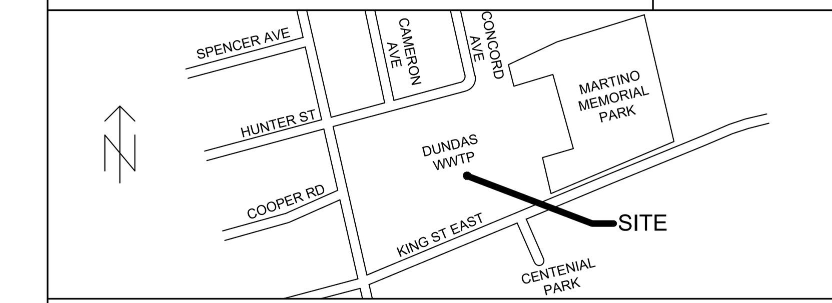
CITY OF HAMILTON
Public Works Department

AERATION TANKS
PLAN & SECTIONS

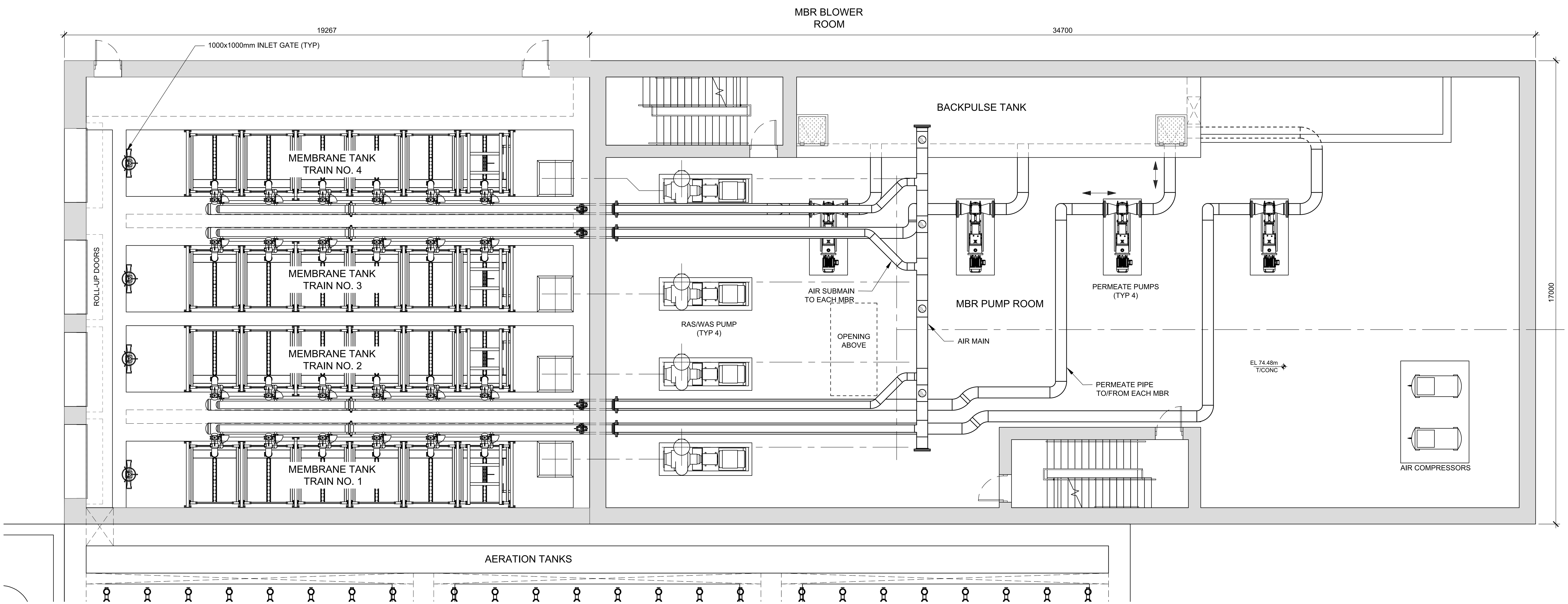
FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–D511.DWG
SHEET No. D511
XX OF



KEY PLAN
N.T.S.



1 BASEMENT FLOOR
SCALE: 1:75

NOTE:

1. NOT ALL PROCESS PIPING SHOWN FOR CLARITY. REFER TO D111.

-1500 0 1500 3000
1:75

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: E.M. DATE: 29-05-2024
CHECKED BY: K.Y.K. DATE: 29-05-2024
APPROVED BY: G.A. DATE: 29-05-2024

Geodetic Bench Mark Index No.
Elevation=

SCALE 1:75

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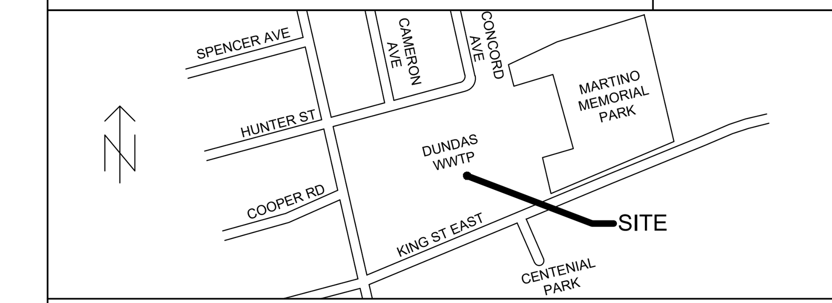
CITY OF HAMILTON
Public Works Department

MEMBRANE EQUIPMENT AND UV BUILDING BASEMENT FLOOR PLAN

FACILITY UPGRADE PLAN
DUNDAS WWTP

DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–D512.DWG
SHEET No. D512
XX OF



KEY PLAN
N.T.S.

2 GROUND FLOOR
SCALE: 1:75

NOTE:

1. CHECKERED PLATES OR GRATING COVERS OVER MEMBRANE TANKS AND UV CHANNELS ARE NOT SHOWN FOR CLARITY.
2. NOT ALL PROCESS PIPING SHOWN FOR CLARITY. REFER TO D111.

-1500 0 1500 3000
1:75

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY: E.M. DATE: 29–05–2024
CHECKED BY: K.Y.K. DATE: 29–05–2024
APPROVED BY: G.A. DATE: 29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE 1:75

Hamilton

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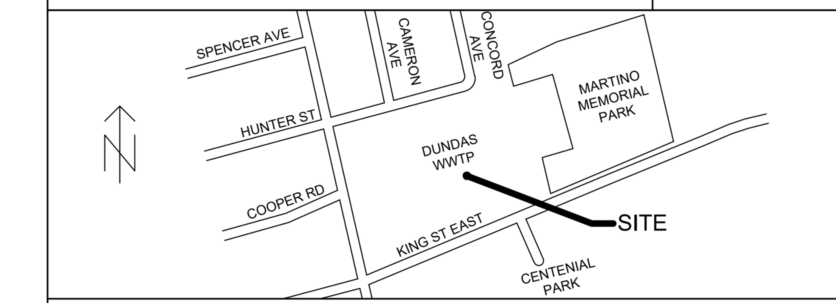
CITY OF HAMILTON
Public Works Department

MEMBRANE EQUIPMENT AND UV BUILDING GROUND FLOOR PLAN

FACILITY UPGRADE PLAN
DUNDAS WWTP

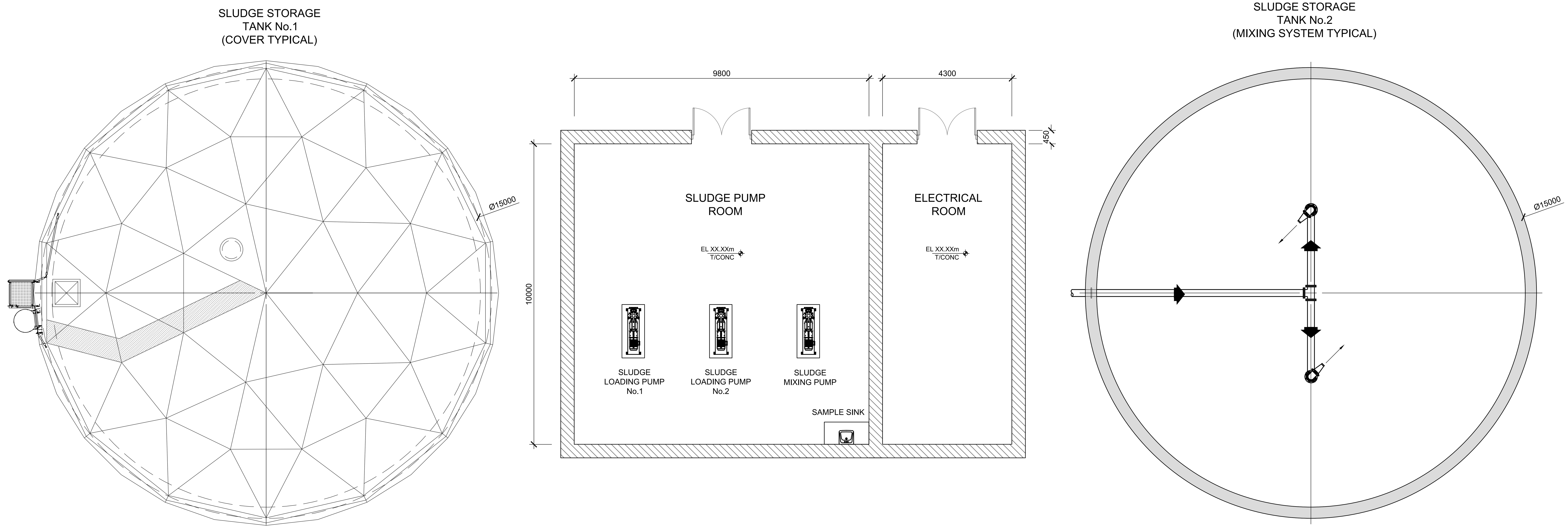
DIMENSIONS SHOWN ON THIS PLAN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

DRAWING No. T001744A
FILE No. T001744A–D811.DWG
SHEET No. D811
XX OF



KEY PLAN
N.T.S.

TRUE NORTH



1 GROUND FLOOR
SCALE: 1:50

NOTE:

1. NOT ALL PROCESS PIPING SHOWN FOR CLARITY. REFER TO D111.

-3000 0 1500 3000
1:75

No.	REVISIONS	INITIAL	DATE
A	ISSUED FOR CONCEPTUAL DESIGN	G.A.	JUNE 2024

DRAWN BY:	N.G.	DATE:	29–05–2024
CHECKED BY:	K.Y.K.	DATE:	29–05–2024
APPROVED BY:	G.A.	DATE:	29–05–2024

Geodetic Bench Mark Index No.
Elevation=

SCALE
1:75

Hamilton

CIMA+
500-5935 AIRPORT ROAD
MISSISSAUGA, ON L4V 1W5
T 905.695.1005 F 905.695.0525
www.cima.ca

CITY OF HAMILTON
Public Works Department

SLUDGE LOADING SYSTEM GROUND PLAN

FACILITY UPGRADE PLAN
DUNDAS WWTP

C

Appendix C: Equipment Cutsheets

Engineering
for **people**

C1

Appendix C1: SPS

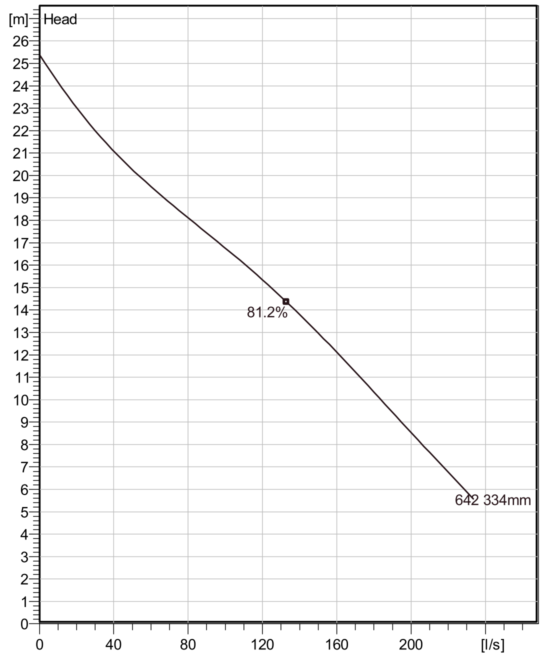
Engineering
for **people**

NP 3202 MT 3~ 642

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

Technical specification

Curves according to: Water, pure Water, pure [100%],4 °C,1 kg/dm³,1.569 mm²/s



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Configuration

Motor number
N3202.095 30-18-6AA-W 35hp

Installation type
P - Semi permanent, Wet

Impeller diameter
334 mm

Discharge diameter
200 mm

Pump information

Impeller diameter
334 mm

Discharge diameter
200 mm

Inlet diameter
250 mm

Maximum operating speed
1170 rpm

Number of blades
2

Max. fluid temperature
40 °C

Material

Impeller
Hard-Iron ™

Project	Xylect-22328103	**Created by**	Michael Matisa		
Block		**Created on**	5/22/2024	**Last update**	5/22/2024

NP 3202 MT 3~ 642

Technical specification

Motor - General

Motor number	Phases	Rated speed	Rated power
N3202.095 30-18-6AA-W 35hp	3~	1170 rpm	26 kW
ATEX approved	**Number of poles**	**Rated current**	**Stator variant**
CSA	6	34 A	3
Frequency	**Rated voltage**	**Insulation class**	**Type of Duty**
60 Hz	600 V	H	S1
Version code			
095			

Motor - Technical

Power factor - 1/1 Load	Motor efficiency - 1/1 Load	Total moment of inertia	Starts per hour max.
0.83	89.2 %	0.385 kg m²	30
Power factor - 3/4 Load	**Motor efficiency - 3/4 Load**	**Starting current, direct starting**	
0.79	89.7 %	208 A	
Power factor - 1/2 Load	**Motor efficiency - 1/2 Load**	**Starting current, star-delta**	
0.69	88.8 %	69.4 A	

Project	Xylect-22328103	Created by	Michael Matisa		
Block		Created on	5/22/2024	Last update	5/22/2024

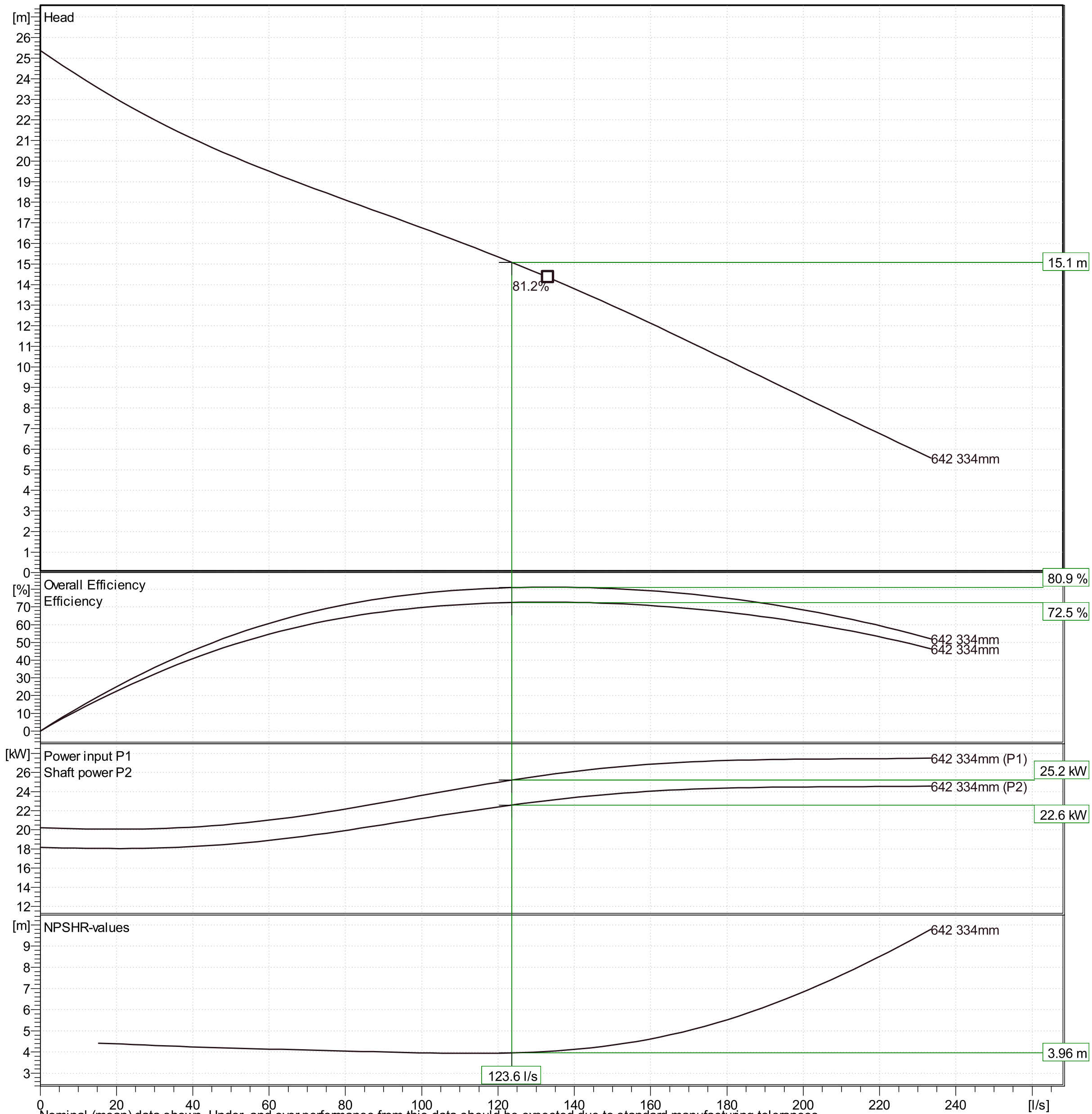
NP 3202 MT 3~ 642

Performance curve

Duty point

Flow	Head
124 l/s	15.1 m

Curves according to: Water, pure Water, pure [100%],4 °C,1 kg/dm³,1.569 mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Curve: ISO 9906

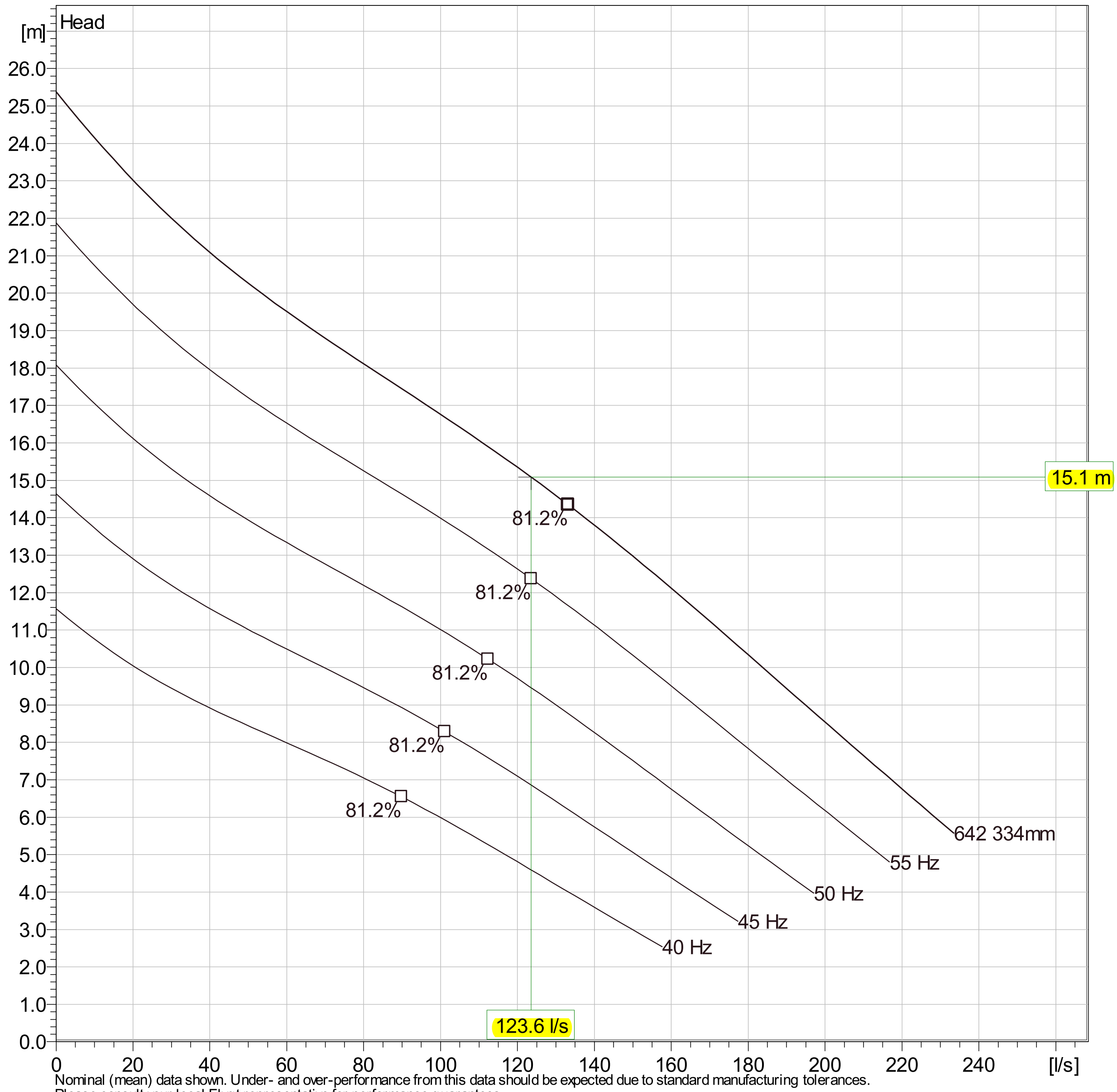
Xylect-22328103		Michael Matisa	
Created on	5/22/2024	Last update	5/22/2024

NP 3202 MT 3~ 642

Duty Analysis

FLYGT
a xylem brand

Curves according to: Water, pure [100%] ; 4°C; 1kg/dm³; 1.569mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating characteristics

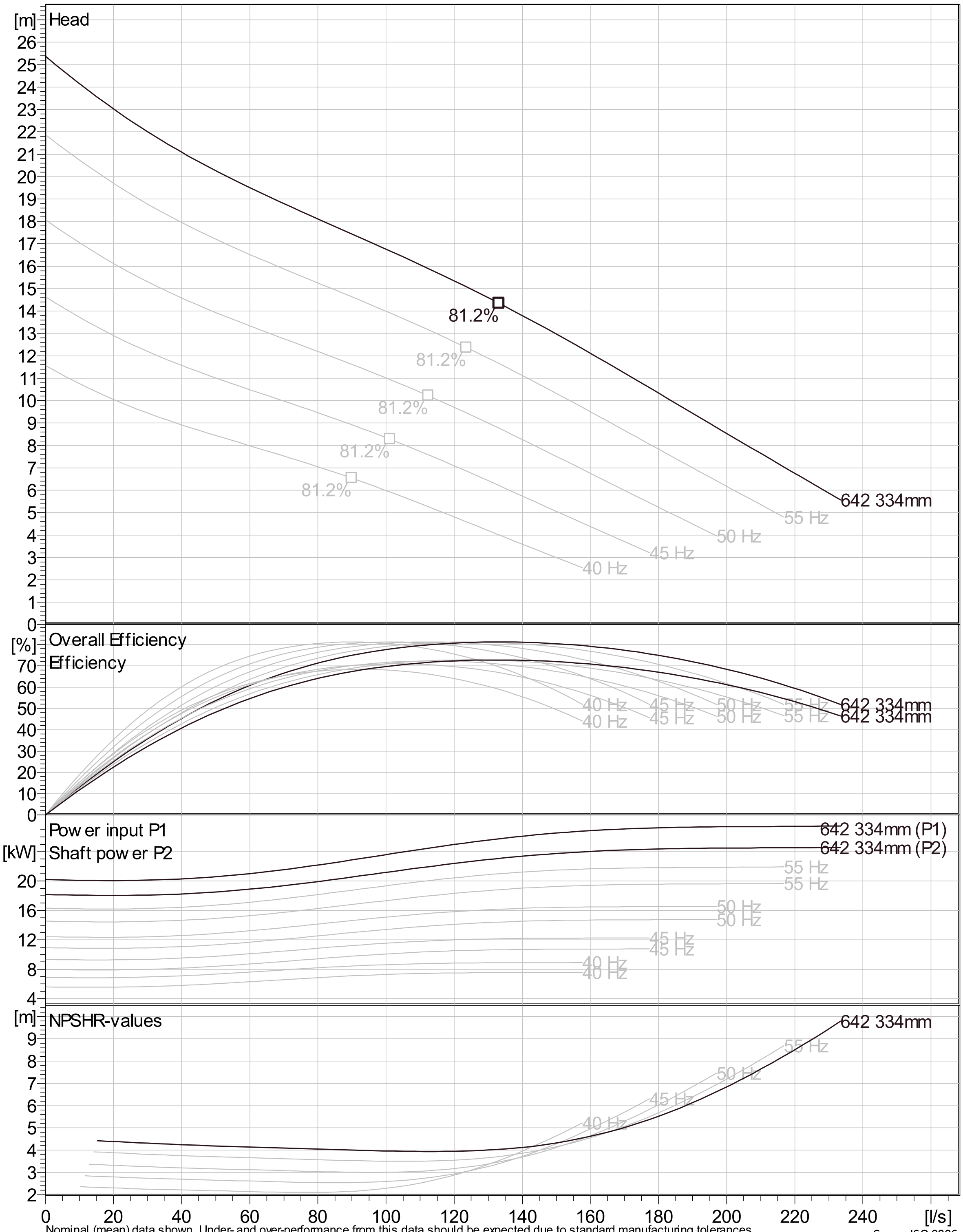
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	l/s	m	kW	l/s	m	kW		kWh/l	m
1	124	15.1	22.6	124	15.1	22.6	80.9 %	5.67E-5	3.96

Project		**Created by**	Michael Matisa		
Block	Xylect-22328103	**Created on**	5/22/2024	**Last update**	5/22/2024

NP 3202 MT 3~ 642

VFD Curve

Curves according to: Water, pure ,4 °C,1 kg/dm³,1.569 mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

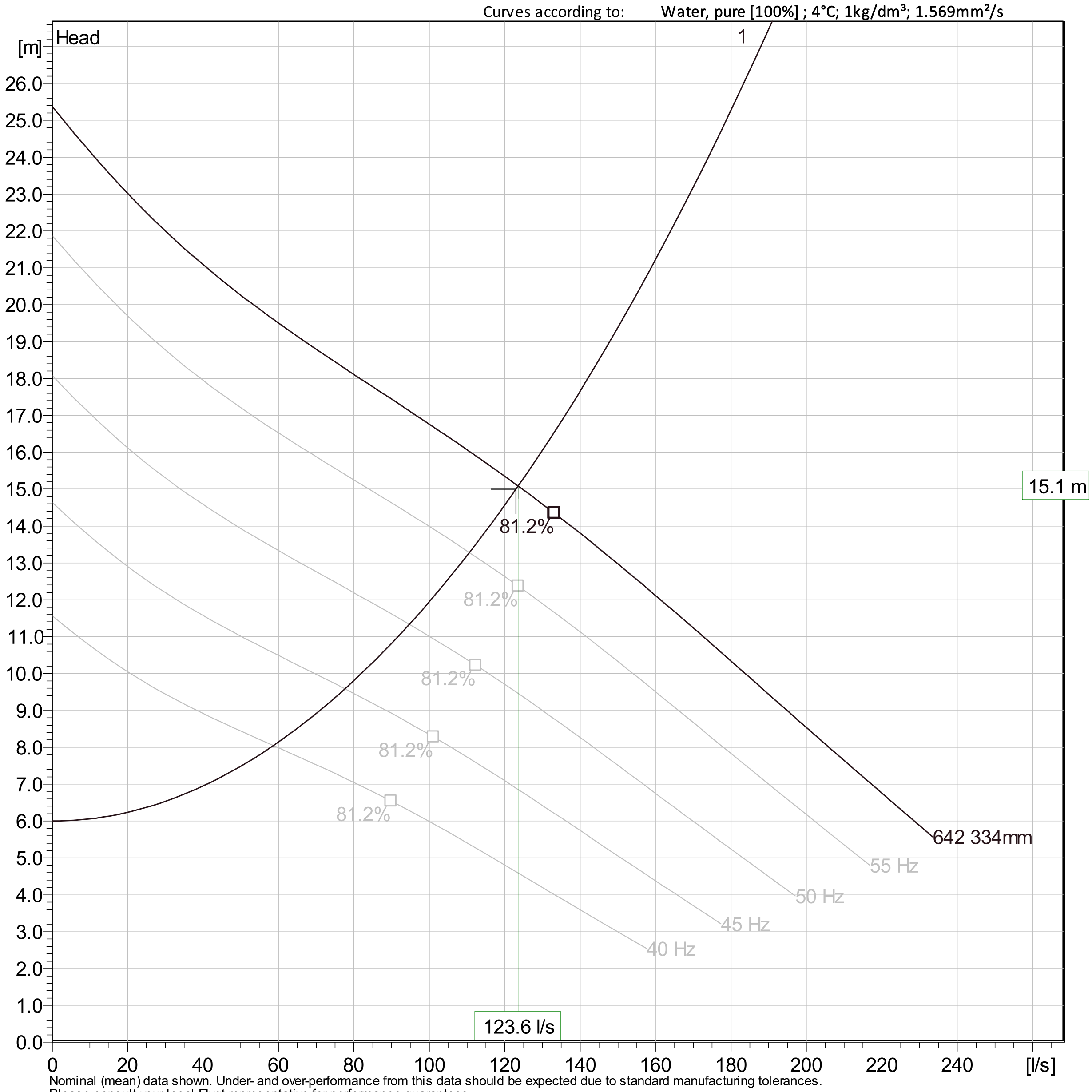
Curve: ISO 9906

Project	Xylect-22328103	**Created by**	Michael Matisa		
Block		**Created on**	5/22/2024	**Last update**	5/22/2024

NP 3202 MT 3~ 642

VFD Analysis

Curves according to: Water, pure [100%] ; 4°C; 1kg/dm³; 1.569mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating Characteristics

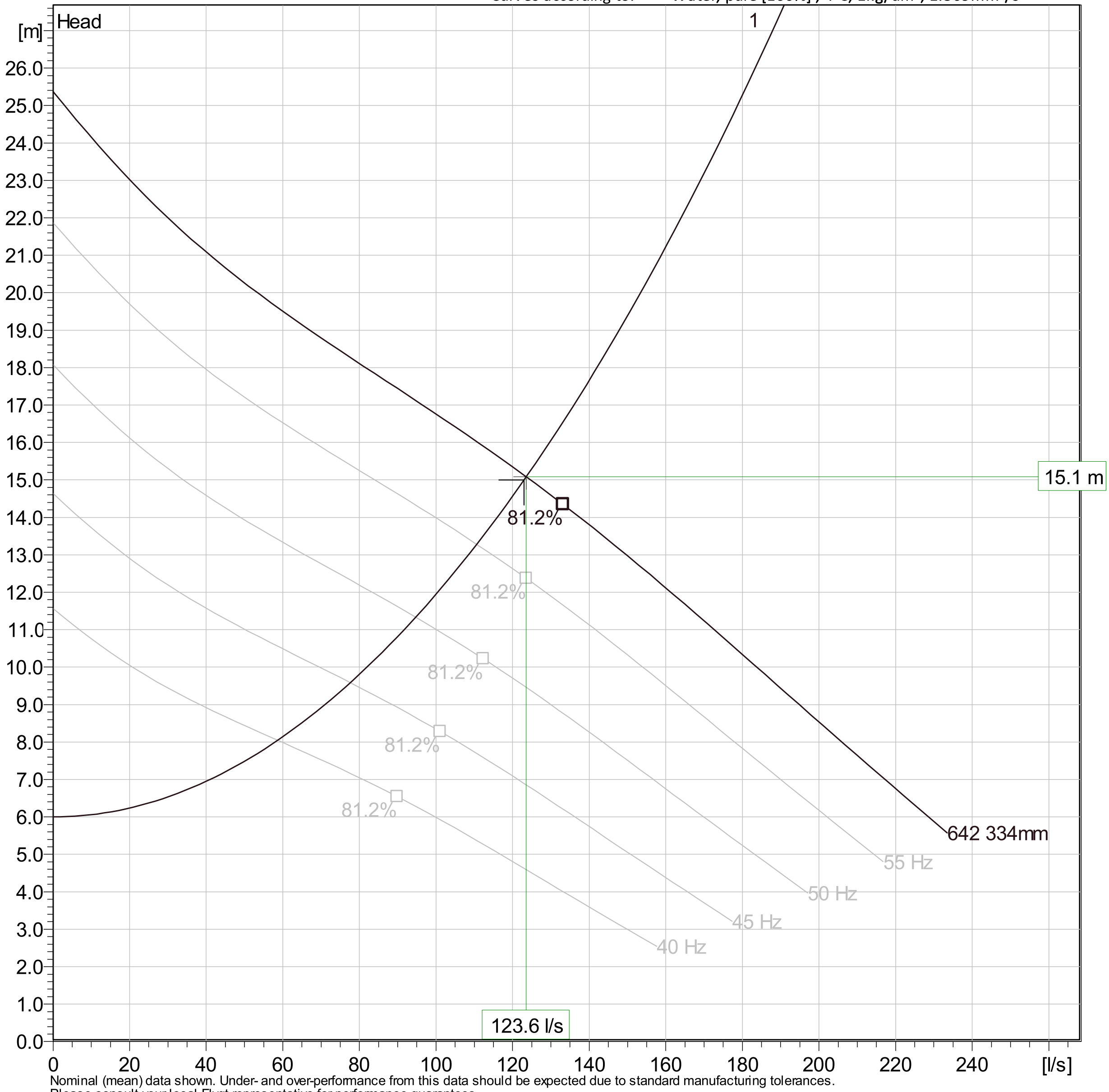
Pumps / Systems	Frequency	Flow l/s	Head m	Shaft power kW	Flow l/s	Head m	Shaft power kW	Hydr.eff.	Specific energy kWh/l	NPSHre m
1	59.2 Hz	124	15.1	22.6	124	15.1	22.6	80.9 %	5.67E-5	3.96
1	55 Hz	111	13.3	17.9	111	13.3	17.9	80.6 %	5.01E-5	3.5
1	50 Hz	94.7	11.3	13.2	94.7	11.3	13.2	79.8 %	4.36E-5	3
1	45 Hz	77.6	9.58	9.35	77.6	9.58	9.35	78.1 %	3.85E-5	2.55

Project	Xylect-22328103	**Created by**	Michael Matisa		
Block		**Created on**	5/22/2024	**Last update**	5/22/2024

NP 3202 MT 3~ 642

VFD Analysis

Curves according to: Water, pure [100%] ; 4°C; 1kg/dm³; 1.569mm²/s

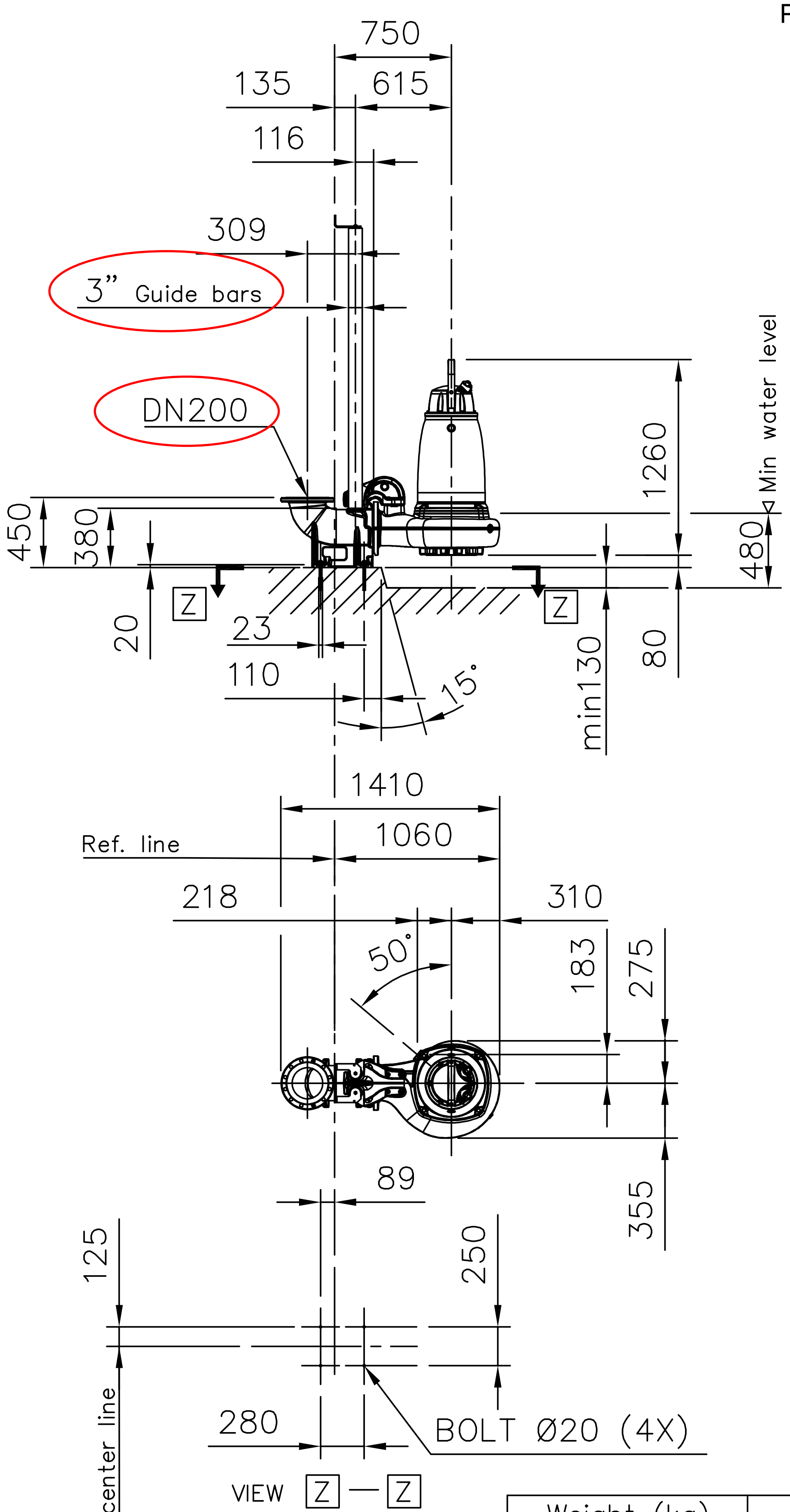


Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating Characteristics

Pumps / Systems	Frequency	Flow l/s	Head m	Shaft power kW	Flow l/s	Head m	Shaft power kW	Hydr.eff.	Specific energy kWh/l	NPSHre m
1	40 Hz	58.7	8.05	6.27	58.7	8.05	6.27	73.9 %	3.59E-5	2.14

Project	Xylect-22328103	**Created by**	Michael Matisa		
Block		**Created on**	5/22/2024	**Last update**	5/22/2024



Weight (kg)	Pump	Discharge
with cooling jacket	580	100
without cooling jacket	530	100

FLYGT	NP,FP	3202	MT	6–poles	Discharge outlet DN 200 / Pump outlet DN 200	Scale 1: 40	Date 210315
	090,095,180,185,350,390,660,670				Pump inlet / Suction inlet	Drawing number 6664500	Revision 10

C2

Appendix C2: Headworks

Engineering
for **people**

WATER TECHNOLOGIES

VEOLIA

DUNDAS WWTP, ON
SCREENINGS AND GRIT REMOVAL SYSTEMS

ATTN: KANG-YOUNG KO, M.ENG. P. ENG.
CIMA+

2024-05-29

BUDGET PROPOSAL REV0

VEOLIA PROJECT NO. CA_05_24_571166

As specialists in potable water, process water, wastewater treatment and stormwater management, the **John Meunier Products** equipment has been serving North American municipalities and industries since 1948.
Further to your request, we are pleased to submit our budget proposal for the supply of the equipment listed hereafter, which is proudly **Made in Canada**.

Fine Screen - 6mm perforated elements

Item	Quantity	Description	Model Number		Price
JOHN MEUNIER® Products – Screenings Removal System					
A.	Two (2)	ESCALATOR® Fine Screen	ESH6-44XA		Included (65%)
B.	One (1)	CONT-FLO® Type GRM Manual Bar Screen	GRM13-39x59		Included (3%)
C.	Two (2)	ROTOPAC® Type RLK Shaftless Screw Conveyor	RLK250X40		Included (11%)
D.	Two (2)	ROTOPAC® Type RPW Screw Washer Compactor	RPW-200XD		Included (21%)
E.	One (1)	PLC/HMI Control System w/ local stations	VEOLIA Standard		Included
		Freight Charges to Site (DDP – Incoterm 2020)			Included
		Mechanical Start-Up Service on Site	1 Trip	3 days	Included
		Control System Start-Up Service on Site	1 Trip	3 days	Included
		Warranty: 12 months from Start Up / 18 months from Shipping			Included
TOTAL FIRM PRICE (as per Scope of Supply and General Conditions)					**$757,000.00**

For the fine screening, we recommend our **John Meunier ESCALATOR® Fine Screen** with **6 mm perforations** which provides a very high screening capture performance of **79%** (as independently verified by UKWIR) using traveling elements. The fine screen is used in combination with our **John Meunier ROTOPAC® Screw Washer Compactor**, in order to wash (**up to 90% organics removal**), dewater (**up to 60% dryness**) and compact (**up to 70% volume reduction**) the screenings. Two 4m shaftless screw conveyors are added to transport the screenings to a remote discharge bin, should it be necessary.

A manual bar screen with ½" spacing is also provided for the bypass channel.

The equipment selection has been based on a **peak flow of 42 200 m^3/d** of municipal wastewater per unit. The hydraulic profile has been correlated with the grit chamber with a water level of **611 mm** downstream of the screen at peak flow.

Grit

Item	Quantity	Description	Model Number		Price
JOHN MEUNIER® Products – Grit Removal System					
F.	Two (2)	MECTAN® Vortex Grit Removal System	JMDV/4-35ISXH		Included (34%)
G.	One (2)	Gorman-Rupp® Grit Pump	Super T-Series 4x4		Included (17%)
H.	One (2)	SAM® Type GDS Grit Dewatering Screw	GDSC/14-12-25XA		Included (49%)
I.	One (1)	PLC/HMI Control System w/ local stations	VEOLIA Standard		Included
		Freight Charges to Site (DDP – Incoterm 2020)			Included
		Mechanical Start-Up Service on Site	1 Trip	3 days	Included
		Control System Start-Up Service on Site	1 Trip	3 days	Included
		Warranty: 12 months from Start Up / 18 months from Shipping			Included
TOTAL FIRM PRICE(as per Scope of Supply and General Conditions)					**$473,350.00**

For this application, we recommend our **John Meunier MECTAN®V 360 degrees forced Vortex Grit Removal System** installed in a concrete grit chamber to capture grit. Grit extraction shall be performed with a top mounted grit pump to discharge in our **SAM® Type GDS Grit Dewatering Screw** to dewater the grit.

The John Meunier MECTAN® Vortex Grit Removal System is guaranteed by VEOLIA to provide the following grit removal performance at unit's peak rated capacity, based on grit with **specific gravity of 2.65**:

95% total removal of all grit down to 140 mesh [100 microns] particle size;

The John Meunier MECTAN®V achieves grit removal performance equivalent to or better than all other vortex grit removal systems available on the market.
Unlike some other grit removal systems that rely purely on hydraulic energy to separate grit, our MECTAN®V uses both hydraulic energy and mechanically driven paddles to create a vortex. This delivers excellent grit removal, and grit separation from organics, at all flow rates (from zero up to the unit's rated maximum). It also results in improving removal performance as flow rate reduces, unlike purely hydraulic systems, which have reduced performances at lower flow rates.

The equipment selection has been based on a **peak flow of 42 200 m^3/d** of municipal wastewater per unit. The hydraulic profile has been based on the assumption of a free fall condition in the channel downstream of the grit chamber.

VEOLIA

Ultra Fine Screen - 2mm Rotary Drum

Item	Quantity	Description	Model Number		Price
JOHN MEUNIER® Products – Screenings Removal System					
J.	Three (3)	ROTARC® Type SD Rotary Druml Fine Screen	SDC2-79XA		Included (87%)
K.	Three (3)	ROTOPAC® Type RLK Shaftless Screw Conveyor	RLK-250X40		Included (13%)
L.	One (1)	PLC/HMI Control System w/ local station(s)	VEOLIA Standard		Included
		Freight Charges to Site (DDP – Incoterm 2020)			Included
		Mechanical Start-Up Service on Site	1 Trip	3 days	Included
		Control System Start-Up Service on Site	1 Trip	3 days	Included
		Warranty: 12 months from Start Up / 18 months from Shipping			Included
TOTAL FIRM PRICE (as per Scope of Supply and General Conditions)					**$877,900.00**

For the tertiary ultra fine screening, we recommend our **John Meunier ROTARC® Type SD Rotary Drum Fine Screen** with **2 mm perforations** which provides a very high screenings capture performance of **90%** using center flow rotating drum. Three 4m shaftless screw conveyors have been added to transport the screenings to a remote discharge bin, should it be necessary.

The equipment selection has been based on a **peak flow of 21 100 m^3/d** of municipal wastewater per unit. The hydraulic profile has been based on the assumption of a free fall condition in the channel downstream of the screens.

The listed prices are based on VEOLIA's payment terms, which facilitate a positive cash flow, thereby avoiding financing costs associated with extended payment periods.

Should you have any questions regarding this proposal, do not hesitate to contact the undersigned.
Sincerely,

Bertrand Landry, P.Eng. | Application Engineer, Tender Team - Pretreatment & CSO

On behalf of:
Jason Boomhour | Business Development Representative - Municipal Ontario
Veolia Water Technologies Canada
Cell.: 519-274-3416, email: jason.boomhour@veolia.com

GENERAL CONDITIONS

SCHEDULE

- **A. SUBMITTAL DOCUMENTS AND SHOP DRAWINGS** — **6 TO 8 WEEKS**
  After receipt of a signed and approved purchase order. Mechanical and electrical submittal sections might be sent separately. Long lead items will be submitted for an early approval.
- **B. APPROVAL OF SUBMITTAL DOCUMENTS AND SHOP DRAWINGS** — **2 WEEKS**
  After emission of submittal documents and drawings by VEOLIA (suggested time). Delays beyond the control of VEOLIA could affect pricing and project schedule.
- **C. MANUFACTURING AND TESTING** — **20 TO 22 WEEKS**
  After receipt by VEOLIA of approved submittals documents and drawings. These manufacturing times are affected by the uncertainty of the current worldwide market. VEOLIA will be able to confirm the delivery schedule once the procurement of all major and critical items for the project execution have been completed. The schedule may be affected by the shop workload at the time of reception of the submittals approval.
- **D. PREPARATION FOR SHIPMENT AND TRANSPORTATION TIME** — **UP TO 5 DAYS**
  Time anticipated. VEOLIA has no control on transport, transit time cannot be guaranteed.

Schedule may be affected by our shop and office annual shutdowns (when applicable): two weeks at the end of July (shop only) and two weeks for Christmas Holidays. These weeks are to be added to our specified delivery time.

SERVICES AND WARRANTY

Our standard proposal includes an extended service plan, featuring a blend of on-site and remote services, to assist and support with the proper installation, operation, maintenance and optimization of the equipment. Please refer to the scope of supply table on page 1 to confirm services on site and warranty included.

PARTICULAR TERMS AND CONDITIONS

- **VEOLIA *General Terms and Conditions for Sale* will apply**
- This proposal will remain valid for **30 days** following the date of this proposal
- All prices are in **CDN** funds, all applicable taxes extra.
- **VEOLIA Payment schedule for positive cashflow:**
  - **10% NET 30 days** with the Purchase Order
  - **25% NET 30 days** with the return of the approved shop drawings
  - **60% NET 30 days** at equipment readiness for shipping, Ex-Works Montreal
  - **5% NET 30 days** at equipment start-up, not to exceed 6 months after delivery
- **Alternate Terms and Conditions and Payment Terms may be considered for a price adder.**
- Mechanical and electrical shop testing is included in the basic price.
- No process or performance warranty is included.
- VEOLIA takes exception to all liquidated damages clauses.

The present budget proposal is provided for indicative purposes and does not represent a formal commitment on the part of VEOLIA. The proposal is provided solely for the purpose of being used as a price estimate and for information only. The information included in this offer may be subject to change at any time and does not bind the company. The terms of this offer cannot under any circumstances constitute a contractual commitment on our part.

John Meunier Products
ESCALATOR® Fine Screen

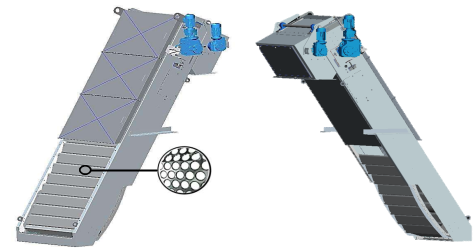
VEOLIA

Equipment Data-Sheet

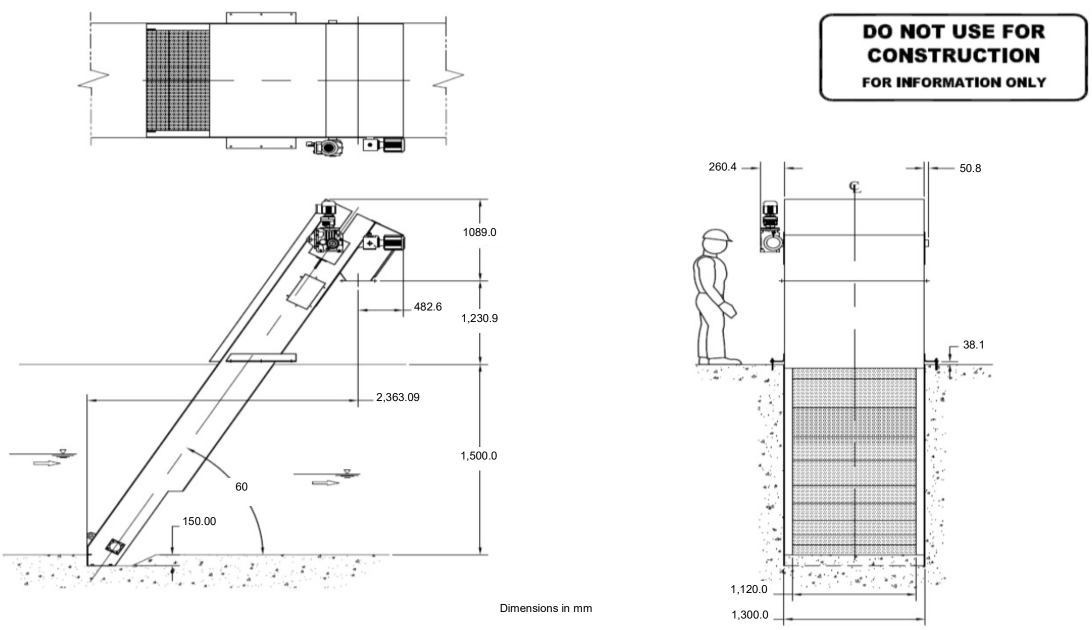
Dundas, ON	**Model # ESH6-44XA**
CA_05_24_571166 Rev. 0 2024-05-21	

Selection

Quantity of screen(s)	**2**
Screen type	**Traveling Perforated Panels**
Design Peak Flow	**42200.00** m³/d
Screen opening	**Ø6.00** mm
Capture ratio	**79** %
Volumetric capacity	**10.8** m³/h
Installation Angle	**60** °
Screening Width	**1120.0** mm
Channel Width	**1300.0** mm
Channel Depth	**1500.0** mm
Bottom recess	**150.0** mm
Discharge Height	**1230.9** mm
Wash Water	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**1636** kg



Dimensions

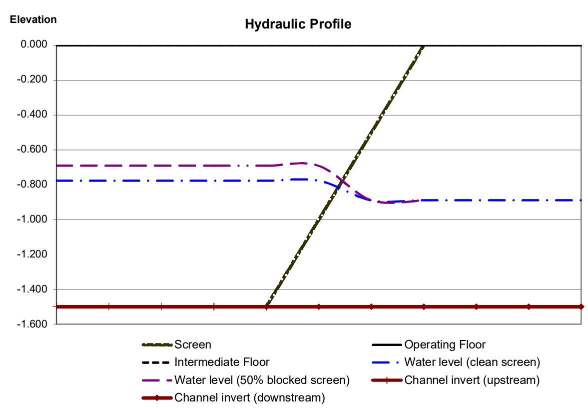


Dimensions in mm

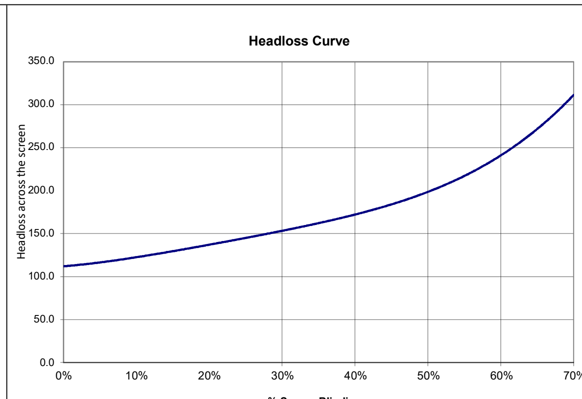
Hydraulic (at design peak flow)

Downstream hydraulic condition	**Client profile**
Downstream water level	**611.00** mm
Approach velocity (clean screen)	**0.52** m/s
Velocity through the screen (clean screen)	**1.02** m/s
Downstream velocity	**0.61** m/s

Headloss across the screen at 0%	**112.10** mm
Available freeboard upstream at 0%	**776.90** mm
Headloss across the screen at 50%	**197.82** mm
Available freeboard upstream at 50%	**691.18** mm



Dimensions in m



Dimensions in mm

John Meunier Products
ESCALATOR® Fine Screen

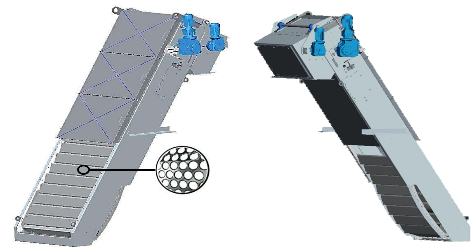
VEOLIA

Equipment Data-Sheet

Dundas, ON			**Model # ESH6-44XA**
CA_05_24_571166	**Rev. 0**	**2024-05-21**	

Selection

Quantity of screen(s)	**2**
Screen type	**Traveling Perforated Panels**
Design Peak Flow	**42200.00** m³/d
Screen opening	**Ø6.00** mm
Capture ratio	**79** %
Volumetric capacity	**10.8** m³/h
Installation Angle	**60** °
Screening Width	**1120.0** mm
Channel Width	**1300.0** mm
Channel Depth	**1500.0** mm
Bottom recess	**150.0** mm
Discharge Height	**1230.9** mm
Wash Water	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**1636** kg



Scope of supply

Structural Frame Assembly			
Frame	4.7625 mm	SS304
Front Cover	2 mm	SS304
Back Housing	1.6 mm	SS304
Discharge Chute	2 mm	SS304
Lateral Access Doors		Plexiglas
Mounting Supports	9.5 mm	SS304
Channel Sides Sealing		Neoprene rubber

Filter Belt Elements				
Qty. 41	**Perforated Elements**	Width	1110 mm	SS304
		Thickness	3 mm	
		Static Differential Load	2.0 m	
		Travelling speed range (with VFD)	3.2 m/min	6.5 m/min
	Back Supports			2 Supports - SS304
	Inner Frame Side Seal			Polyethylene
	Lower Frame Seal			Polypropylene brushes covered with rubber flap

Belt Screen Mechanism		
Conveyor Type Chain	Regular - ISO M80	80 kN Breaking Load
Chain Links and Bushings		Zinc Coated Extra Strong Carbon Steel
Chain Pins		Carbon Steel c/w Special Lubricator
Drive Shaft		SS304
Top Sprockets		SS304
Bottom Sprockets		SS304

Belt Screen Drive System			
Motor	WEG	1 HP (0.74 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1780 RPM	Class F insulation
Reducer	SEW	6.14 RPM	Parallel-Helical Type
	1.4 s.f. (per AGMA)		

Self-Adjusting Brush		
Assembly	1110 mm	Nylon
Bristles		Nylon
Drive Shaft	Solid type	SS304

Self-Adjusting Brush Drive System			
Motor	WEG	2 HP (1.49 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1780 RPM	Class F insulation
Reducer	SEW	130.40 RPM	Parallel-Helical Type
	1.4 s.f. (per AGMA)		

Element Washing System				
	Spray Wash Manifold	Ø1 in FNPT [Ø25 mm]	Up to 1.0 L/s @ 55 psi	SS304
Qty. 10	**Spray Nozzles**			SS316
Qty. 1	**Solenoid Valve**	Ø1 in FNPT [Ø25 mm]	120V	Brass
		Cl.1 Div.1	NEMA-7	
Qty. 1	**Manual Ball Valve**	Ø1 in FNPT [Ø25 mm]		Brass
Qty. 1	**Manual Y-Strainer**	Ø1 in FNPT [Ø25 mm]	20 mesh	Bronze

Anchors		
Type / Material	As preferred	NOT INCLUDED
Operating Floor	Drop-In	Ø5/8 in
Deflector	Expansion	Ø3/8 in
Instruments supports	Expansion	Ø3/8 in

Instrumentation				
Qty. 1	**Differential Level Control System - Ultrasonic Type**			INCLUDED
	Qty. 2	Ultrasonic probes	NEMA-7	
		with mounting bracket and 50 ft cable		
	Qty. 1	Remote Two-Points Controller	NEMA-4X	
Qty. 1	**Floating Bulb with micro-switch**			INCLUDED
	with mounting bracket and 65 ft cable		NEMA-4X with Safety Barrier	

Control System				
Qty. 1	**Main Common Control Panel**	Unclassified Area - NEMA-4/12 Painted		INCLUDED
	PLC with Ethernet Port and Modem	Allen-Bradley Micro800	CSA Approval	
	Operator Interface Screen		7 inches	
	Main fusible disconnect switch with splitter		NEMA-4/12	
	Operator devices (selectors, buttons, lights)	22 mm	NEMA-4X	
	Elements motor Variable Frequency Drive c/w overcurrent		IEC	
	Brush motor Full voltage non-reversible Starter		IEC	
	Components power supply protection			
	Safety barriers for digital signals			
Qty. 1	**Local Control Station (per unit)**	Cl.1 Div.1	NEMA-7	INCLUDED
	Qty. 1	Emergency Stop (Pushbutton)		
	Qty. 1	Off/Remote/Man.Test* (Selector Switch)		
		** Spring Return*		

Options			
Qty. 0	**Screen Pivot**		NOT INCLUDED
Qty. 0	**Odor Control Connection**	Ø4.0 in ANSI [Ø102 mm]	NOT INCLUDED
Qty. 0	**Cold Weather Protection Package**		NOT INCLUDED
Qty. 0	**Filtering elements designed for correctional facilities**		NOT INCLUDED
Qty. 0	**Frame shipped in several sections**		NOT INCLUDED
Qty. 0	**Velocity plates**		NOT INCLUDED
Qty. 0	**Automatic Gray Water Recirculation System**		NOT INCLUDED

Spare Parts (per unit)		
Qty. 0	Rotating Cleaning Brush (with solid shaft)	NOT INCLUDED
Qty. 0	Filtering Elements	NOT INCLUDED
Qty. 0	Upper Sprocket	NOT INCLUDED
Qty. 0	Driving Chain Links	NOT INCLUDED
Qty. 0	Bottom Brush Pad Assembly (2 rows)	NOT INCLUDED
Qty. 0	Bottom Sprocket Nylatron Sleeves and seals	NOT INCLUDED
Qty. 0	Bottom Sprocket Stud Shaft	NOT INCLUDED
Qty. 0	Bottom Sprocket	NOT INCLUDED

John Meunier Products
CONT-FLO® type GRM Manual Bar Screen

VEOLIA

Equipment Data-Sheet

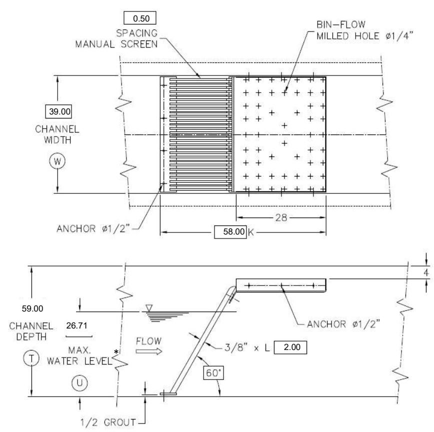
Dundas, ON		
CA_05_24_571166	**Rev.0**	**2024-05-24**

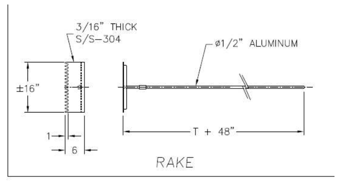
Model # GRM13-39x59

Selection

Quantity of Screens	**1**
Type	**Manual Screen**
Peak Flow per Screen	**42,200.00** m³/d
Bar Spacing	**12.70** mm
Installation Angle	**60** °
Screening Width	**990** mm
Channel Width	**1000** mm
Channel Depth	**1500** mm
Unit weight	**353** Kg

Dimensions





FOR INFORMATION
John Meunier

DO NOT USE FOR CONSTRUCTION
FOR INFORMATION ONLY
John Meunier

*Max upstream water level upstream at clean screen

Dimensions in in

Scope of supply

Manual bar screen

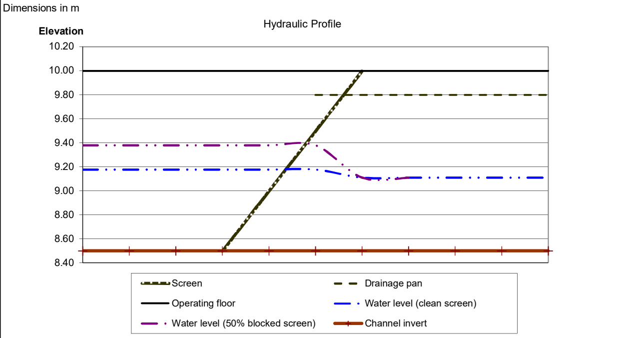
Qty.44	**Bars**		SS304
	Bar spacing	12.7 mm	
	Bar thickness	9.525 mm	
	Bar width	50.8 mm	
Qty.1	**Rake**		
	Rake width	658.2 mm	SS304
	Rake handle	2720 mm	Aluminium
Qty.1	**Drainage pan**		SS304
	Thickness	6.35 mm	
	Edge height	101.6 mm	

Hydraulic

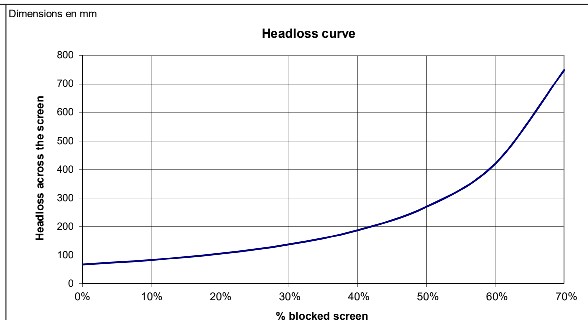
Downstream hydraulic condition	**Client profile**
Downstream water depth	**611.00** mm
Approach velocity (clean screen)	**0.72** m/s
Velocity between bars (clean screen)	**1.15** m/s
Downstream velocity	**0.80** m/s

Headloss across the screen at 0%	**67.37** mm
Available freeboard upstream at 0%	**821.63** mm
Headloss across the screen at 50%	**269.50** mm
Available freeboard upstream at 50%	**619.50** mm

Dimensions in m



Dimensions en mm



Informations B80

Numéro CA 05 24 571166
Model MODEL: GRM13-39x59

T 1,500.0 mm

	Screen	Drainage pan	Operating floor	vel (clear	el (50% blocke	Channel invert
0			**10.000**	**9.178**	**9.380**	**8.500**
1			**10.000**	**9.178**	**9.380**	**8.500**
2			**10.000**	**9.178**	**9.380**	**8.500**

Hydraulic Profile
Headloss curve
Headloss across the screen
% blocked screen

John Meunier Products
ROTOPAC® type RLK Screw Conveyor

VEOLIA

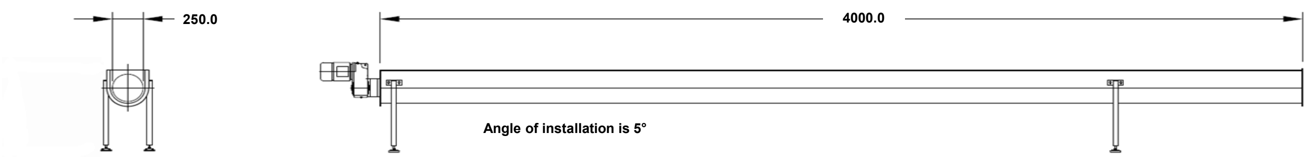
Equipment Data-Sheet

Dundas, ON			
CA_05_24_571166	Rev. 0	2024-05-24	Model RLK-250X40

Selection

Quantity	2
Type	Shaftless Screw Conveyor
Material handling	Screenings
Discharge Type	Axial
Length	4,000 mm
Installation angle	5 °
Transport mode	Pushing
Solids loading capacity	2.4 m³/h
Wash water (if applicable)	Potable or Treated Effluent
Main Power Supply	575V / 3Ph / 60Hz
Unit weight	705 Kg

Dimensions



Dimensions are in mm

Scope of Supply

Screw Conveyor Body				
Qty.1	**Inlet Hopper**	Height	500 mm	SS304
	U-trough	Diameter	Ø230 mm	SS304
	Wear Liner	Thickness	10 mm	HDPE
Qty.2	**Supporting legs**	Length	500 mm	SS304

Drive system				
Motor	WEG	1 HP (0.75 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1750 RPM	Class F insulation
Reducer	NORD Gear	15 RPM	Parallel-Helical Type
	1.4 s.f. (per AGMA)		

Spiral screw			
Type	Shaftless - Helicoidal flights		Abrasion resistant carbon steel
Diameter		Ø230 mm	
Flight thickness		19 mm	

Anchors		
Type / Material	As preferred	NOT INCLUDED
Operating Floor	Internally Threaded	Ø5/8 in

Instrumentation				
Qty. 0	**Safety Pull Cord**			NOT INCLUDED
		Emergency-Stop Switch		NEMA-7
		Includes mounting bracket and cable holders		
Qty. 1	**Rotating Shaft Motion Detector**			INCLUDED
	Probe with 50 ft cable		NEMA-7 probe with NEMA-4X controller	

Control System				
Qty. 1	**Main Control Panel**			INCLUDED
	Classification	Unclassified Area	NEMA-4/12 Painted	
	Included in Common Control Panel		CSA Approval	
	As per main control panel			
	Main fusible disconnect switch with splitter		NEMA-4X	
	Operator devices (selectors, buttons, lights)	22 mm	NEMA-4X	
	Motor full voltage reversible starter		IEC Rated	
	Equipment power supply protection			
	Safety barriers for digital signals			
Qty. 1	**Local Control Station (per unit)**	Cl.1 Div.1	NEMA-7	INCLUDED
		Emergency Stop (Pushbutton)		
		Off/Remote/Man.Test* (Selector Switch)		
		Forward*/Off/Reverse* (Selector Switch)		
		** Spring Return*		

Options			
Qty. 0	**Weather Protection System**		NOT INCLUDED
Qty. 0	**Bagging System**		NOT INCLUDED
Qty. 1	**Drain Pipe Connexion**	Ø2.5 in FNPT [Ø64 mm]	INCLUDED

Spare Parts		
Qty.0	**Bagger (Spare 295 ft [90 m])**	NOT INCLUDED
Qty.0	**Wear Liners**	NOT INCLUDED

John Meunier Products
ROTOPAC® Type RPW Screw Washer Compactor

VEOLIA

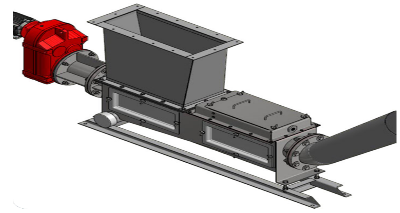
Equipment Data-Sheet

Dundas, ON			
CA_05_24_571166	**Rev. 0**	**2024-05-21**	

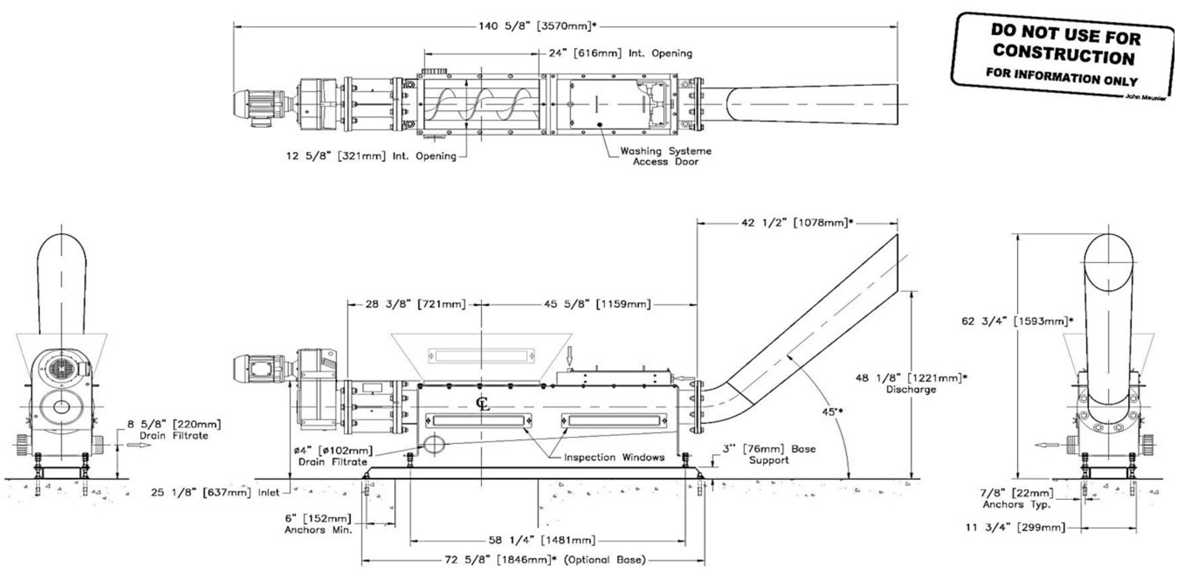
Model # RPW-200XD

Selection

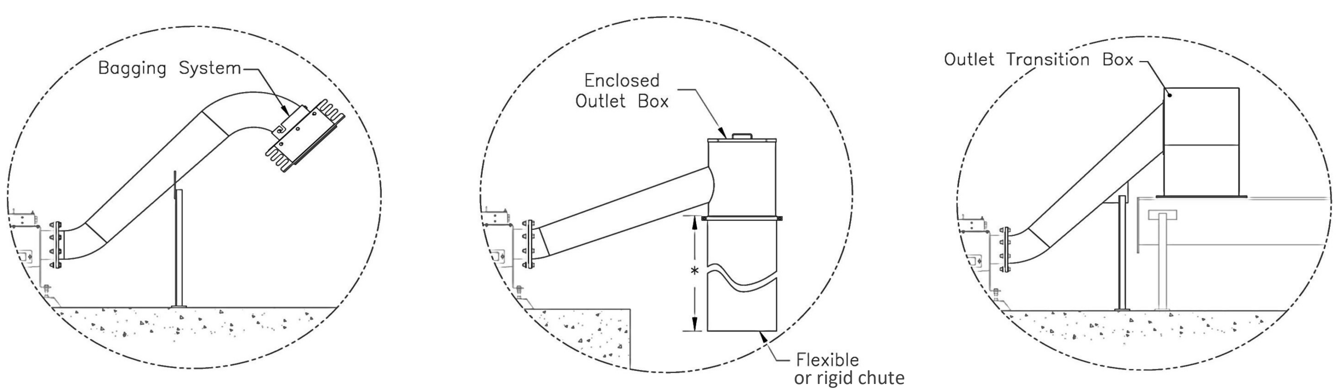
Quantity of units	**2**
Type	**High Efficiency Washer Compactor**
Material Handling	**Screenings**
Loading Capacity	**2** m³/h
Volume Reduction	**Up to 70** %
Dryness.	**Up to 60** %
Organics Reduction	**Up to 90** %
Screw Nominal Diameter	**200** mm
Installation Angle	**Horizontal**
Discharge Angle	**45** °
Discharge Height	**1200.0** mm
Main Power Supply	**575V / 3Ph / 60Hz**
Unit Weight	**567.4** kg



Dimensions



Possible Discharge Options



John Meunier Products
ROTOPAC® Type RPW Screw Washer Compactor

VEOLIA

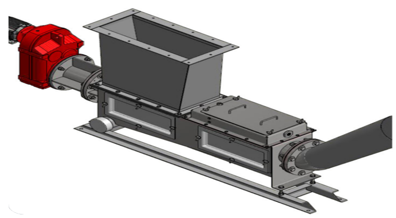
Equipment Data-Sheet

Dundas, ON			
CA_05_24_571166	**Rev. 0**	**2024-05-21**	

Model # RPW-200XD

Selection

Quantity of units	**2**
Type	**High Efficiency Washer Compactor**
Material Handling	**Screenings**
Loading Capacity	**2** m³/h
Volume Reduction	**Up to 70** %
Dryness.	**Up to 60** %
Organics Reduction	**Up to 90** %
Screw Nominal Diameter	**200** mm
Installation Angle	**Horizontal**
Discharge Angle	**45** °
Discharge Height	**1200.0** mm
Main Power Supply	**575V / 3Ph / 60Hz**
Unit Weight	**567.4** kg



Scope of Supply

Compactor Body Assembly

Bearing Box		Enclosed Housing - Grease Filled		ASTM A-36 CS (Plate)
				C-1020 CS (mechanical tubing)
Screw Housing		Diameter	Ø206 mm	SS304
		Thickness	4.8 mm	
		Perforations	Ø6 mm	
Wear Bars (Compaction Zone)			25.4 mm x 50.8 mm	CHT400
Collecting Trough		Thickness	3 mm	SS304
	Qty. 2	Drain	Ø4 in NPT(M)	
	Qty. 4	Inspection Ports	76.2 mm x 508 mm	

Screw Assembly

Spiral Screw	Shafted - Full pitch	Abrasion Resistant Carbon Steel (CHT 400)	
	Diameter	Ø195 mm	
	Flight Thickness (Drainage Section)	6 mm to 12.7 mm	
	Flight Thickness (Compaction Section)	25.4 mm	
Screw Shaft	Diameter	Ø88.9 mm	
Wiper Blade	Drainage Section		Neoprene

Inlet and Outlet

Inlet Hopper	Height	611 mm	SS304
	Bottom Opening Length	609.6 mm	
	Top Opening Length	1295.4 mm	
	Thickness	3 mm	
Discharge Tube	Diameter (Start)	Ø203.2 mm	SS304
	Diameter (End)	Ø254 mm	
	Thickness	3 mm	

Drive system

Motor	WEG	2 HP (1.49 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1750 RPM	Class F insulation
Reducer	SEW	11 RPM	Parallel-Helical Type
	1.4 s.f. (per AGMA)		

Washing System

	Main Wash Line	Up to 0.6 L/s @ 55 psi	Ø1 in NPT	
Qty. 1	**Solenoid Valve**	120V	Ø1 in FNPT	Brass
		NEMA-7	Cl.1 Div.1	
Qty. 1	**Manual Ball Valve**		Ø1 in FNPT	Brass
Qty. 1	**Manual Y-Strainer**	20 mesh	Ø1 in FNPT	Bronze
	Washing Zone Line		Ø1/2 in FNPT	
Qty. 1	**Manual Globe Valve**		Ø3/8 in FNPT	Bronze
Qty. 2	**Spray Nozzles**			SS316
	Compaction Zone Line		Ø3/4 in FNPT	
Qty. 1	**Manual Ball Valve**		Ø3/4 in FNPT	Brass
Qty. 10	**Spray Nozzles**			SS316

Anchors

Type / Material	As preferred	**NOT INCLUDED**
Operating Floor	Internally Threaded	Ø5/8 in

Control System

Qty. 1	**Main Control Panel**	Unclassified Area - NEMA-4/12		**INCLUDED**
	Included in Common Control Panel			CSA Approval
	Details and components as per main control panel			
	Main fusible disconnect switch with splitter			NEMA 4/12
	Operator devices (selectors, buttons, lights)		22 mm	NEMA-4X
	Motor full voltage reversible starter			IEC Rated
	Equipment power supply protection			
	Safety barriers for digital signals			

Qty. 1	**Local Control Station**	Cl.1 Div.1	NEMA-7	**INCLUDED**
	Qty. 1	Emergency Stop (Pushbutton)		
	Qty. 1	Local/Remote/Man.Test* (Selector Switch)		
	Qty. 1	Forward*/Off/Reverse* (Selector Switch)		
		** Spring Return*		

Options

Qty. 1	**Cross Channel Supporting Base**		**INCLUDED**
Qty. 0	**90º Elbow Discharge Tube**		**NOT INCLUDED**
Qty. 0	**Enclosed Outlet Box**		**NOT INCLUDED**
Qty. 0	**Outlet Transition Box**		**NOT INCLUDED**
Qty. 0	**Rigid Discharge Tube**	6 m	**NOT INCLUDED**
Qty. 0	**Flexible discharge tube**	6 m	**NOT INCLUDED**
Qty. 0	**Support for discharge tube**		**NOT INCLUDED**
Qty. 0	**Bagging System**	90 m	**NOT INCLUDED**
Qty. 0	**Odor Control Connection**	Ø4.0 in ANSI [Ø102 mm]	**NOT INCLUDED**
Qty. 0	**Cold Weather Protection Package**		**NOT INCLUDED**
Qty. 0	**Safety Pull Cord**	NEMA-7	**NOT INCLUDED**
Qty. 0	**Spiral Screw designed for correctional facilities**		**NOT INCLUDED**
Qty. 0	**Automatic Gray Water Recirculation System**		**NOT INCLUDED**

Spare Parts

Qty. 0	Flight Leather Wiper Set	**NOT INCLUDED**
Qty. 0	Wear Bars (Set of 4)	**NOT INCLUDED**
Qty. 0	Bearing Box Seal Set	**NOT INCLUDED**
Qty. 0	Bagger cartridge (295 ft [90 m])	**NOT INCLUDED**

John Meunier Products
MECTAN® Vortex Grit Removal System

VEOLIA

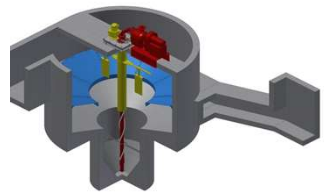
Equipment Data-Sheet

Dundas, ON			
CA_05_24_571166	**Rev. 0**	**2024-05-21**	

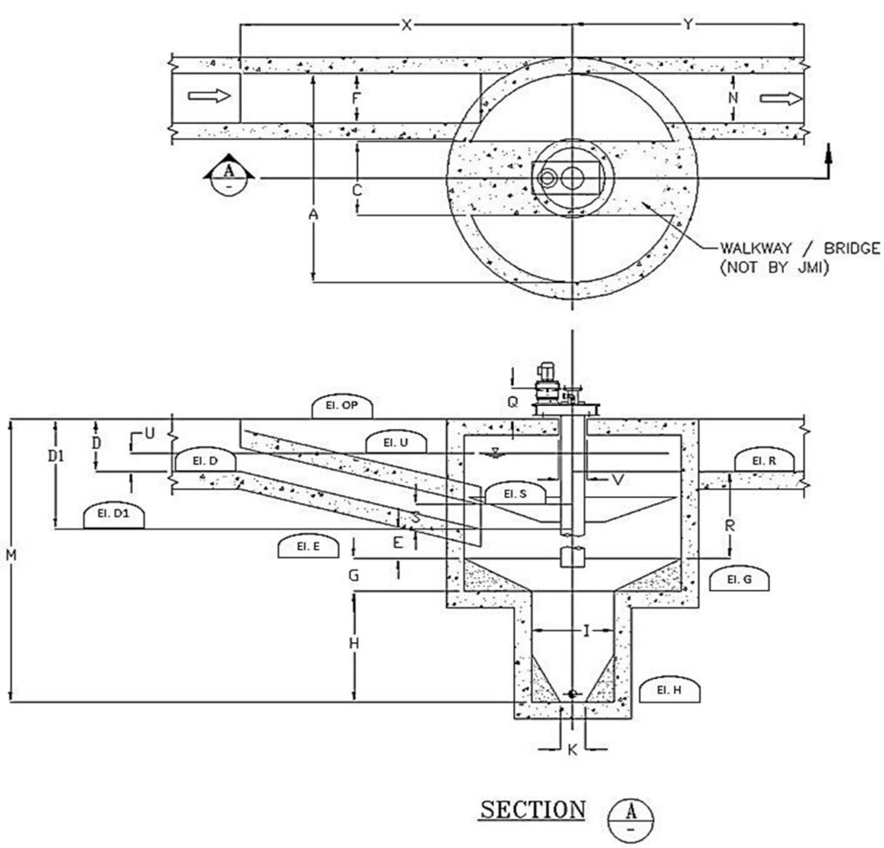
Model # JMDV/4-35ISXH

Selection

Quantity	**2**
Unit Type	**MECTAN® V**
Design peak flow per unit	**42200.00** m³/d
Unit rated Capacity	**42200.00** m³/d
Installation Type	**Concrete tank (by others)**
Rotation	**Clockwise**
Downstream Water Depth	**533.1** mm
Headloss (at peak flow)	**78.33** mm
Grit Extraction Type	**Top Mounted Grit Pump**
Grit Extraction Flow	**13** L/s
Wash Water (if applicable	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight (preliminary)	**1256** Kg



Dimensions



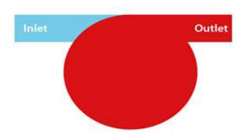
Controlling device
Weir

Dimensions (mm)	
A	Ø3500
C	1100
D	1500
D1	2430
E	150
F	850
G	350
H	1830
I	Ø1500
K	Ø400
M	4760
N	850
Q	388
R	1080
S	700
U*	611.4
V	Ø330
X	4971.6
Y	2485.8

*See Note 1.

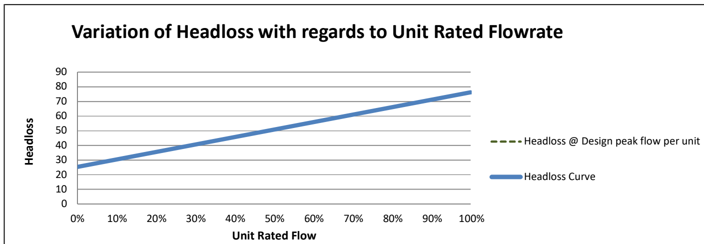
Elévations (m)	
El. OP	100.00
El. U	99.11
El. D	98.50
El. R	98.50
El. S	98.27
El. D1	97.57
El. E	97.42
El. G	97.07
El. H	95.24

Channels Configuration
360°



Note 1: HEADWORKS HYDRAULIC DESIGN SHALL PROVIDE A "U" IN THE GRIT CHAMBER AT PEAK FLOW

Hydraulics and Performances



Dimensions in mm **Headloss at Design peak flow per unit 78.33 mm**

The efficiency levels below apply to all flowrates and relate to grit having a S.G. of 2.65 and to the difference in grit content in the influent channel, as compared to that in the effluent channel.

MECTAN® Grit Removal Efficiency		
MECTAN® V	**Microns**	**Mesh**
96%	≥ 300	≥ 50
87%	≥ 210 & < 300	≥ 70 & < 50
75%	≥ 150 & < 210	≥ 100 & < 70
68%	≥ 100 & < 150	≥ 140 & < 100

MECTAN V® Global Grit Removal Efficiency
95% Removal Down to 100 Microns (140 Mesh)

John Meunier Products
MECTAN® Vortex Grit Removal System

VEOLIA

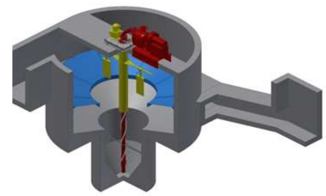
Equipment Data-Sheet

Dundas, ON
CA_05_24_571166 **Rev. 0** **2024-05-21**

Model # JMDV/4-35ISXH

Selection

Quantity	**2**
Unit Type	**MECTAN® V**
Design peak flow per unit	**42200.00** m³/d
Unit rated Capacity	**42200.00** m³/d
Installation Type	**Concrete tank (by others)**
Rotation	**Clockwise**
Downstream Water Depth	**533.1** mm
Headloss (at peak flow)	**78.33** mm
Grit Extraction Type	**Top Mounted Grit Pump**
Grit Extraction Flow	**13** L/s
Wash Water (if applicable	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight (preliminary)	**1256** Kg



Scope of Supply

Paddles Assembly

Qty. 1	**Drive Torque Tube**	17 RPM	Ø250 mm	SS304
Qty. 2	**Paddles**		Horizontal	SS304
Qty. 1	**Gear Case**	Standard Assembly		Epoxy Painted Carbon steel
		Pinion and Slewing Bearing		Carbon steel
		Bearing	5.0 s.f	B10-20 years
Qty. 1	**Grit Extraction Pipe**		Ø100 mm	SS304

Torque Tube Drive System

Motor	WEG	1 HP (0.74 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1750 RPM	Class F insulation
Reducer	SEW	17 RPM	Parallel-Helical Type
	2.0 s.f. (per AGMA)		

Internal Separator Plate

Qty. 1	**360° Conical Baffle Assembly**	SS304

Grit Extraction System

Qty. 1	**Grit Pump Gorman-Rupp® T-Series**		13 L/s @ 10 m TDH	**INCLUDED**
	with Eradicator™ Solids Mangement System			
	Motor	WEG	7.5 HP (5.59 kW)	Premium Efficiency
		Cl.1 Div.1	TEFC	1.15 s.f.
		Single Speed	1750 RPM	Class F insulation
	Skid Base Height	300 mm		Epoxy Painted Carbon steel

Water Fluidization

Qty. 1	**Water Fluidization System**		4.8 L/s @ 380 kPa	**INCLUDED**
Qty. 1	Solenoid Valve	Ø2 in FNPT [Ø51 mm]	120 V	Brass
		Cl.1 Div.1	NEMA-7	
Qty. 1	Manual Valve	Ø2 in FNPT [Ø51 mm]		Brass
Qty. 2	Fluidization Lines			PVC flexible tubing reinforced

Self-standing pre-fabricated tank

Qty. 0	**Steel Tank**		**NOT INCLUDED**
	Tank and Supports	0.25 in	SS304
	Inlet/Outlet Flange	ANSI - Roll on type	SS304
	Drain Connection	Ø2.0 in ANSI [Ø51 mm]	SS304
Qty. 0	**Walkway Path**		**NOT INCLUDED**
	Covers		Enclosed Grating (FRP)
	Handrail		Not included

Anchors

Type / Material	As preferred	**NOT INCLUDED**
Operating Floor	Internally Threaded	Ø16 mm
Gear Case	Internally Threaded Expansion	Ø16 mm
Extraction Tube Support	Wedge Expansion type	Ø10 mm
Conical Baffle	Adhesive threaded rod	Ø13 mm

Control System

Qty. 1	**Main Control Panel**	Unclassified Area	NEMA-4/12 Painted	**INCLUDED**
	PLC with Ethernet Port and Modem		Allen-Bradley Micro800	CSA Approval
	Operator Interface Screen			7 inches
	Main fusible disconnect switch with splitter			NEMA 4/12
	Operator devices (selectors, buttons, lights)		22 mm	NEMA 4/12
	Motor(s) full voltage non-reversible starter(s)			IEC Rated
	Equipment power supply protection			
	Safety barriers for digital signals			

Qty. 1	**Local Control Station (Mectan)**		Cl.1 Div.1	NEMA-7	**INCLUDED**
		Qty. 1	Emergency Stop (Pushbutton)		
		Qty. 1	Off/Auto (Selector Switch)		
Qty. 1	**Local Control Station (Pump)**		Cl.1 Div.1	NEMA-7	**INCLUDED**
		Qty. 1	Emergency Stop (Pushbutton)		
		Qty. 1	Off/Remote/Man.Test* (Selector Switch)		
			* Spring Return		

Options

Qty. 0	**Walkway (elevated)**	**NOT INCLUDED**
Qty. 0	**Parshall Flume**	**NOT INCLUDED**
Qty. 0	**Level / velocity control plates**	**NOT INCLUDED**
Qty. 0	**Grit Pump Casing Heater**	**NOT INCLUDED**
Qty. 0	**Grit Performance Testing**	**NOT INCLUDED**
Qty. 0	**Grit Pump Performance Testing**	**NOT INCLUDED**
Qty. 0	**Odor Control Connection (for self-standing tank)**	**NOT INCLUDED**
Qty. 0	**Air Release Solenoid Valve for Grit Pump Discharge Pipe**	**NOT INCLUDED**

Spare Parts (per unit)

Qty. 0	**Grit Pump Set of Mechanical Seals**	**NOT INCLUDED**
Qty. 0	**Grit Pump Set Gaskets & O-Rings**	**NOT INCLUDED**

John Meunier Products
SAM® type GDS Grit Dewatering Screw

VEOLIA

Equipment Data-Sheet

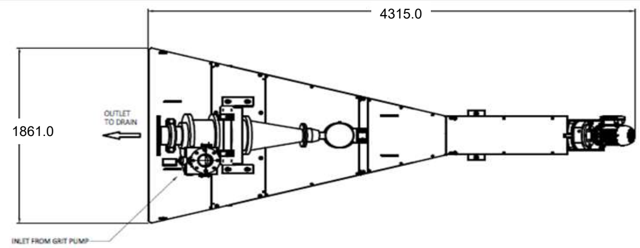
Dundas, ON			
CA_05_24_571166	**Rev. 0**	**2024-05-21**	**Model # GDSC/14-12-25XA**

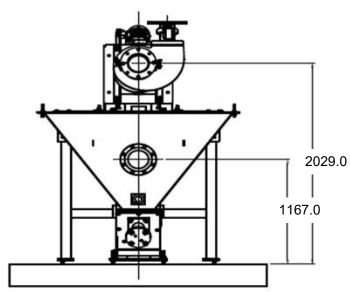
Selection

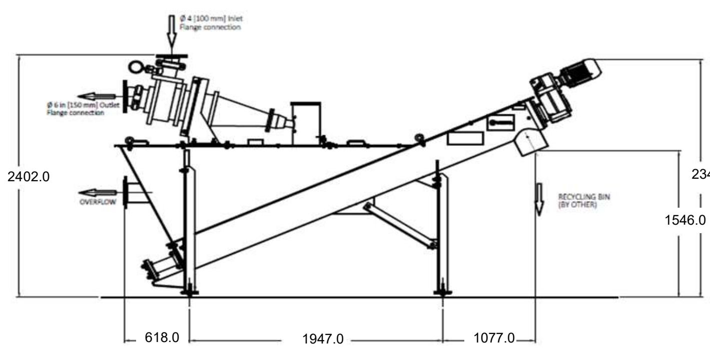
Quantity	**2**
Material Handling	**Grit**
Extraction Type	**Grit Pump**
Extraction Flow	**13** L/s
Number of Inlet(s)	**1**
Inlet Component	**Hydro-Cyclone**
Inlet Flow	**10 to 20% of extraction flow**
Grit Recovery	**95% of 200 mesh [75 microns] particles**
Inlet Pressure Drop	**8.5** psi
Hopper Hydraulic Capacit	**51** m³/h
Solid Handling Capacity	**3** m³/h
Installation Angle	**25** °
Discharge Height	**1546** mm
Wash Water (if applicable	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**1263** kg

Dimensions

DO NOT USE FOR CONSTRUCTION
FOR INFORMATION ONLY
John Meunier

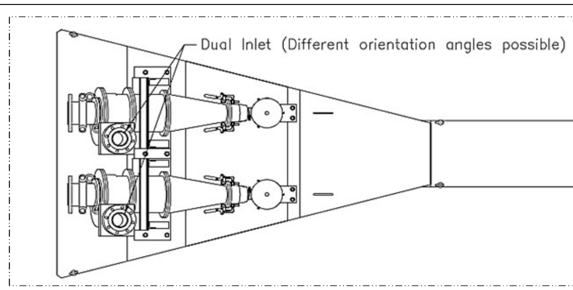


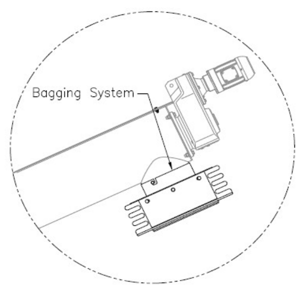


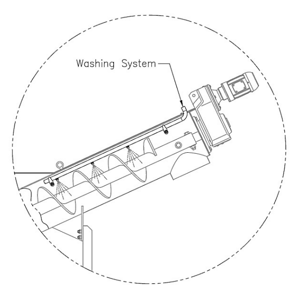


Dimensions in mm*
*Overall dimensions exclude an equipment installation at 1.5 in above grade

Possible Options







John Meunier Products
SAM® type GDS Grit Dewatering Screw

VEOLIA

Equipment Data-Sheet

Dundas, ON			
CA_05_24_571166	**Rev. 0**	**2024-05-21**	**Model # GDSC/14-12-25XA**

Selection

Quantity	**2**
Material Handling	**Grit**
Extraction Type	**Grit Pump**
Extraction Flow	**13** L/s
Number of Inlet(s)	**1**
Inlet Component	**Hydro-Cyclone**
Inlet Flow	**10 to 20% of extraction flow**
Grit Recovery	**95% of 200 mesh [75 microns] particles**
Inlet Pressure Drop	**8.5** psi
Hopper Hydraulic Capacit	**51** m³/h
Solid Handling Capacity	**3** m³/h
Installation Angle	**25** °
Discharge Height	**1546** mm
Wash Water (if applicable	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**1263** kg

Scope of Supply

Inlet Hopper			
Hopper	Thickness	4.76 mm	SS304
	Covers Thickness	1.3 mm	
	Overflow Diameter Connection	Ø6 in ANSI [Ø152 mm]	
Settling Plates	Thickness	1.3 mm	SS304

Trough and Support			
Trough	Length	3.66 m	SS304
	Thickness	6.35 mm	
	Trough Drain Connection	Ø2 in MNPT [Ø51 mm]	
Support	Thickness	6.35 mm	SS304

Screw Assembly			
Spiral Screw	Shafted - Full pitch	Abrasion Resistant Carbon Steel (CHT 400)	
	Diameter	Ø356 mm	
	Flight Thickness	Ø6.4 mm	
Screw Shaft	Diameter	Ø76 mm	
	Lower Shaft Assembly	Watertight Sacrificial Bushing	

Drive system			
Motor	WEG	2 HP (1.49 kW)	Premium Efficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1750 RPM	Class F insulation
Reducer	SEW	13 RPM	Parallel-Helical Type
	1.4 s.f. (per AGMA)		

Inlet Component			
Qty. 1 **Cyclone**			Inlet direction: From the top
	Inlet Diameter	Ø4 in ANSI [Ø102 mm]	Painted A36 Carbon Steel
	Overflow Diameter	Ø6 in ANSI [Ø152 mm]	Painted A36 Carbon Steel
	Housing	Ø10 in [Ø254 mm]	Painted A36 Carbon Steel
	Inlet Head Liner		Pure Gum Rubber

Anchors		
Type / Material	As preferred	**NOT INCLUDED**
Operating Floor	Internally Threaded	Ø16 mm

Control System			
Qty. 1 **Main Control Panel**	Unclassified Area	NEMA-4/12	**INCLUDED**
Included in Common Control Panel			CSA Approval
Details and components as per main control panel			
Main fusible disconnect switch with splitter			NEMA 4/12
Operator devices (selectors, buttons, lights)	22 mm		NEMA 4/12
Motor full voltage reversible starter			IEC Rated
Equipment power supply protection			
Safety barriers for digital signals			

Qty. 1 **Local Control Station**	Cl.1 Div.1	NEMA-7	**INCLUDED**
Qty. 1	Emergency Stop (Pushbutton)		
Qty. 1	Manual/Remote/Man.Test* (Selector Switch)		
	** Spring Return*		

Options		
Qty. 0 **Rigid Discharge Tube**		**NOT INCLUDED**
Qty. 0 **Flexible Discharge Sprout**		**NOT INCLUDED**
Qty. 0 **Bagging System**	90 m	**NOT INCLUDED**
Qty. 0 **Odor Control Connection**		**NOT INCLUDED**
Qty. 0 **Cold Weather Protection Package (auger trough only)**		**NOT INCLUDED**
Qty. 0 **Safety Pull Cord**	NEMA-7	**NOT INCLUDED**
Qty. 0 **Washing System**		**NOT INCLUDED**

Spare Parts (per Unit)		
Qty. 0	**Cyclone Apex Insert**	**NOT INCLUDED**
Qty. 0	**Cyclone Cone Section Liner**	**NOT INCLUDED**
Qty. 0	**Cyclone Cylinder Section Liner**	**NOT INCLUDED**
Qty. 0	**Cyclone Inlet Head Liner**	**NOT INCLUDED**
Qty. 0	**Bottom Bearing Assembly**	**NOT INCLUDED**
Qty. 0	**Bagger cartridge (295 ft [90 m])**	**NOT INCLUDED**

John Meunier Products
ROTARC® type SD Rotary Drum Fine Screen

VEOLIA

Equipment Data-Sheet

Dundas, ON
CA_05_24_571166 Rev. 0 2024-05-21

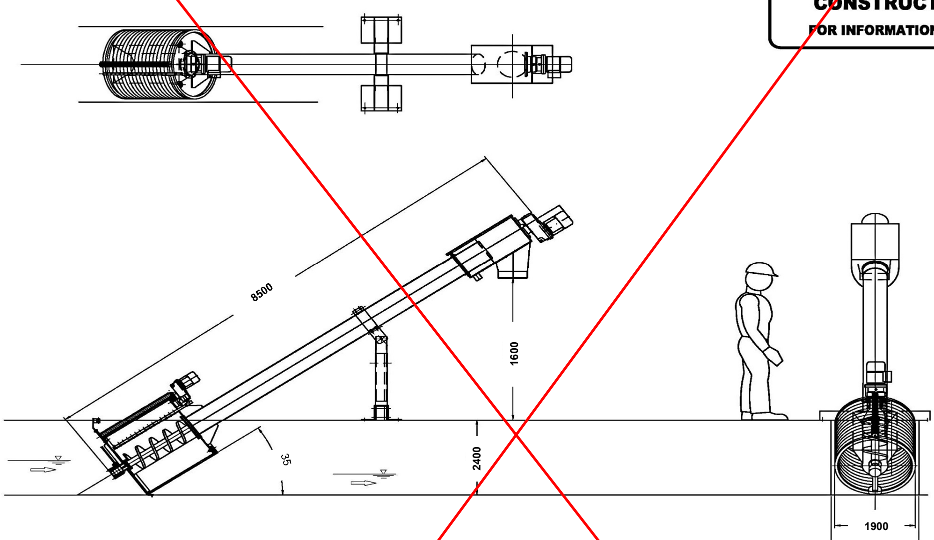
Model #SDC2-79XA

Selection

Quantity	3
Type	Perforated Drum Fine Screen
Installation Type	Concrete Channel (By Others)
Application Peak Flow	21,100.00 m³/d
Screen openings	Ø2 mm
Capture ratio	90 %
Installation angle	35 °
Channel width	Ø2000 mm
Channel depth	Ø2400 mm
Discharge height	1600 mm
Volume reduction	Up to 50 %
Dryness	Up to 30 %
Organics reduction	Up to 60 %
Solids loading capacity	Up to 0.5 m³/h
Waste Water	Potable or Treated Efluent
Main Power Supply	575V / 3Ph / 60Hz
Unit weight	1671 Kg

Dimensions

DO NOT USE FOR CONSTRUCTION
FOR INFORMATION ONLY

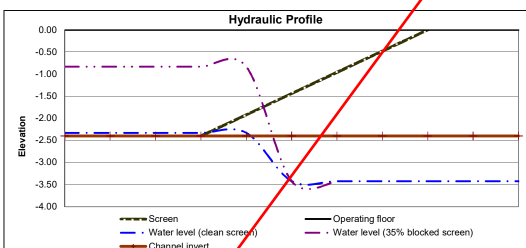


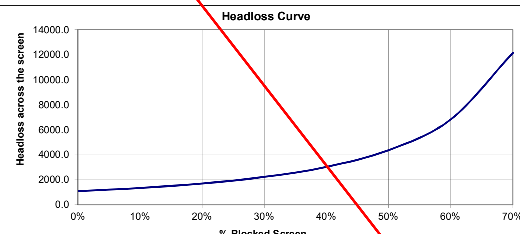
Dimensions in mm

Hydraulic

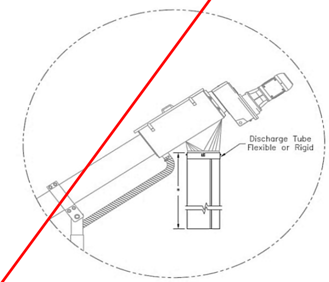
Downstream hydraulic condition	Freefall
Downstream water depth	78.86 mm
Approach velocity (clean screen)	0.57 m/s
Velocity trough screen (clean screen)	3.44 m/s
Downstream velocity	-0.04 m/s

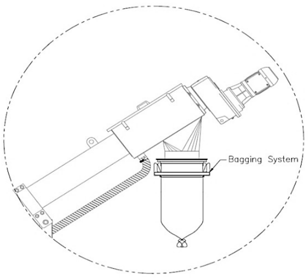
Headloss across the screen at 0%	1094.6 mm
Available freeboard upstream at 0%	2328.73 mm
Headloss across the screen at 50%	2590.78 mm
Available freeboard upstream at 50%	1567.44 mm

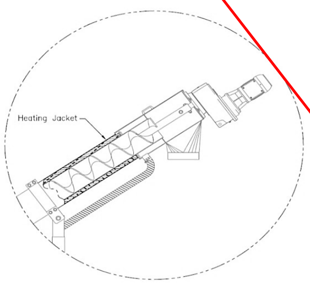




Available Options







John Meunier Products
ROTARC® type SD Rotary Drum Fine Screen

VEOLIA

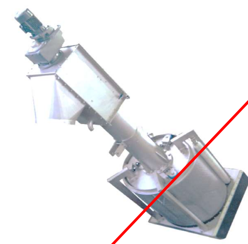
Equipment Data-Sheet

Dundas, ON			
	CA_05_24_571166	**Rev. 0**	**2024-05-21**

Model #SDC2-79XA

Selection

Quantity	**3**
Type	**Perforated Drum Fine Screen**
Installation Type	**Concrete Channel (By Others)**
Application Peak Flow	**21,100.00** m³/d
Screen openings	**Ø2** mm
Capture ratio	**90** %
Installation angle	**35** °
Channel width	**Ø2000** mm
Channel depth	**Ø2400** mm
Discharge height	**1600** mm
Volume reduction	**Up to 50** %
Dryness	**Up to 30** %
Organics reduction	**Up to 60** %
Solids loading capacity	**Up to 0.5** m³/h
Waste Water	**Potable or Treated Efluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**1671** Kg



Scope of Supply

Screen and Transport Zone

	Drum Screen	Type	Wedge wire	SS304
		Diameter	Ø1900 mm	
		Thickness	3 mm	
		Maximum upstream water level	778 mm	
		Side wall seals		Rubber
Qty.1	**Roller Brush**	External drum periphery		Nylon holder and bristles
	Transport Tube	Diameter	Ø508 mm	
Qty.4	**Wear Bars**	Thickness	8 mm	SS304

Dewatering / Compaction zone

Dewatering Box	Perforation	6 mm	SS304
	Drain Hose Stub	Ø60 mm	PVC
	Discharge Outlet Diamete	Valeur non tourvée	

Self-Standing Tank

Self-Standing Tank			**NOT INCLUDED**
	Body	1/8 in [3 mm] thick	SS304
	Inlet/Outlet Flange	ANSI - Roll-on type	SS304

Screw Assembly

Spiral Screw	Shafted - Helicoidal flights		HTCS
	Diameter	Ø475 mm	
	Flight thickness	6 mm	

Drive System

Motor	WEG	5 HP (3.75 kW)	.PremiumEfficiency
	Cl.1 Div.1	TEFC	1.15 s.f.
	Single Speed	1750 RPM	Class F insulation
Reducer	NORD Gear	5 RPM	Parallel-Helical Type
	Minimum 1.25 s.f.		

Washing System

	Screen Zone Washing System		1.0 L/s @ 5 bars	SS304
Qty.1	Solenoid Valve	Ø1.0 in FNPT [Ø25.4 mm	120 V	Brass
		Cl.1 Div.1	NEMA-4X	
Qty.1	Manual Ball Valve	Ø1.0 in FNPT [Ø25.4 mm]		Bronze
	Compaction Zone Washing System		0.8 L/s @ 3 bars	SS304
Qty.1	Solenoid Valve	Ø0.5 in FNPT [Ø12.7 mm	120 V	Brass
		Cl.1 Div.1	NEMA-4X	
Qty.1	Manual Ball Valve	Ø0.5 in FNPT [Ø12.7 mm]		Bronze

Anchors

Type / Material	As preferred	**NOT INCLUDED**
Operating Floor	Internally Threaded	Ø5/8 in

Instrumentation

Qty.1	**Differential Level Control System - Ultrasonic Type**		**INCLUDED**
	Qty.2	Ultrasonic probes	NEMA-7
	Qty.1	Remote Two-Points Controller	NEMA-4X
	Includes mounting bracket and 50 ft cable		
Qty.1	**Floating Bulb with Micro Switch**		**INCLUDED**
	Includes mounting bracket and 50 ft cable		NEMA-4X with Safety Barrier
Qty.0	**Safety Pull Cord**		**NOT INCLUDED**
		Emergency-Stop Switch	NEMA-7
		Includes mounting bracket and 65 ft cable	

Control System

Qty.1	**Main Control Panel**	Unclassified Area	NEMA-4/12	**INCLUDED**
	PLC with Ethernet Port and Modem		Allen-Bradley Micro800	CSA Approval
	Operator Interface Screen			7 inches
	Main fusible disconnect switch with splitter			NEMA 4/12
	Operator devices (selectors, buttons, lights)		22 mm	NEMA-4X
	Motor full voltage reversible starter			IEC Rate
	Equipment power supply protection			
	Safety barriers for digital signals			

Qty.1	**Local Control Station**	Cl.1 Div.1	NEMA-7	**INCLUDED**
		Qty.1	Emergency Stop (Pushbutton)	
		Qty.1	Off/Remote/Man.Test* (Selector Switch)	
		Qty.1	Forward/Off/Reverse* (Selector Switch)	
			** Spring Return*	

Options

Qty.0	**Cold Weather Protection Package**			**NOT INCLUDED**
Qty.0	**Rigid Discharge Tube**		6 m	**NOT INCLUDED**
Qty.0	**Flexible Discharge Tube**		6 m	**NOT INCLUDED**
Qty.0	**Bagging System**			**NOT INCLUDED**
Qty.0	**By Pass**		-	**NOT INCLUDED**
Qty.0	**Manual Bar Screen**	Bar Spacing	1.0 in	**NOT INCLUDED**
Qty.0	**Tank Zone Washing System**			**NOT INCLUDED**
Qty.0	**Odor Control Connection**		Ø4.0 in ANSI [102 mm]	**NOT INCLUDED**
Qty.0	**Automatic Gray Water Recirculation System**			**NOT INCLUDED**

Spare Parts

Qty.0	**Spare Brush**	**NOT INCLUDED**
Qty.0	**Complet set of anti-directional wear bars**	**NOT INCLUDED**
Qty.0	**Bagger (Spare 295 ft [90 m])**	**NOT INCLUDED**

John Meunier Products
ROTOPAC® type RLK Screw Conveyor

VEOLIA

Equipment Data-Sheet

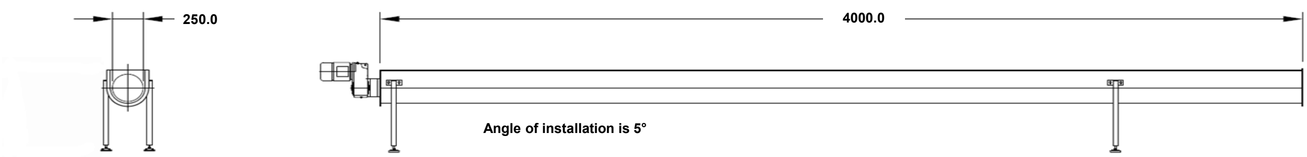
Dundas, ON		
CA_05_24_571166	**Rev. 0**	**2024-05-24**

Model RLK-250X40

Selection

Quantity	**3**
Type	**Shaftless Screw Conveyor**
Material handling	**Screenings**
Discharge Type	**Axial**
Length	**4,000** mm
Installation angle	**5** °
Transport mode	**Pushing**
Solids loading capacity	**2.4** m³/h
Wash water (if applicable)	**Potable or Treated Effluent**
Main Power Supply	**575V / 3Ph / 60Hz**
Unit weight	**705** Kg

Dimensions



Dimensions are in mm

Scope of Supply

Screw Conveyor Body				
Qty.1	**Inlet Hopper**	Height	500 mm	SS304
	U-trough	Diameter	Ø230 mm	SS304
	Wear Liner	Thickness	10 mm	HDPE
Qty.2	**Supporting legs**	Length	500 mm	SS304

Drive system				
	Motor	WEG	1 HP (0.75 kW)	Premium Efficiency
		Cl.1 Div.1	TEFC	1.15 s.f.
		Single Speed	1750 RPM	Class F insulation
	Reducer	NORD Gear	15 RPM	Parallel-Helical Type
		1.4 s.f. (per AGMA)		

Spiral screw			
Type	Shaftless - Helicoidal flights		Abrasion resistant carbon steel
Diameter		Ø230 mm	
Flight thickness		19 mm	

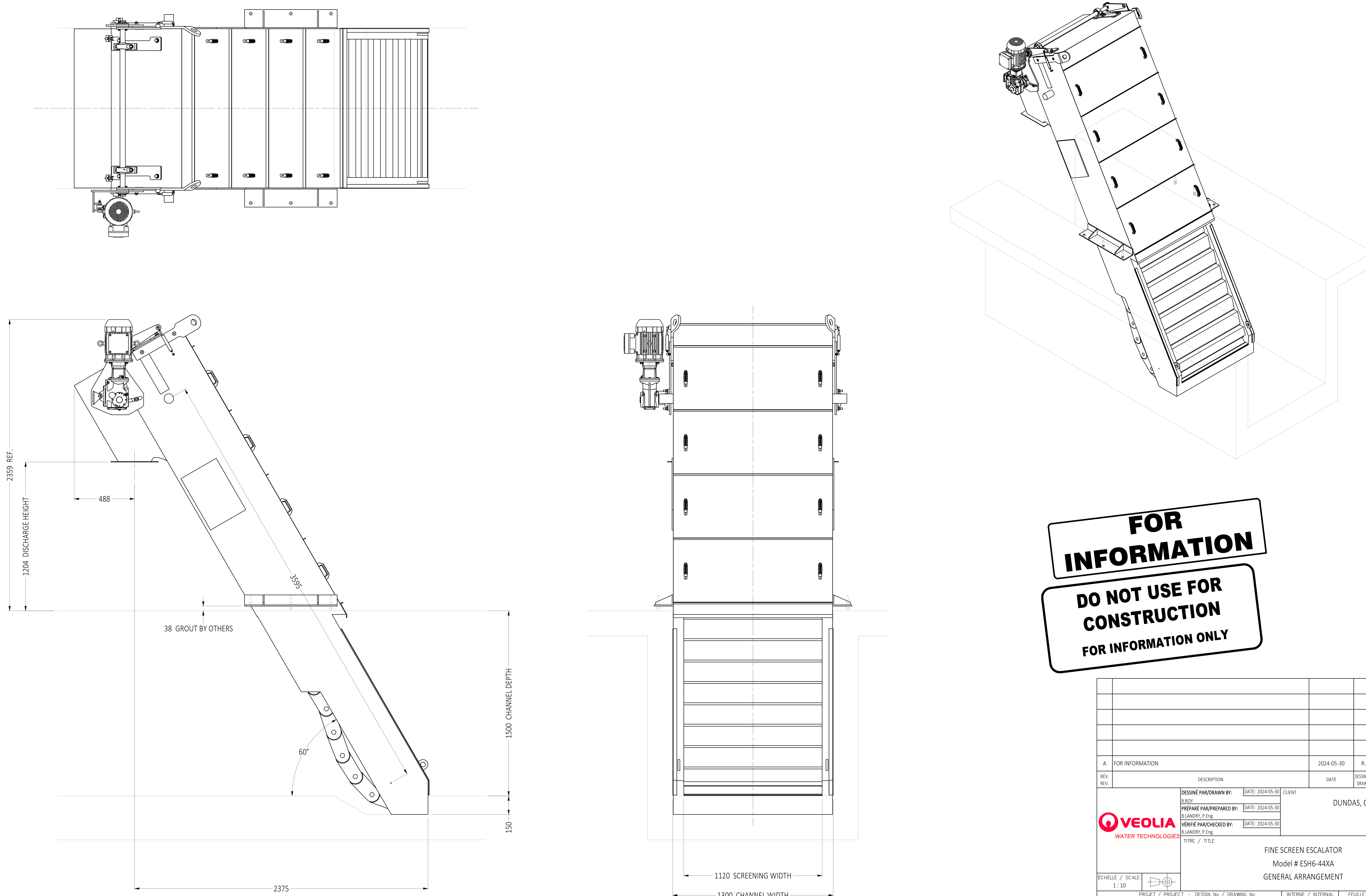
Anchors		
Type / Material	As preferred	**NOT INCLUDED**
Operating Floor	Internally Threaded	Ø5/8 in

Instrumentation			
Qty. 0	**Safety Pull Cord**		**NOT INCLUDED**
		Emergency-Stop Switch	NEMA-7
		Includes mounting bracket and cable holders	
Qty. 1	**Rotating Shaft Motion Detector**		**INCLUDED**
	Probe with 50 ft cable	NEMA-7 probe with NEMA-4X controller	

Control System				
Qty. 1	**Main Control Panel**			**INCLUDED**
	Classification	Unclassified Area		NEMA-4/12 Painted
	Included in Common Control Panel			CSA Approval
	As per main control panel			
	Main fusible disconnect switch with splitter			NEMA-4X
	Operator devices (selectors, buttons, lights)		22 mm	NEMA-4X
	Motor full voltage reversible starter			IEC Rated
	Equipment power supply protection			
	Safety barriers for digital signals			
Qty. 1	**Local Control Station (per unit)**	Cl.1 Div.1	NEMA-7	**INCLUDED**
		Emergency Stop (Pushbutton)		
		Off/Remote/Man.Test* (Selector Switch)		
		Forward*/Off/Reverse* (Selector Switch)		
		** Spring Return*		

Options			
Qty. 0	**Weather Protection System**		**NOT INCLUDED**
Qty. 0	**Bagging System**		**NOT INCLUDED**
Qty. 0	**Drain Pipe Connexion**	Ø2.5 in FNPT [Ø64 mm]	**NOT INCLUDED**

Spare Parts		
Qty.0	**Bagger (Spare 295 ft [90 m])**	**NOT INCLUDED**
Qty.0	**Wear Liners**	**NOT INCLUDED**



FOR INFORMATION

DO NOT USE FOR CONSTRUCTION

FOR INFORMATION ONLY

RÉV. / REV.	DESCRIPTION	DATE	DESSINÉ PAR/ DRAWN BY	PRÉPARÉ PAR/ PREPARED BY	VÉRIFIÉ PAR/ CHECKED BY
A	FOR INFORMATION	2024-05-30	R.R.	B.L.	B.L.

VEOLIA WATER TECHNOLOGIES

DESSINÉ PAR/DRAWN BY: R.ROY	DATE: 2024-05-30
PRÉPARÉ PAR/PREPARED BY: B.LANDRY, P.Eng.	DATE: 2024-05-30
VÉRIFIÉ PAR/CHECKED BY: B.LANDRY, P.Eng.	DATE: 2024-05-30

CLIENT: DUNDAS, ON

TITRE / TITLE:
FINE SCREEN ESCALATOR
Model # ESH6-44XA
GENERAL ARRANGEMENT

ÉCHELLE / SCALE: 1 : 10

PROJET / PROJECT - DESSIN No / DRAWING No	INTERNE / INTERNAL	FEUILLET / SHEET	RÉV/REV
CA_05_24_571166 - LA010		1 / 1	A

REF:

ANSI D

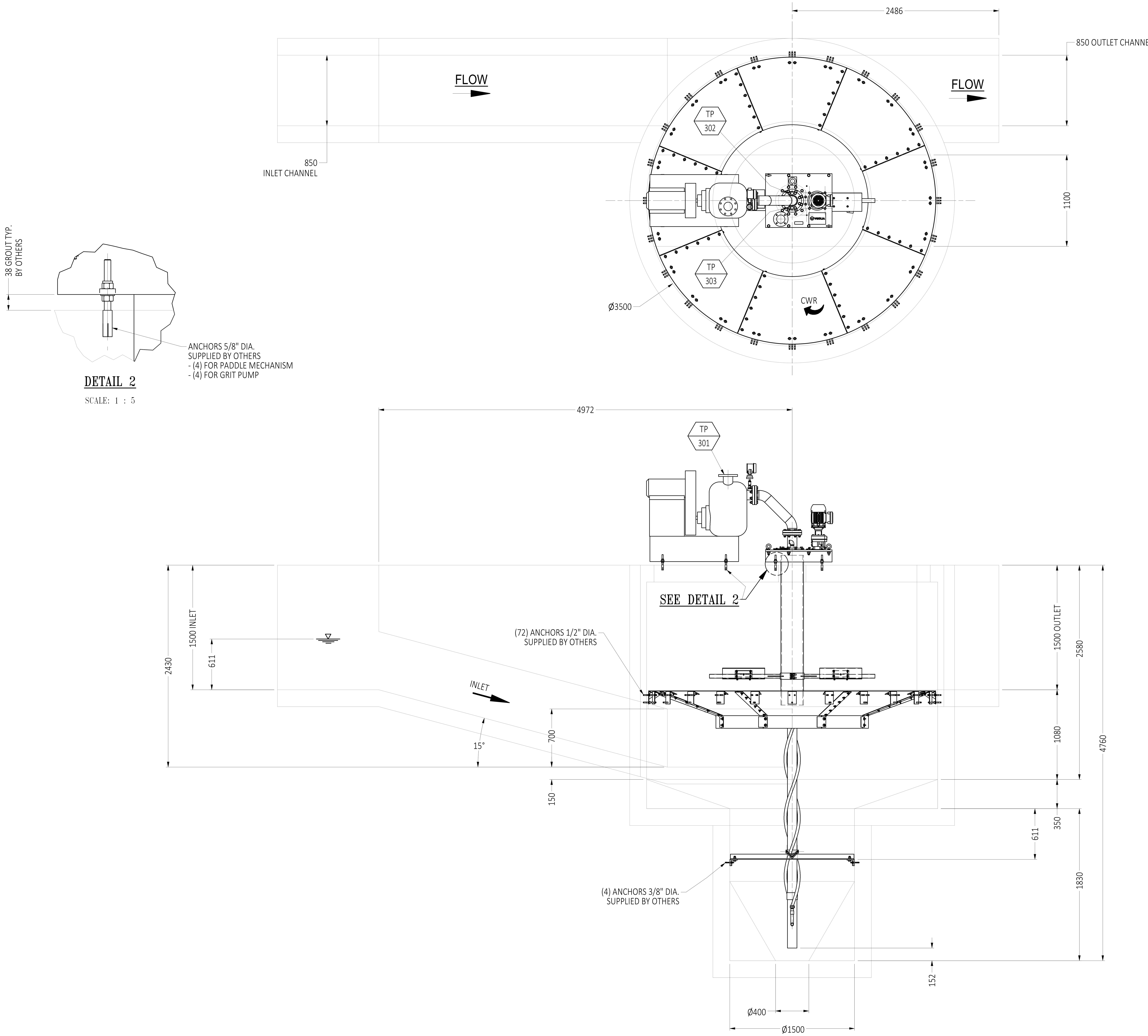


TABLE		
TI-POINT NO.	DESCRIPTION	DIMENSION / TYPE
TP-301	GRIT PUMP OUTLET	4" ANSI #150 FLANGE
TP-302	FLUIDISATION WATER INLET	1" FNPT
TP-303	FLUIDISATION WATER INLET	1" FNPT

1- ALL DIMENSIONS ARE IN MILLIMETERS.
2- PIPING IS NOT SUPPLIED BY VEOLIA.

PRELIMINARY

DO NOT USE FOR CONSTRUCTION

FOR INFORMATION ONLY

RÉV. / REV.	DESCRIPTION	DATE	DESSINÉ PAR / DRAWN BY	PRÉPARÉ PAR / PREPARED BY	VÉRIFIÉ PAR / CHECKED BY
A	FOR INFORMATION	2024-05-30	R.R.	B.L.	B.L.

VEOLIA WATER TECHNOLOGIES

DESSINÉ PAR/DRAWN BY: R.ROY — DATE: 2024-05-30
PRÉPARÉ PAR/PREPARED BY: B.LANDRY, P.Eng. — DATE: 2024-05-30
VÉRIFIÉ PAR/CHECKED BY: B.LANDRY, P.Eng. — DATE: 2024-05-30

CLIENT: DUNDAS, ON

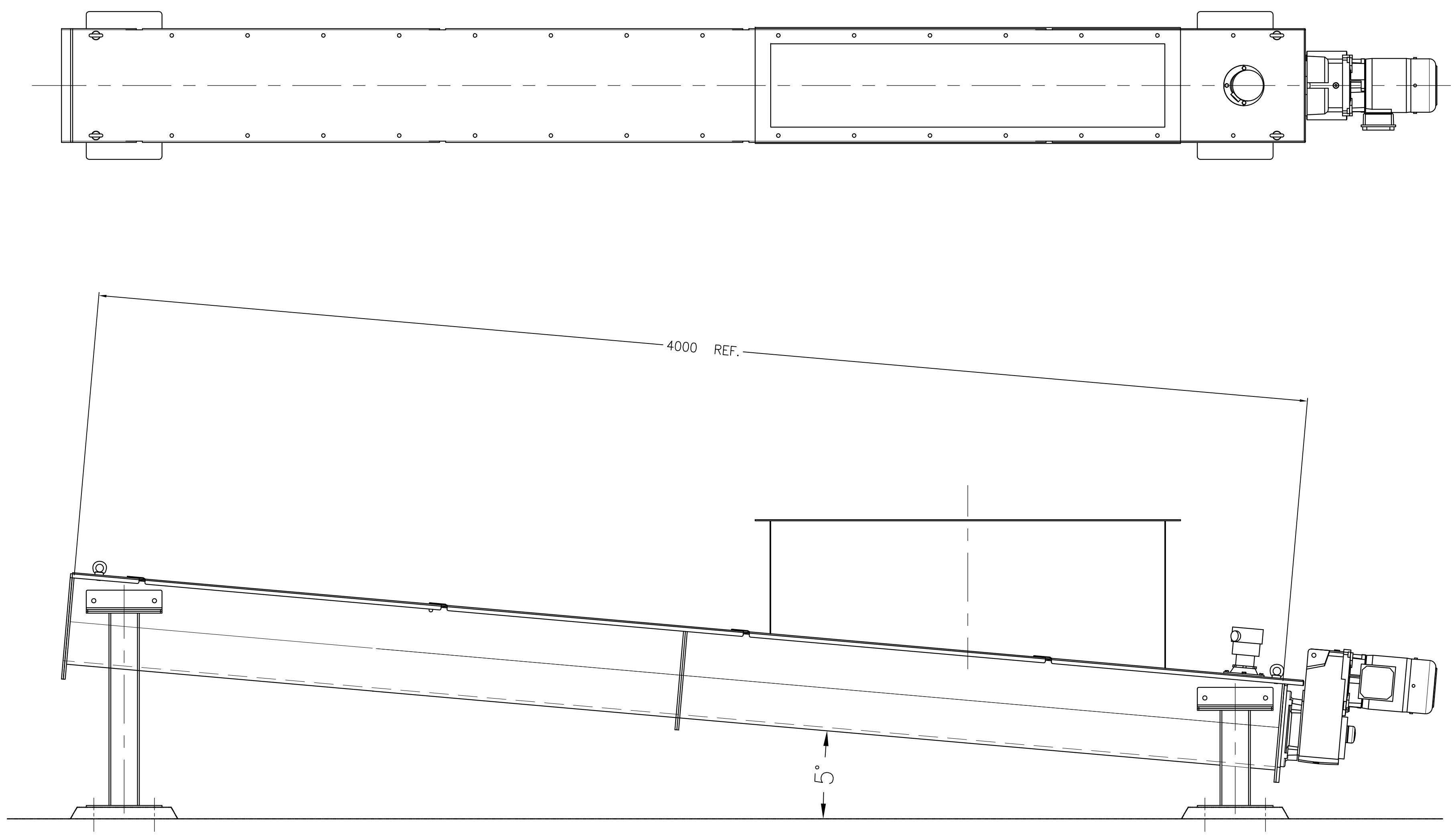
TITRE / TITLE: MECTAN "V" GRIT CHAMBER
JMDV/4-35ISXH
GENERAL ARRANGEMENT

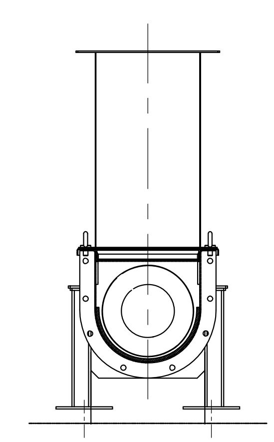
ÉCHELLE / SCALE: 1 : 25

PROJET / PROJECT	DESSIN No / DRAWING No	INTERNE / INTERNAL	FEUILLET / SHEET	RÉV/REV
CA_05_24_571166	LA042	-	1 / 1	A

REF: US_05_23_506920

ANSI D





FOR INFORMATION

DO NOT USE FOR CONSTRUCTION

FOR INFORMATION ONLY

REV.	DESCRIPTION	DATE	DESSINÉ PAR DRAWN BY:	PRÉPARÉ PAR PREPARED BY:	VÉRIFIÉ PAR CHECKED BY:
A	FOR INFORMATION	2024-05-30	R.R.	B.L.	B.L.

VEOLIA WATER TECHNOLOGIES

DESSINÉ PAR/DRAWN BY: R.ROY	DATE: 2024-05-30	CLIENT: DUNDAS, ON
PRÉPARÉ PAR/PREPARED BY: B.LANDRY, P.Eng.	DATE: 2024-05-30	
VÉRIFIÉ PAR/CHECKED BY: B.LANDRY, P.Eng.	DATE: 2024-05-30	

TITRE / TITLE: ROTOPAC TYPE RLK SCREW CONVEYOR
RLK-250X40
GENERAL ARRANGEMENT

ÉCHELLE / SCALE: 1 : 20

PROJET / PROJECT	DESSIN /DRAWING	INTERNE / INTERNAL	FEUILLET / SHEET	RÉV./REV
CA_05_24_571166	LA030		1 / 1	A

REF: CA_03_21_363444

ANSI D

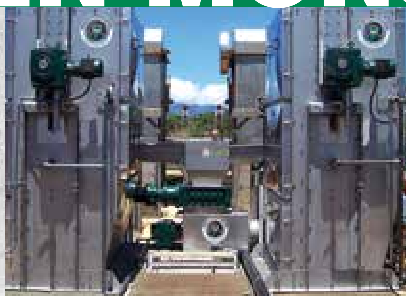
May 31, 2024 10:19:58 – C:\Users\simon.morin\Downloads\CA_05_24_571166-LA030_A (Convoyeur).dwg – simon.morin

JWC Environmental®
Trust Monster Quality™

MUFFIN MONSTER®

Monster Separation Systems®

BANDSCREEN MONSTER®


This system offers incredibly high capture rates and is able to remove a wider variety of solids, particularly small debris, better than traditional screens. It can also be used to protect high-tech Membrane Bioreactors (MBR).

The rotating panels are positioned parallel to the flow and as wastewater enters the screen it flows through the perforated screening panels. It is easy to retrofit into existing channels and installs at a 90º inclination.

Unique Flow Design

- Zero carryover and the highest capture rate of all screens.
- Perforated openings capture twice as much debris as bar screens.
- Perforated UHMW replaceable inserts with stainless steel frame limit hair pinning.

Enhanced Cleaning System

- Spray bar keeps the screen panels clear.

Heavy-Duty Stainless Steel Roller Chains

- Stainless steel construction ensures long life.
- Roller chains track smoothly in UHMW guides.

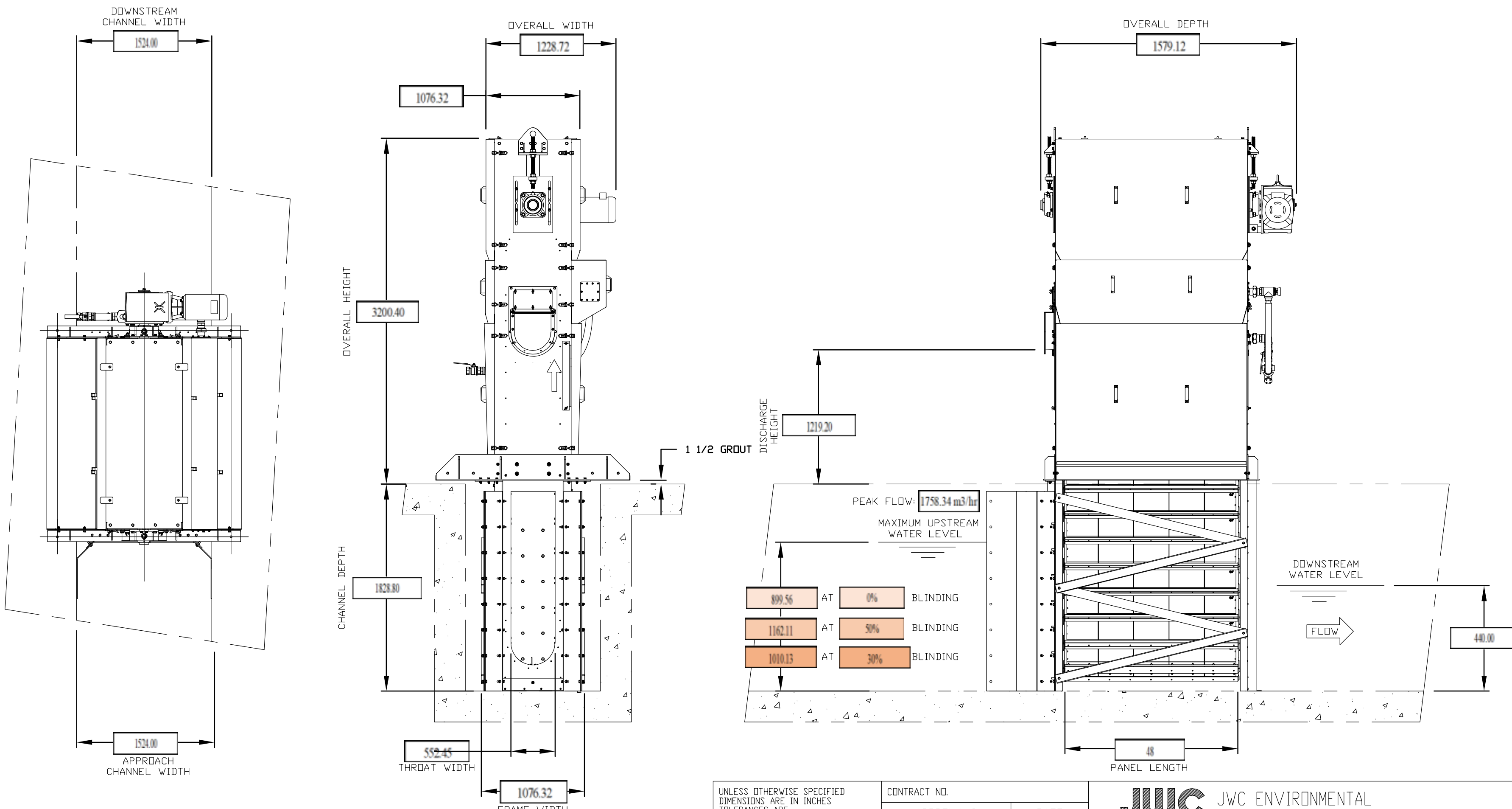
Equipment Sizing

Screen Panel Hole Size: ø 2, 3, 5, 6 or 10 mm perforations
Depth: Up to 40' (12.2 m) with a 8' (2.4 m) max discharge height
Minimum Wash Water Pressure at Spray Jets: 40 PSI (2.7 bar)

Materials of Construction

Screen Structure: 304 or 316 stainless steel
Screen Panels: UHMW plates, 1/4" (6.4 mm) or 3/8" (9.5 mm) thick

DRAWING NO. MBS-BUDGET-02



NOTES UNLESS OTHERWISE SPECIFIED:
1. BUDGET DRAWING ONLY. NOT FOR CONSTRUCTION.
2. DIMENSIONS SUBJECT TO CHANGE.
3. EQUIPMENT DEPICTED IS APPROXIMATE.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES

MATERIAL
304 SST GEN CONST.

FINISH
125 UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

CONTRACT NO.	
APPROVALS	DATE
DRAWN C.G.	10-1-16
CHECKED	
MANUF.	
QC	

JWC ENVIRONMENTAL
2850 S. Red Hill Ave, Ste 125, Santa Ana, California 92705

GENERAL VIEWS
BANDSCREEN MONSTER®
SINGLE LEVEL DISCHARGE, STRAIGHT CHANNEL

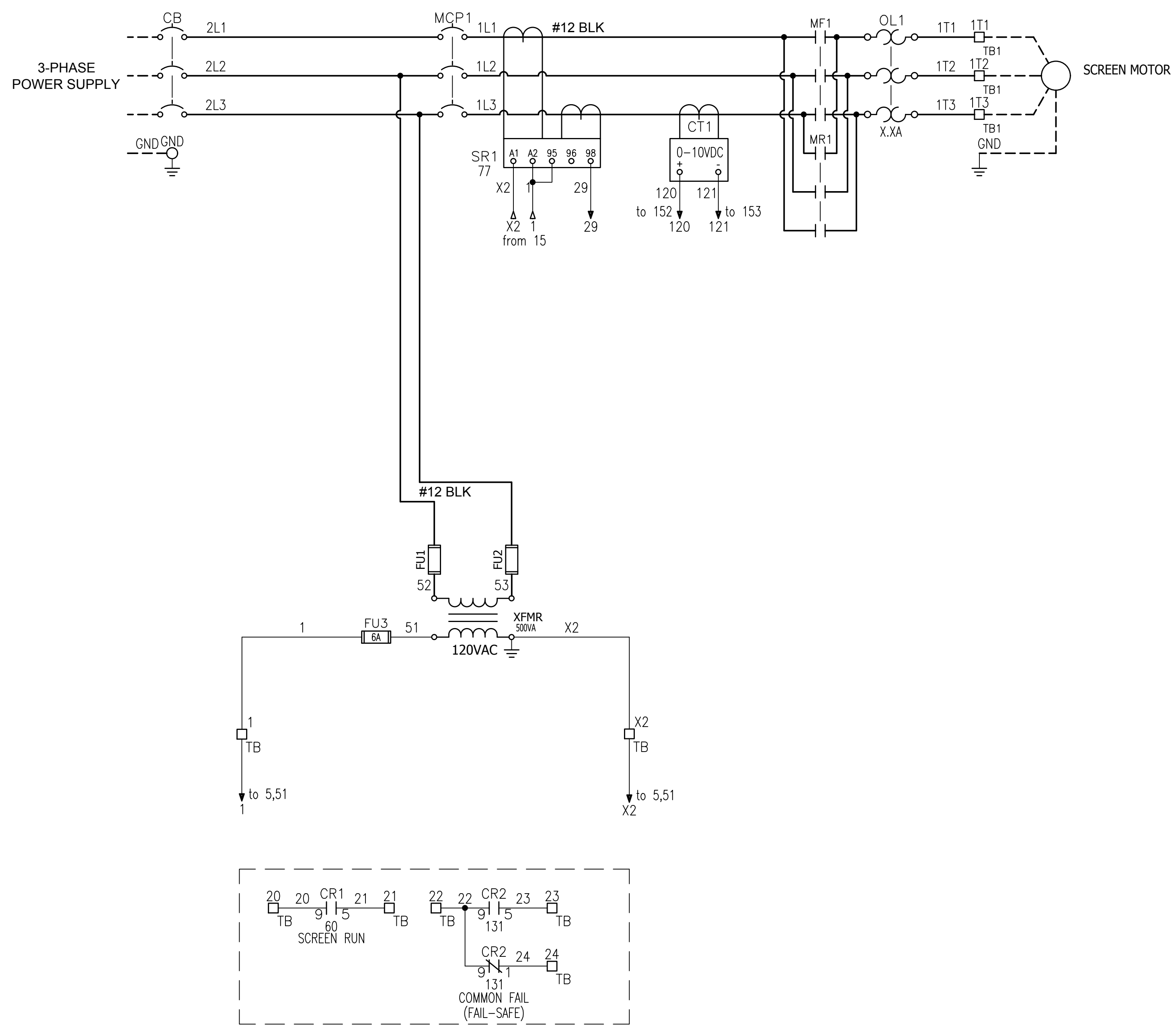
SIZE	CODE IDENT NO.	DRAWING NO.	REV
B	53242	MBS-BUDGET-02	X3

SHT 1 OF 1

DRAWING NO. PC2520-010

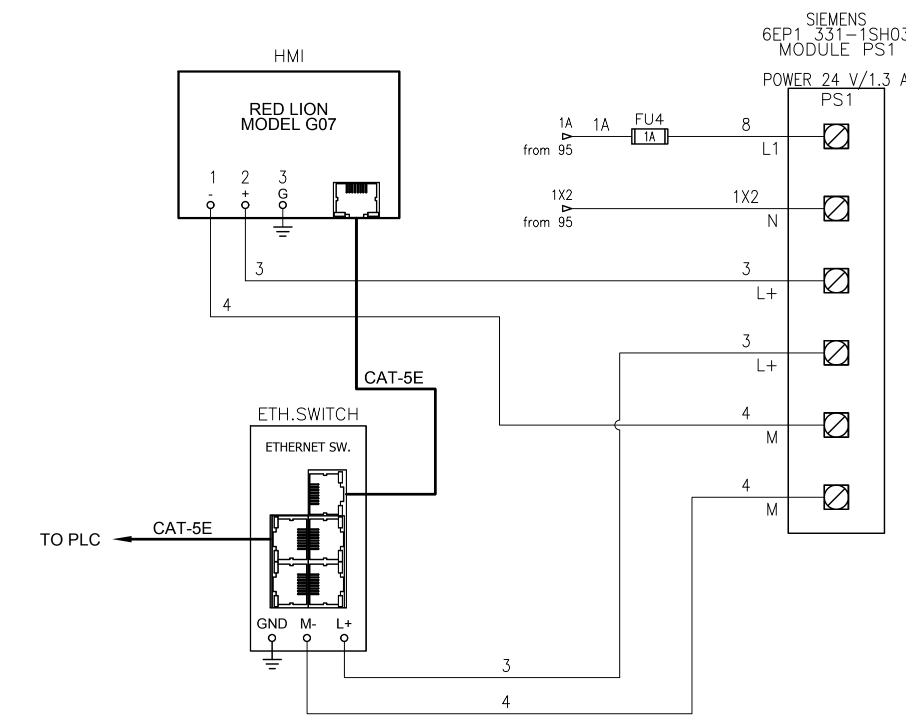
ZONE	REV	DESCRIPTION	ECN NO	DATE	CHK	PE	MFG	QC
ALL	A	INITIAL RELEASE		1/6/15				

REVISION HISTORY



#16 ORANGE WIRE CIRCUITS.

*** CAUTION ***
OPEN MAIN DISCONNECT SWITCH
WILL NOT DE-ENERGIZE ORANGE
COLOR WIRE CIRCUITS.



NOTES: UNLESS OTHERWISE SPECIFIED.

1. PROGRAM NUMBER: PC2520-010
2. SHORT CIRCUIT CURRENT RATING (SCCR) FOR THE CONTROLLER IS 65kA @ 208/230, 25kA @ 460V, 18kA @ 575V.
3. CALIBRATED AMPERAGE X.X A TO BE DETERMINED AFTER THE MOTORS HAVE BEEN SELECTED.
4. SR1 TRIP SETPOINT SHALL BE CALIBRATED TO .8 TIMES MOTOR FLA. SET THE START TIME DIAL TO .4 SECONDS (*). SET THE SHOCK TIME DIAL TO .2 SECONDS (*). (*) DEFAULT VALUE IS SHOWN.
5. A WIRE JUMPER IS REQUIRED, IF THE MOTOR IS NOT EQUIPPED WITH THE THERMOSTAT.
6. WIRE SIZE, TYPE AND COLOR:
   POWER CIRCUIT: #12 AWG TYPE MTW BLACK
   CONTROL CIRCUIT, 120VAC: #16 AWG TYPE MTW RED
   CONTROL CIRCUIT, 120VAC NEUTRAL: #16 AWG TYPE MTW WHITE
   CONTROL CIRCUIT, 24VDC: #16 AWG TYPE MTW BLUE
   CONTROL CIRCUIT WITH EXTERNAL POWER SOURCE: #16 AWG TYPE MTW ORANGE
   CONTROL CIRCUIT GROUNDING: #14 AWG TYPE MTW GREEN
   POWER CIRCUIT GROUNDING: #12 AWG TYPE MTW GREEN

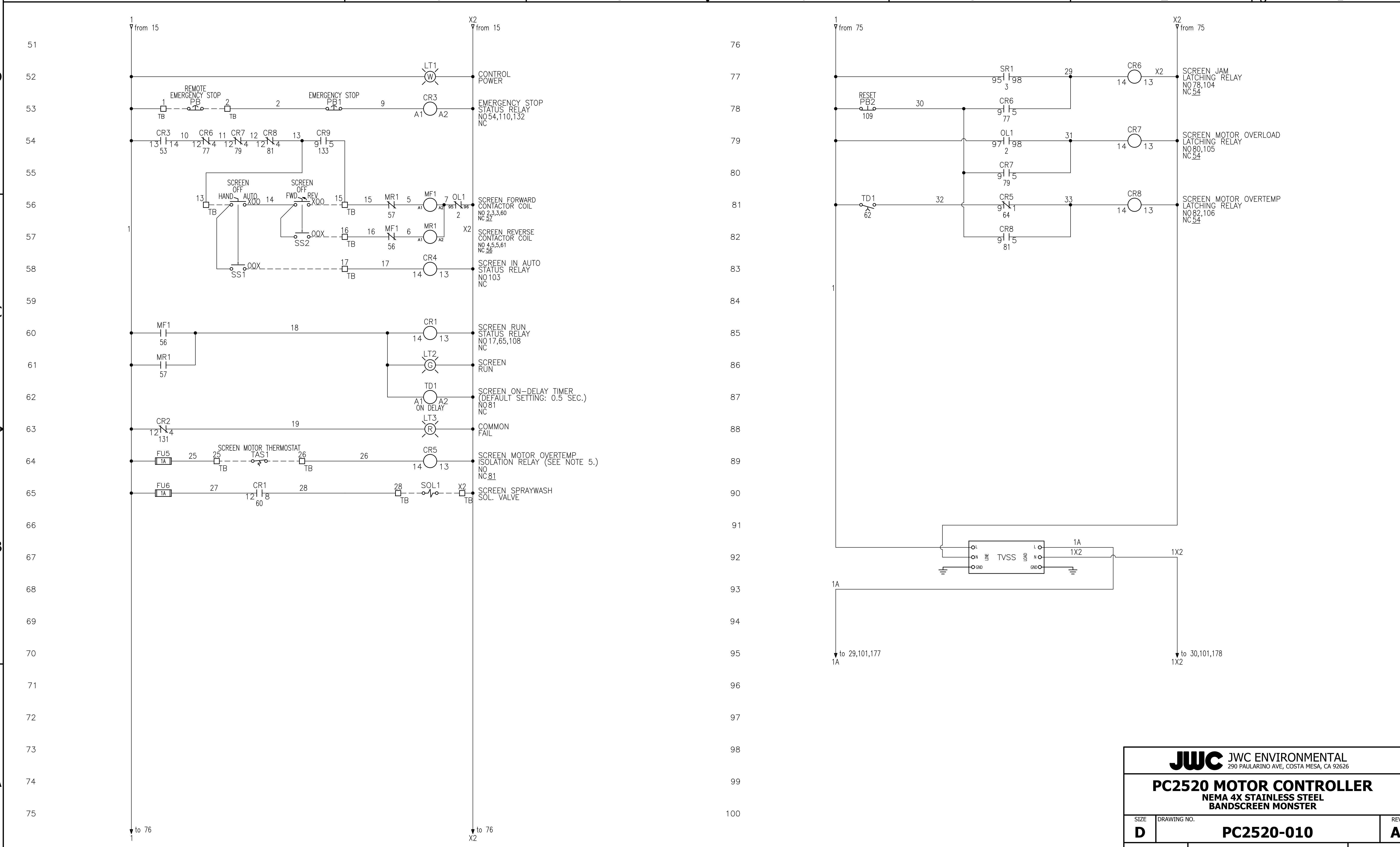
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/32 | DECIMALS .XX ± .06 .XXX ± .005 | ANGLES ± 1/2°
MATERIAL
FINISH 250 (CAST) 125 (MACHINED) UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING

APPROVALS		DATE
DRAWN	FUENTES, I.	01-06-15
CHECKED		
MANUF.		
Q.C.		

JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626

PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL BANDSCREEN MONSTER

SIZE: D | DRAWING NO.: PC2520-010 | REV: A
SCALE: NTS | 1 OF 6

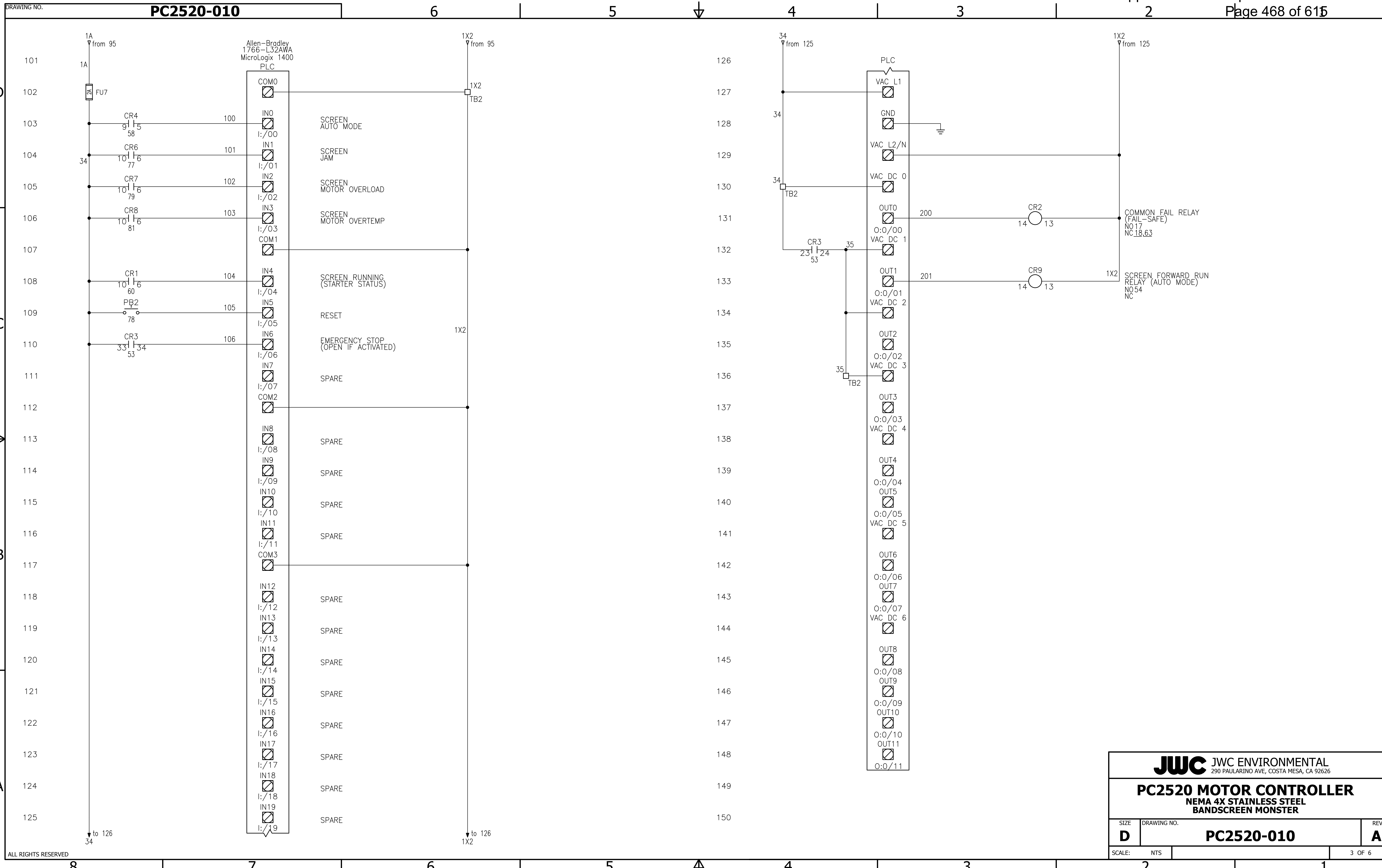


JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626

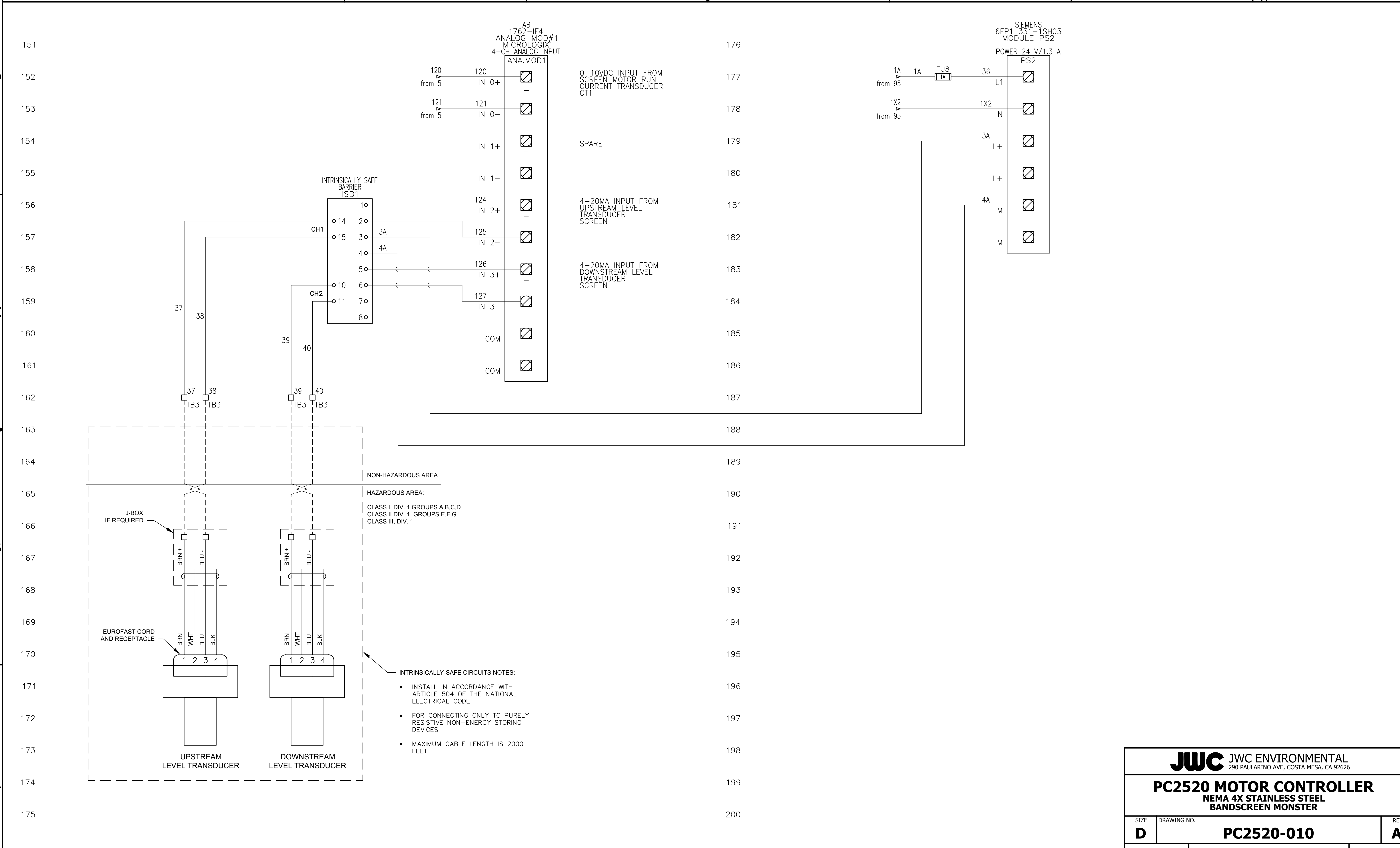
PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL
BANDSCREEN MONSTER

SIZE	DRAWING NO.	REV
D	PC2520-010	A

SCALE: NTS — 2 OF 6


DRAWING NO. PC2520-010
1A from 95
FU7
CR4 9 5 58
CR6 10 6 77
CR7 10 6 79
CR8 10 6 81
CR1 10 6 60
PB2 78
CR3 33 34 53
to 126 34
Allen-Bradley
1766-L32AWA
MicroLogix 1400
PLC
COM0
IN0 I:/00 100 SCREEN AUTO MODE
IN1 I:/01 101 SCREEN JAM
IN2 I:/02 102 SCREEN MOTOR OVERLOAD
IN3 I:/03 103 SCREEN MOTOR OVERTEMP
COM1
IN4 I:/04 104 SCREEN RUNNING (STARTER STATUS)
IN5 I:/05 105 RESET
IN6 I:/06 106 EMERGENCY STOP (OPEN IF ACTIVATED)
IN7 I:/07 SPARE
COM2
IN8 I:/08 SPARE
IN9 I:/09 SPARE
IN10 I:/10 SPARE
IN11 I:/11 SPARE
COM3
IN12 I:/12 SPARE
IN13 I:/13 SPARE
IN14 I:/14 SPARE
IN15 I:/15 SPARE
IN16 I:/16 SPARE
IN17 I:/17 SPARE
IN18 I:/18 SPARE
IN19 I:/19 SPARE
1X2 from 95
1X2 TB2
1X2
to 126 1X2
34 from 125
34
34 TB2
CR3 23 24 53
35
35 TB2
PLC
VAC L1
GND
VAC L2/N
VAC DC 0
OUT0 O:0/00 200
VAC DC 1
OUT1 O:0/01 201
VAC DC 2
OUT2 O:0/02
VAC DC 3
OUT3 O:0/03
VAC DC 4
OUT4 O:0/04
OUT5 O:0/05
VAC DC 5
OUT6 O:0/06
OUT7 O:0/07
VAC DC 6
OUT8 O:0/08
OUT9 O:0/09
OUT10 O:0/10
OUT11 O:0/11
CR2 14 13
CR9 14 13
1X2 from 125
1X2
COMMON FAIL RELAY (FAIL-SAFE) NO 17 NC 18,63
SCREEN FORWARD RUN RELAY (AUTO MODE) NO 54 NC
JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626
PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL
BANDSCREEN MONSTER
SIZE D
DRAWING NO. PC2520-010
REV A
SCALE: NTS
3 OF 6
ALL RIGHTS RESERVED

DRAWING NO. PC2520-010

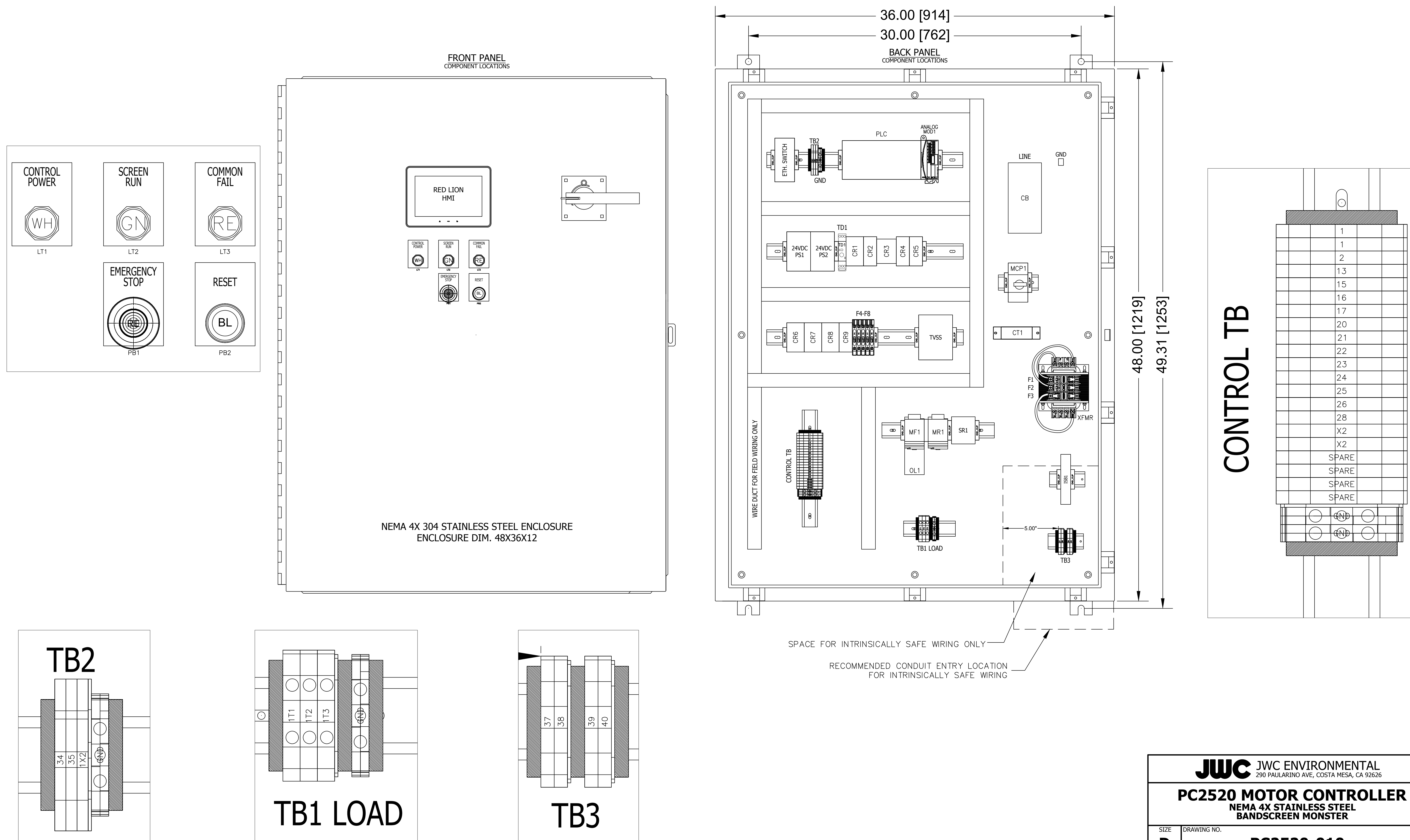


JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626

PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL
BANDSCREEN MONSTER

SIZE	DRAWING NO.	REV
D	PC2520-010	A
SCALE: NTS		4 OF 6

DRAWING NO. PC2520-010



JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626

PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL
BANDSCREEN MONSTER

SIZE	DRAWING NO.	REV
D	PC2520-010	A
SCALE: NTS		5 OF 6

DRAWING NO. PC2520-010

SCREEN SEQUENCE OF OPERATION:

Screen HAND–OFF–AUTO selector switch located on the Local Control Station:
In HAND MODE, the SCREEN FWD–OFF–REV selector switch located on the Local Control Station is enabled.

In OFF MODE, the Screen will not run.

In AUTO MODE, the Screen is started by one of the following control inputs:
- Differential Level monitor
- High Level Start condition
- High Level Alarm condition
- Backup Timer
- Input error from a level transducer, "Loss of Echo"

If the Differential Level starts the Screen Cycle, the Screen will run until the differential drops below the Start setpoint and the off–delay timer has timed out.

If the High Level Start set point is reached, the Screen will start. The Screen will stop when the upstream water level drops below the High Level Start set point, the off–delay timer has timed out, and when the differential level is below the Start set point. The High Level Start value must be set lower than the High Level Alarm value.

If the High Level Alarm starts the Screen Cycle, the Screen will run until the upstream water level descends below the High Level setpoint and the off–delay timer has timed out.

If the Backup Timer starts the Screen Cycle ("exercise run"), the Screen will run for a programmed period set on the backup run timer.

The Screen runs continuously if there is an error with one of the level transducer inputs.

The off–delay timer period should allow the Screen to rotate about 1/2 revolution.

OIT'S ALARM MESSAGES:

Screen Upstream Level Sensor Failure
Screen Downstream Level Sensor Failure
Screen High Water Level

Screen Jammed
Screen Motor Overload
Screen Motor Overtemp
Screen Fail to Start

Emergency Stop Activated

OTHER OIT FUNCTIONS:

Screen Status.
Screen Statistical Data Display.
Screen Start Differential Setpoint Setting.
Screen High Level Start and
High Water Level Alarm Setpoint Settings.
Screen Timer Setup

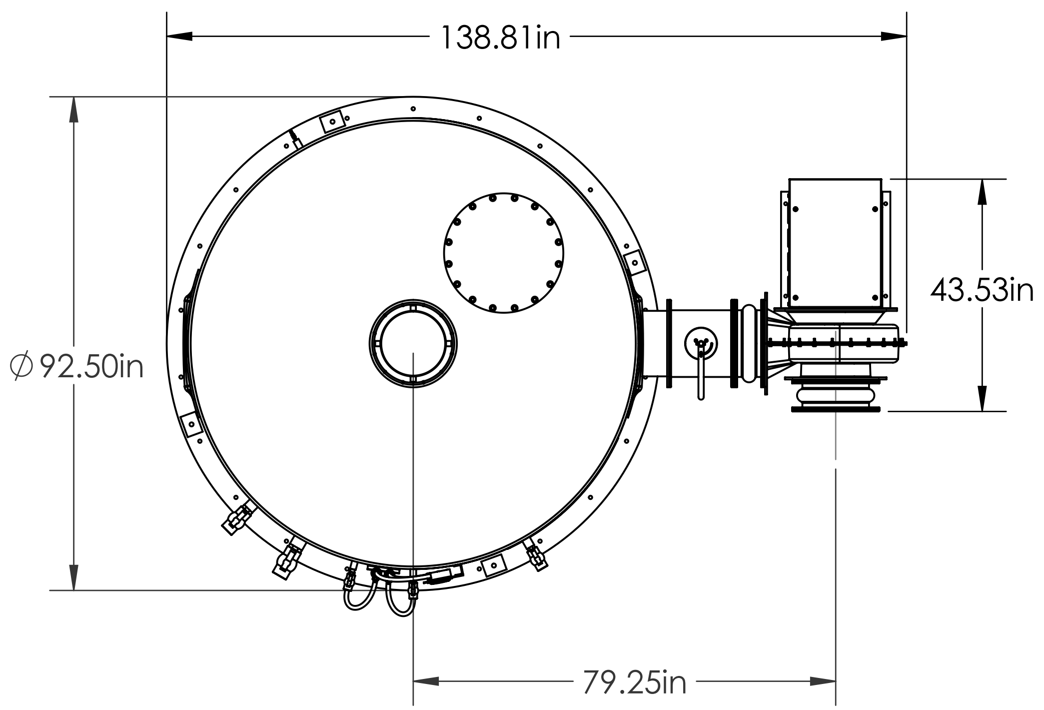
Screen Level Sensor Setup
Current Transducer Setup

JWC ENVIRONMENTAL
290 PAULARINO AVE, COSTA MESA, CA 92626

PC2520 MOTOR CONTROLLER
NEMA 4X STAINLESS STEEL
BANDSCREEN MONSTER

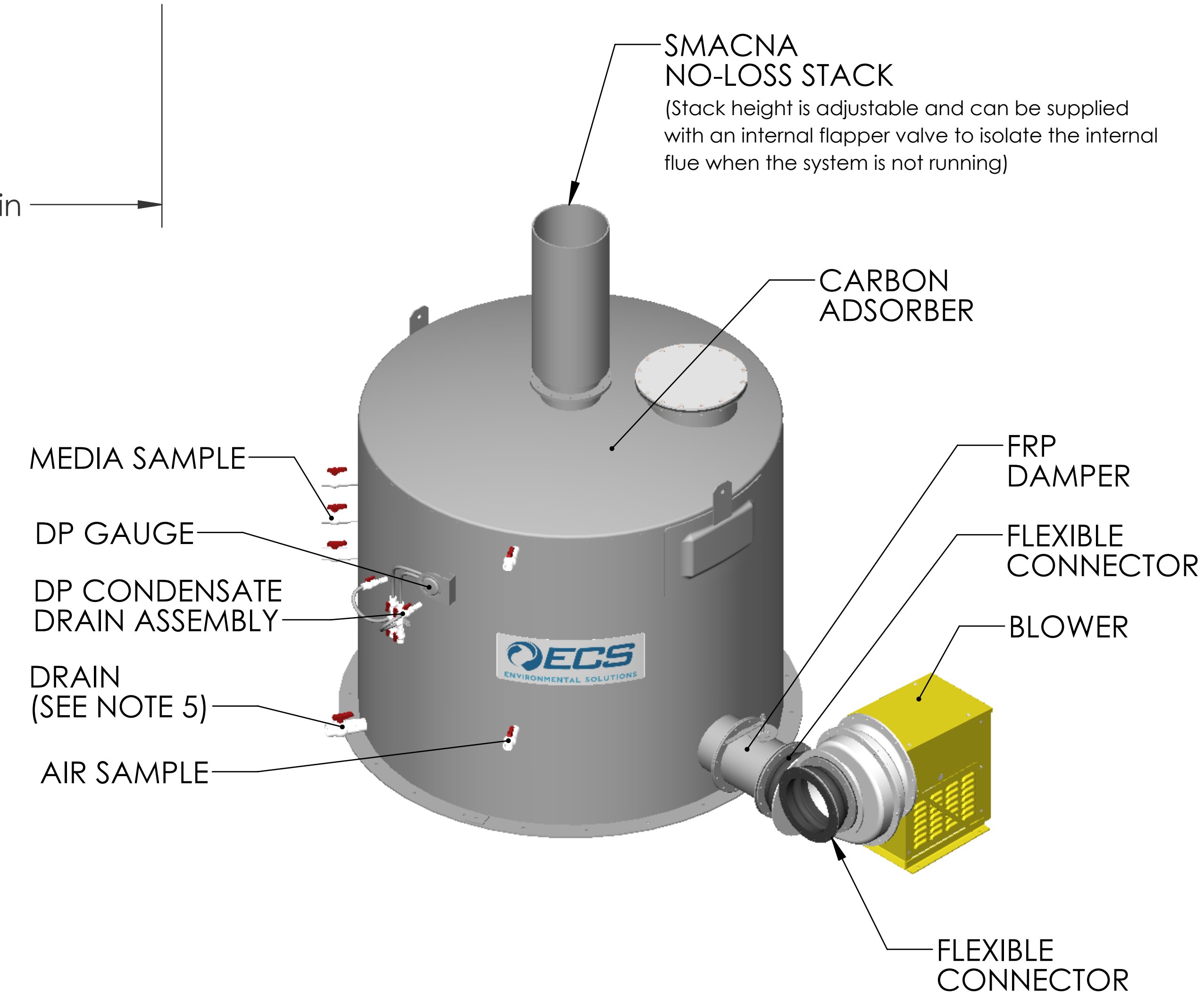
SIZE	DRAWING NO.	REV
D	PC2520-010	A
SCALE: NTS		6 OF 6

ECS V1 CARBON ADSORBER SYSTEM	
MODEL:	60 SERIES V1-84-2250
CARBON CAPACITY:	115 FT^3 (3' BED DEPTH)
BED VELOCITY:	58 FPM
EBRT:	3.08 SECONDS
SYSTEM PRESSURE DROP:	4.8" W.C.*
FAN DATA	
MODEL:	NYB RFE315
DESIGN:	2250 CFM @ 10" W.C.
MOTOR:	3-60-230/460V; 10 HP; FLA 14 AMPS



BASE SYSTEM SHOWN, INCLUDES:

- FRP VESSEL
- SMACNA NO-LOSS EXHAUST STACK
- ISOLATION / BALANCING DAMPER
- FRP BLOWER WITH INLET & OUTLET EXPANION JOINTS
- DWYER MAGNEHELIC DP GAUGE
- MOTOR STARTER
  (SHIPPED LOOSE, MOUNTED 3' FROM AIRSTREAM)

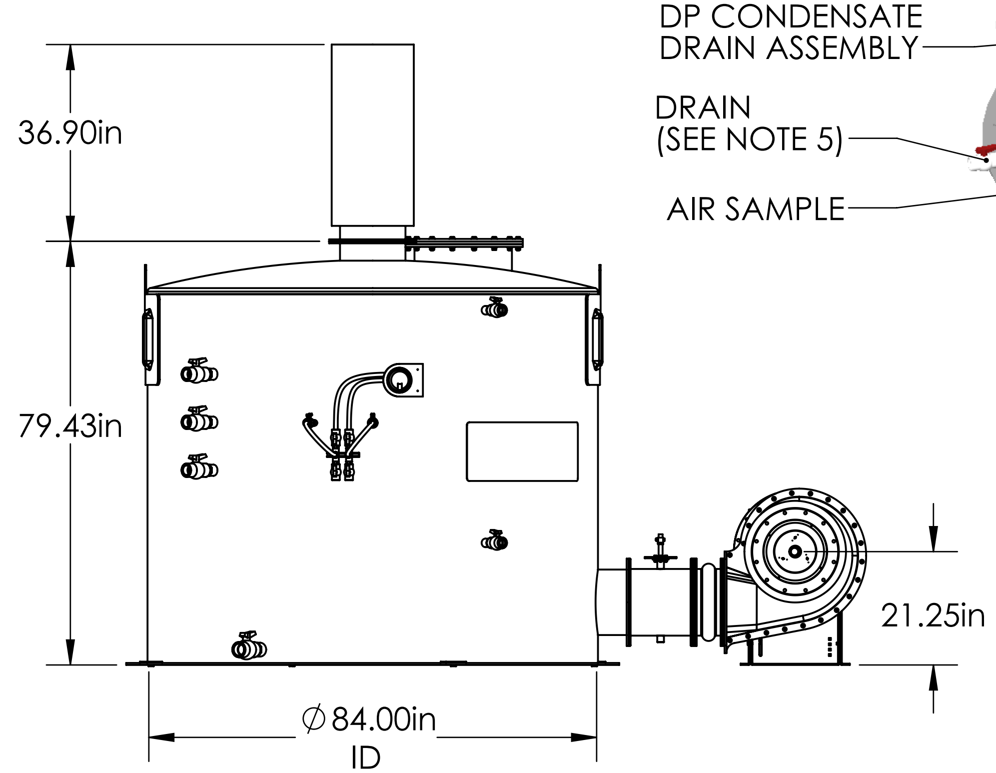


NOTES:

1. ALL FLANGES PER PS 15-69 UNLESS OTHERWISE NOTED
2. VESSEL CONSTRUCTION IS FRP
   - RESIN SYSTEM IS A CLASS 1 FLAME RESISTANT VINYL ESTER
   - ALL INTERNAL SURFACES HAVE A 100-MIL COROSION BARRIER
   - EXTERIOR SURFACES TO HAVE UV-INHIBITOR APPLIED
3. NOZZLE ORIENTATIONS ARE PLACED FOR CLARITY AND CAN BE CHANGED TO FIT SITE CONDITIONS
4. NEMA 4X MOTOR STARTER MOUNTED 3' FROM AIR STREAM.
5. DRAIN PORT MAY HAVE A CONSTANT DRIP AND SHOULD BE PLUMBED AWAY FROM THE SYSTEM WITH SIX-INCH WATER TRAP. IF FREEZING CONDITIONS MAY EXIST, THIS EXTERNAL PIPING SHOULD BE INSULATED AND HEAT TRACED (EXTREME CONDITIONS)
6. IF THE ODOR CONTROL SYSTEM IS INSTALLED OUSIDE INA COLD CLIMATE, AND THE INFLUENT AIR IS WARM / MOIST, A 2" THICK FACTORY APPLIED INSULATION SYSTEM IS RECOMMENED
7. COLORS OPTIONS ARE GRAY, WHITE, OR TAN.
8. CONSULT ECS FOR MEDIA SELECTION. DIFFERENT CARBONS OR POLISHING AGENTS ARE OFFERED BASED ON TREATMENT OBJECTIVES AND CONCENTRATIONS WITH THE INTENT TO OPTIMIZE MEDIA LIFE

ESTIMATED ASSEMBLED WEIGHTS:

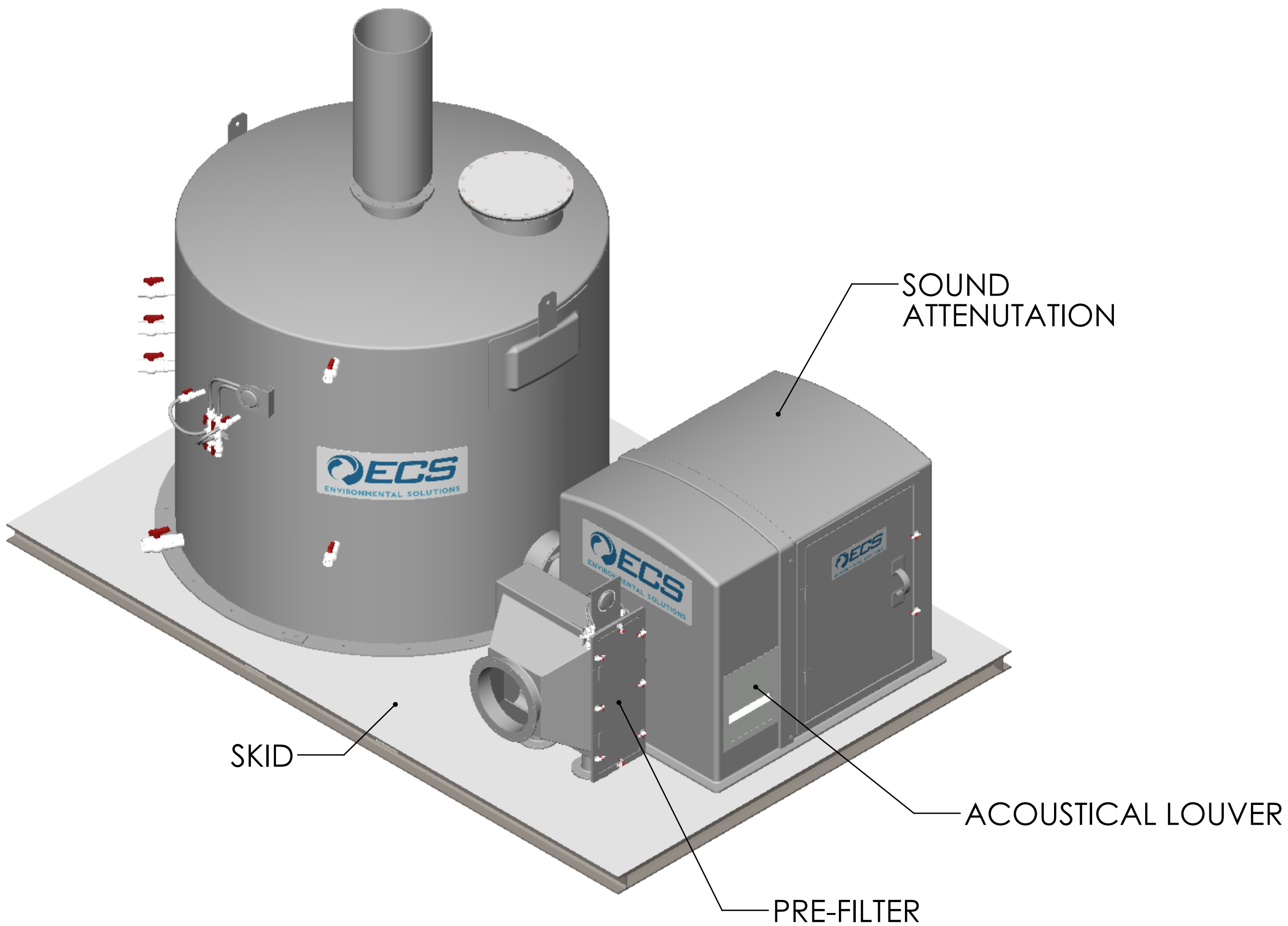
EMPTY: 1659#
FLOODED: 15997#
OPERATING: 5354#

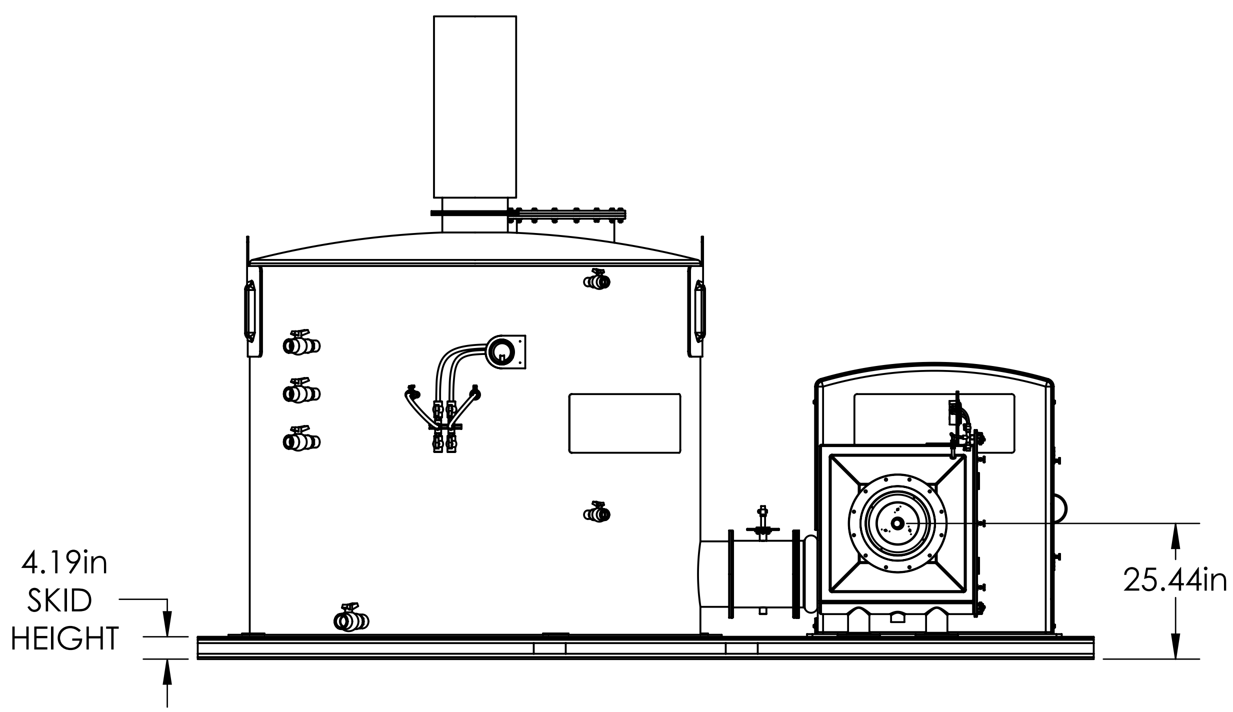


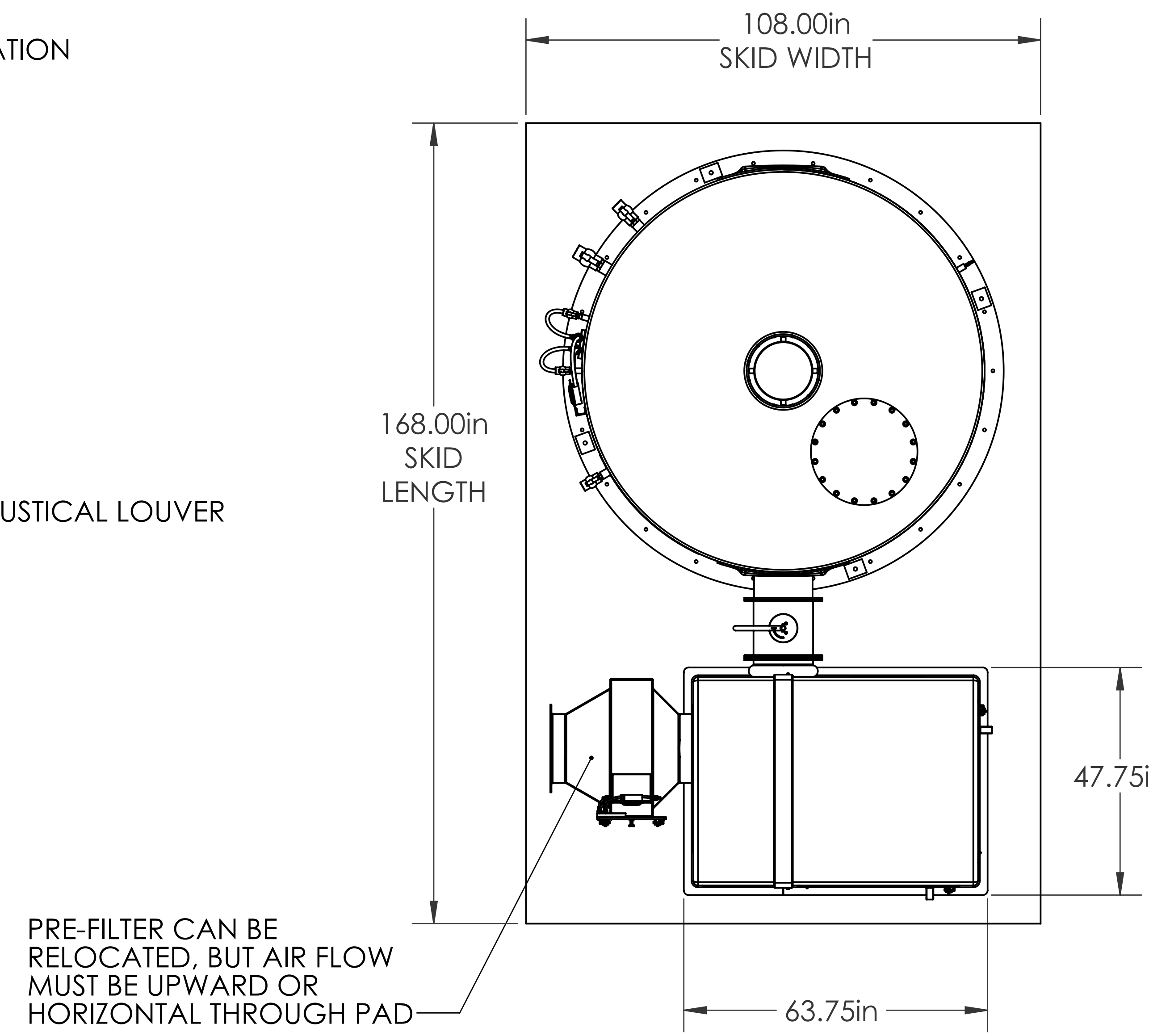
UNLESS OTHERWISE SPECIFIED:		NAME	DATE	File: 60S V1-84-2250 V1 System Pad Asy
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN	D Tagtow	11/4/2015	TITLE:
	CHECKED			**V1-84 2250 CFM**
	ENG APPR.			
	MFG APPR.			
INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
MATERIAL	ECS ENVIRONMENTAL SOLUTIONS			SIZE **B** / DWG. NO. V1-84 / REV **A**
FINISH				SCALE: 1:36 / SHEET 1 OF 5
DO NOT SCALE DRAWING				

OPTIONAL ACCESSORIES:

- ECS SOUND ABSORB ENCLOSURE
- ECS GUARDIAN PRE-FILTER
- EPOXY COATED STEEL SKID







UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005	DRAWN	D Tagtow	11/4/2015
	CHECKED		
	ENG APPR.		
	MFG APPR.		
INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

File: 60S V1-84-2250 V1 System Pad Asy

TITLE:

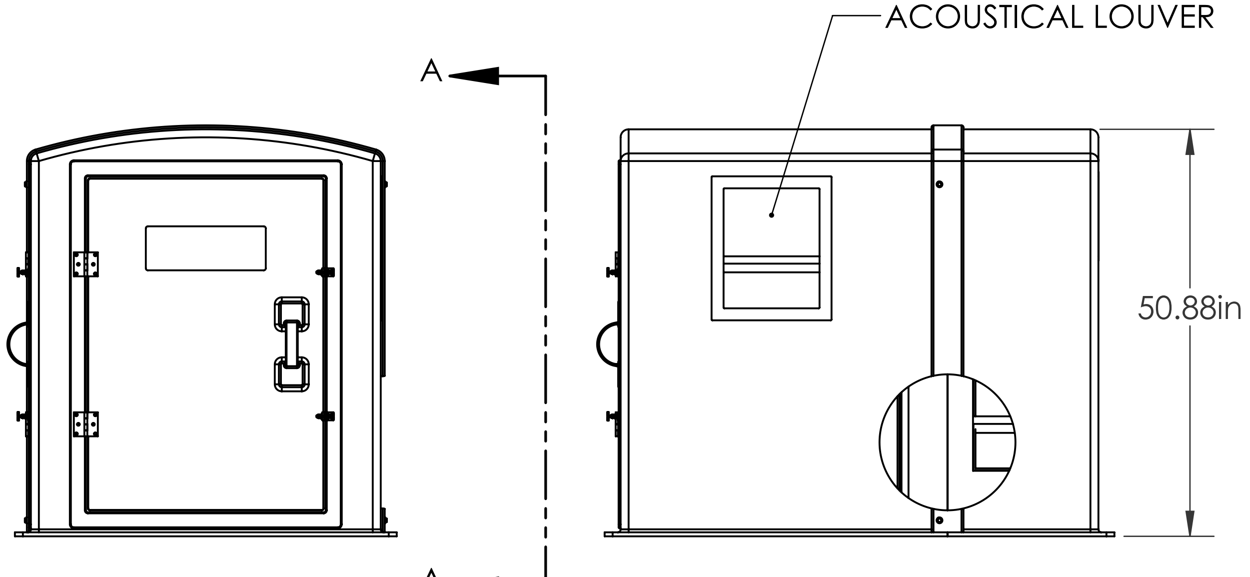
V1-84 2250 CFM

ECS ENVIRONMENTAL SOLUTIONS

SIZE B | DWG. NO. V1-84 | REV A

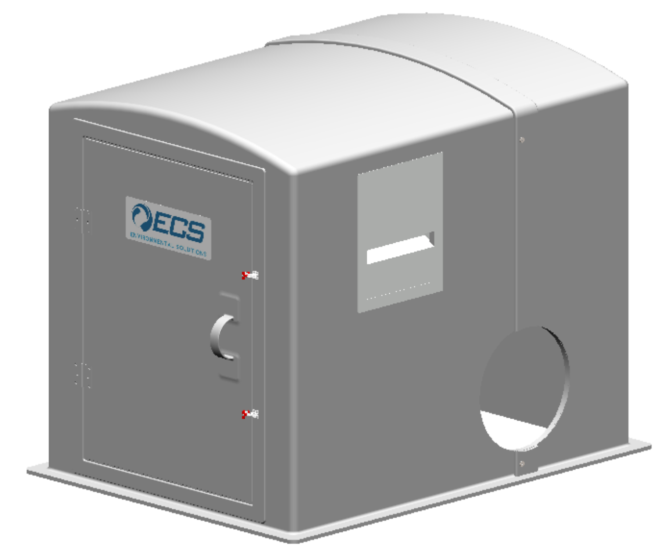
SCALE: 1:36 | SHEET 2 OF 5

TRANSMISSION LOSS						
2 - 125	3 - 250	4 - 500	5 - 1000	6 - 2000	7 - 4000	OCT
26	29	33	44	52	60	DB



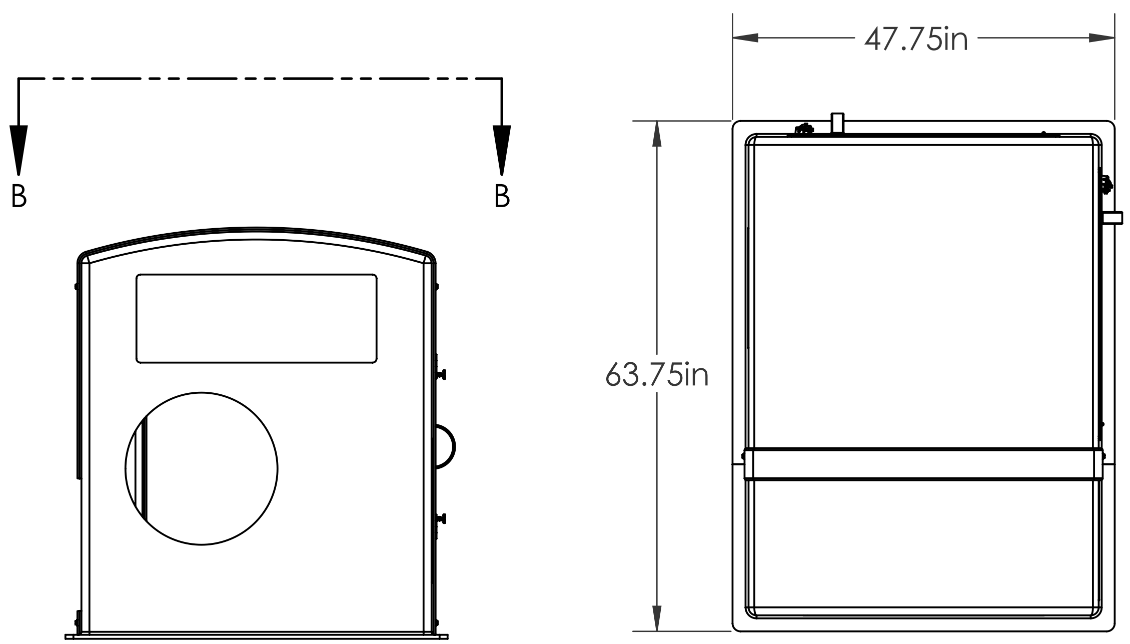
MOTOR SIDE

SECTION A-A



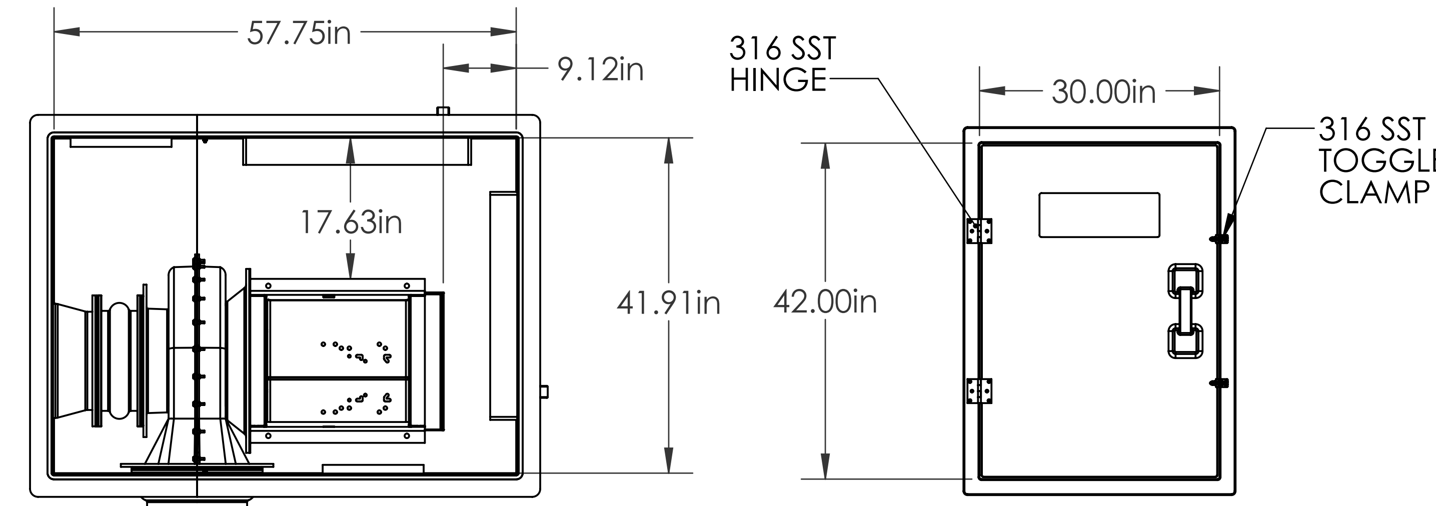
GENERAL NOTES:

- **CONSTRUCTION**
  - WALLS VACUUM-FORMED WITH TWO LAYERS OF FRP OVER A HONEY-COMB CORE
  - RESIN, LINER, AND COLOR TO MATCH V1 CONSTRUCTION
  - SPLIT LINE TO BE CENTERED ON FAN HOUSING
  - 2" OF ECS SOUND-ABSORB LINING ON ALL INTERNAL SURFACES
  -
- **STANDER FEATURES:**
  - TWO HINGED ACCESS DOORS WITH TOGGLE CLAMPS
  - TWO ACOUSTICAL LOUVERS
- **OPTIONAL FEATURES**
  - CLASS 1 DIV 1 EXHAUST FAN
  - TEMPERATURE SWITCH
  - INTERNAL LIGHTE (AVAILABLE ON LARGER ENCLOSURES)



AIR INLET SIDE

SECTION B-B



ACCESS DOOR DETAIL

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005	DRAWN	D Tagtow	11/4/2015
	CHECKED		
	ENG APPR.		
	MFG APPR.		
INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

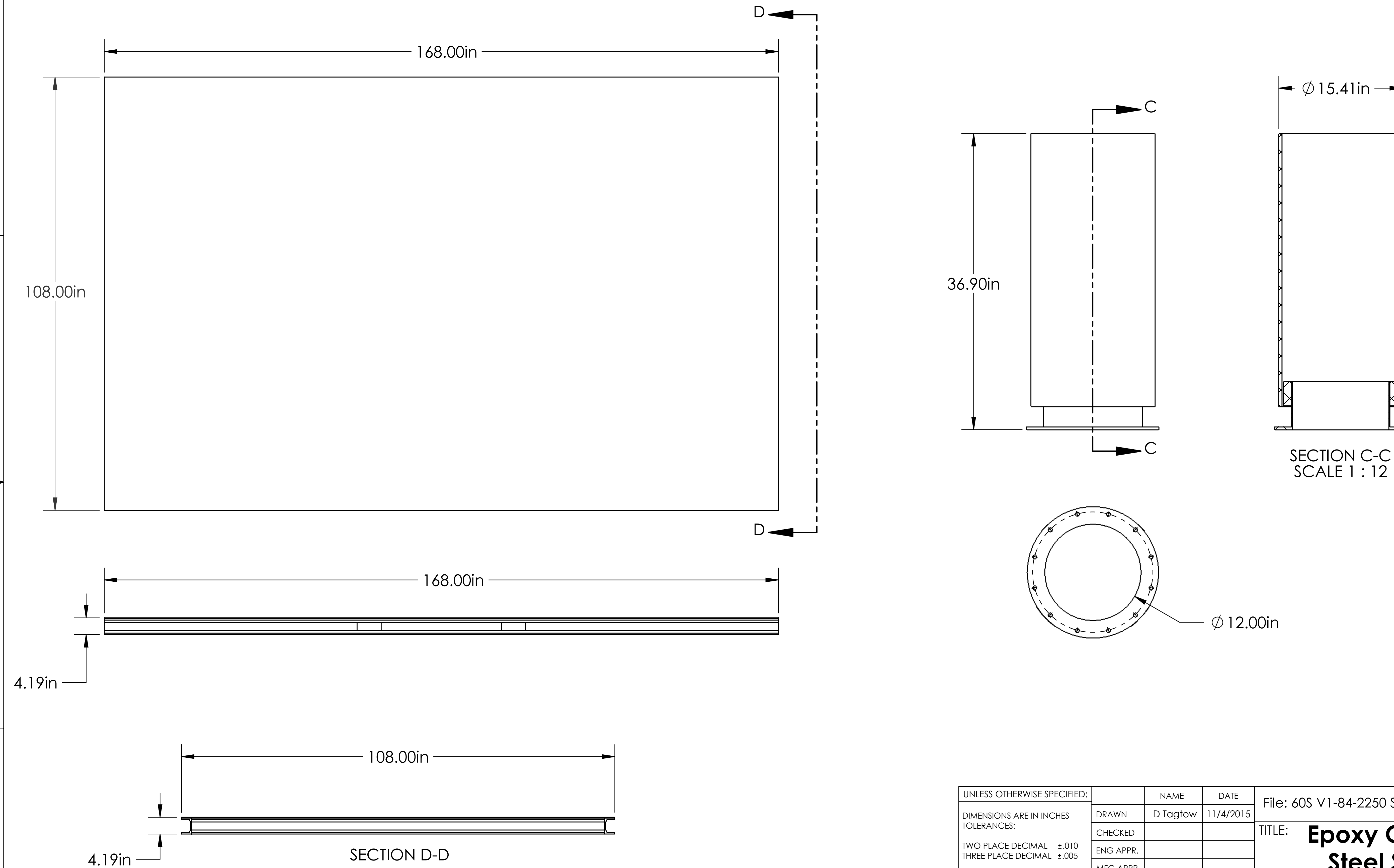
ECS ENVIRONMENTAL SOLUTIONS

File: 60S V1-84-2250 Sound Enclosure

TITLE:

Sound Enclosure

SIZE	DWG. NO.	REV
B	SE-01	A
SCALE: 1:24		SHEET 3 OF 5



UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005	DRAWN	D Tagtow	11/4/2015
	CHECKED		
	ENG APPR.		
	MFG APPR.		
INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF <INSERT COMPANY NAME HERE>. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF <INSERT COMPANY NAME HERE> IS PROHIBITED.

ECS ENVIRONMENTAL SOLUTIONS

File: 60S V1-84-2250 Skid

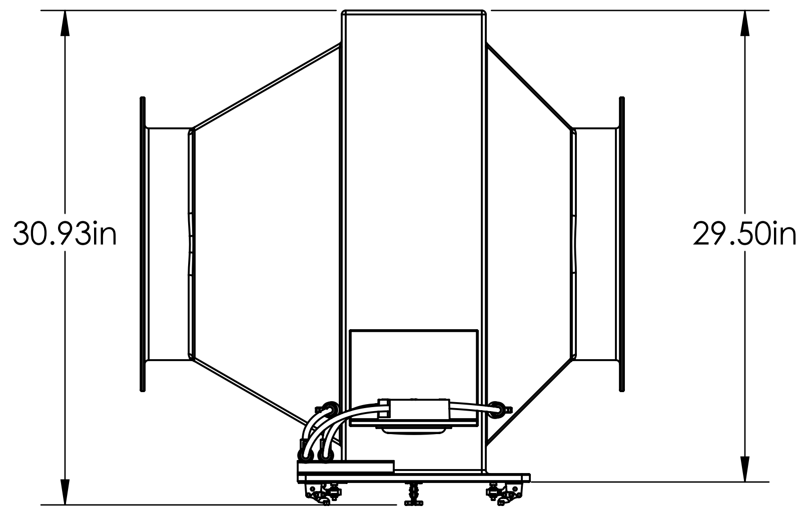
TITLE: **Epoxy Coated Steel Skid, No Loss Stack**

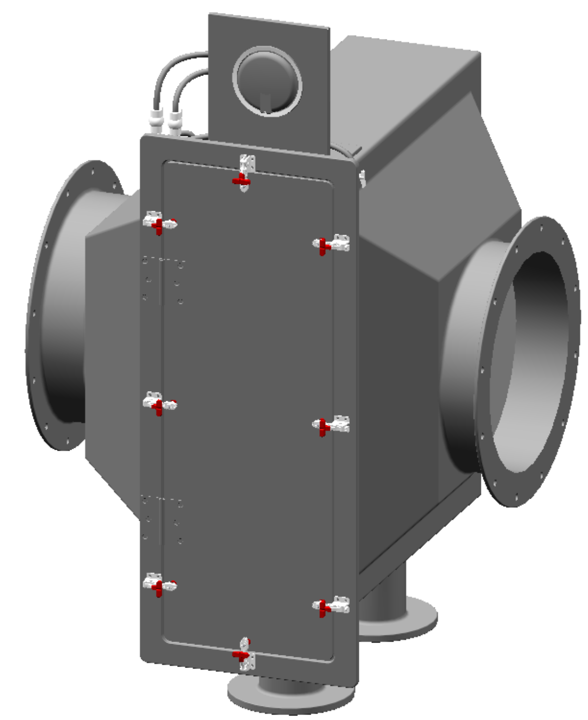
SIZE	DWG. NO.	REV
B	SKD-01	A
SCALE: 1:24		SHEET 4 OF 5

Item	Part	Part Number	Qty
1	Housing	ECS-GUARD-2250	1
2	Combination Pad	ECS-GFME-2250-29x29	1
3	Differential Pressure Gauge	ECS-DP-2015	1

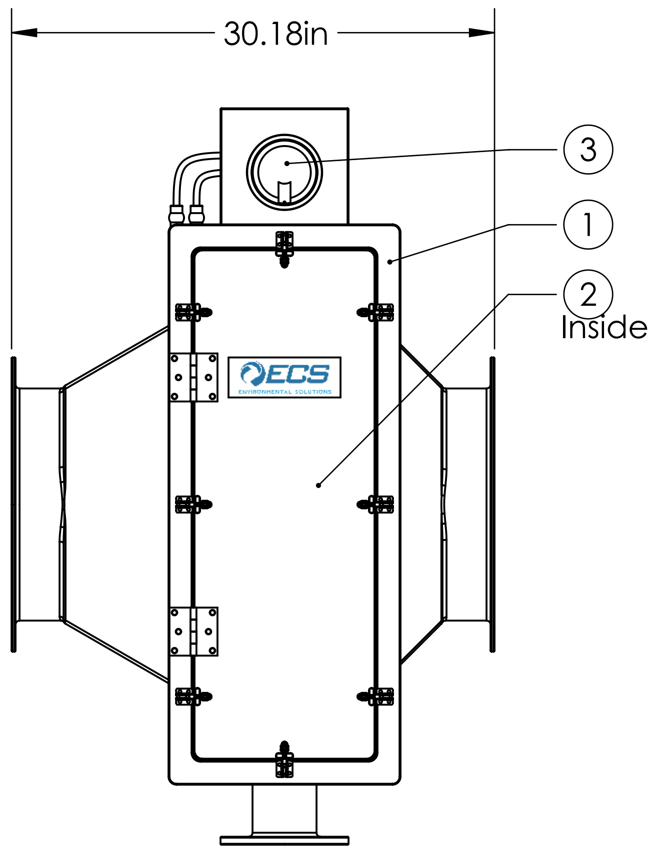
REVISIONS

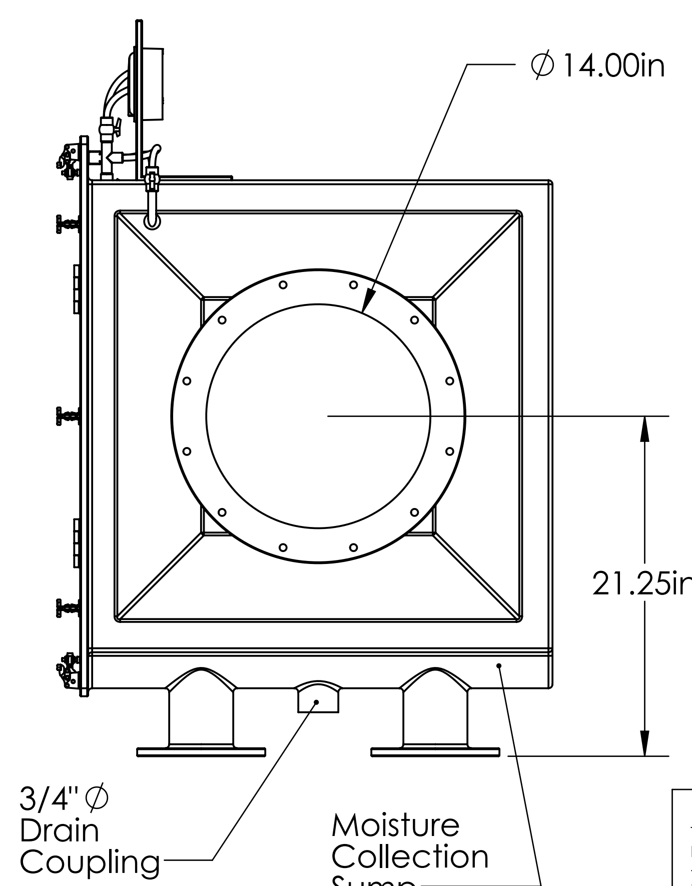
ZONE	REV.	DESCRIPTION	DATE	APPROVED
-	A	Initial Release	8/18/2015	J Jones





GUARDIAN® PREFILTER





General Notes
1. Operating Weight: 126 lbs
2. Standard end connections are sized per ASTM 3982 / NBS PS 15-169 Table 2 parameters. If alternate connection sizes are necessary please specify when ordering.
3. ECS Guardian prefilters come standard with a mechanical differential pressure indicator.
4. Pressure drop with clean pad at the design airflow will be .5" w.c.
5. Pressure drop with dirty pad at the design airflow will be 1.25" w.c.
6. Performance: 99% removal of particles 10 micron or larger
7. For applications where moisture removal is not desired an alternative particulate / grease removal pad can be supplied. Contact ECS technical service for additional information.
8. Base drain connection should be piped away from the unit
9. Effluent piping should include a water trap to prevent hold-up of liquid due to negative pressure in the prefilter housing. If freezing conditions exist this piping should be heat traced and insulated.
10. FRP housing is manufactured using a vinyl ester resin system with a class 1 flame spread rating. All interior surfaces have a 100-mil corrosion liner, exterior surfaces are gelcoated and contain a UV inhibitor. Standard colors are grey, white or tan. Please specify when ordering.
11. Client to advise Inlet CL height when ordering
12. 30" of clearance required at access door for pad removal

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL See Notes
FINISH See Notes
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	D Tagtow	8/18/2015
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

ECS ENVIRONMENTAL SOLUTIONS

CAD File: ECS-GFME-2250-29X29 Asy
TITLE:
Prefilter - 2250 cfm

SIZE B | DWG. NO. | REV A
SCALE: 1:12 | WEIGHT: 49.76 | SHEET 5 OF 5

C3

Appendix C3: MBR

Aerzen Canada
980 rue Valois, Vaudreuil-Dorion, Québec J7V 8P2

Customer Reference: Dundas WWTP
Aerzen Reference: 513270

Submitted by: Jonathan Kechekoul
jonathan.kechekoul@aerzen.com

SCOPE OF SUPPLY

4 Aerzen Generation 5 Blower Package - GM 100S DN 250 - Pressure - including:

Aerzen GM 100S Blower
Drive Motor: 200hp, 1800rpm, TEFC, 575V/60Hz
  Thermistors - 2/Ph
Base with integrated reactive type discharge silencer
Intake filter silencer
Hinged motor support as automatic belt tensioning device
Set of vibration isolation mounts
Narrow v-belt drive with guard - 1 set
Spring loaded relief valve
Discharge manifold with externally accessible integrated check valve
Flexible connector with clamps for schedule 40 pipe, discharge
Acoustic Enclosure - Indoor/Outdoor
Inlet flexible sleeve - DN 300 (12")

Instruments
Pressure gauge c/w isolation ball valve (4x)
Temperature switch c/w thermowell (4x)
Dirty filter indicator (4x)

Optional Instruments
Pressure switch 120V (4x)

Optional Spare Parts
1 Year Maintenance Kit (1 x V-Belt Set, 1 x Intake Filter)
2 Year Maintenance Kit (1 x V-Belt Set, 1 x Oil Change (Delta Lube), 2 x Air Filter)

Connection Points:
Intake Connection: DN 300 - 12"
Discharge Connection: DN 250 - 10"

Exclusions: See page 2

Aerzen Canada
980 rue Valois, Vaudreuil-Dorion, Québec J7V 8P2

AERZEN

Customer Reference: Dundas WWTP
Aerzen Reference: 513270

PERFORMANCE DATA

Aerzen Blower Package - GM 100S DN 250 - Pressure

Configuration: **G5**

		Design	VFD Min.
Conditions:	**Sm3/hr**	**4400**	
Flow at inlet conditions	m³/min	88.2	22.68
	Icfm	3114	801
Inlet pressure (abs.)	bar	0.958	0.958
	Psi	13.9	13.9
Pressure differential	mbar(g)	703	703
	Psig	10.2	10.2
Inlet temperature	°C	40	40
Discharge temperature	°C	118	148
Blower speed	RPM	2119	795
Blower maximum speed	RPM	2400	2400
% of maximum blower speed		88%	33%
Power required at shaft (with accessories) **	kW	131.8	44.3
	HP	176.7	59.4
Total Power (Wire to Air):	HP	195.7	65.8
Motor rating	HP	200.0	
Motor speed	RPM	1780	668
Motor frequency	Hz	60	22

Noise level without acoustic hood	dB(A)	103
Noise level with acoustic hood	dB(A)	79

Tolerances as per EN 10204, in accordance with standard ISO 1217:
Flow at inlet conditions / Power required at shaft +/- 5%

Blower package noise level:
Free field measurement at 1m from the complete blower package (tolerance +/- 2 dB(A))

Tests and measurements:
Blower stage: 1.5 hour flow test at the factory (Germany) on a calibrated test bed, at maximum operating conditions and according to DIN 1945. acceptance tolerance: +/- 5%.
A complete test report is available upon request.

On Site Commissioning
Available upon request, charges to be advised.
- Any commissioning activity is subject to two weeks prior notice and completion of commissioning checklist.
- Any on-site activity outside the time indicated will be billed according to the Aerzen Standard Rate Sheet

Exclusions
Control Panels, Motor Starters, Piping and Electrical Connections
* Unloading valves are required for reduced voltage starters

Warranty
Blowers including accessories are warranted for a period of 12mo / max 18mo after delivery and after provisional acceptance of the work against defects in workmanship and design. This warranty does not cover wearing parts unless such parts are defective during shipping / commissioning.
As per Aerzen standard warranty terms.

** Power at shaft excludes drive motor and belt drive

Aerzen Canada
980 rue Valois, Vaudreuil-Dorion, Québec J7V 8P2

AERZEN

Customer Reference: Dundas WWTP
Aerzen Reference: 513270

PRICING

	Unit Cost	Extended Cost	
Pressure Package - GM 100S DN 250	$ 98,646.00	$ 394,584.00	4 Units

OPTIONS

Optional Instruments			
Pressure Switches	$ 690.00	$ 2,760.00	4 Units
Motor protection for VFD use: **SGR**	$ 950.00	$ 3,800.00	4 Units
Optional Spare Parts			
1 Year Maintenance Kit	$ 2,220.00	$ 8,880.00	4 Units
2 Year Maintenance Kit	$ 3,560.00	$ 14,240.00	4 Units

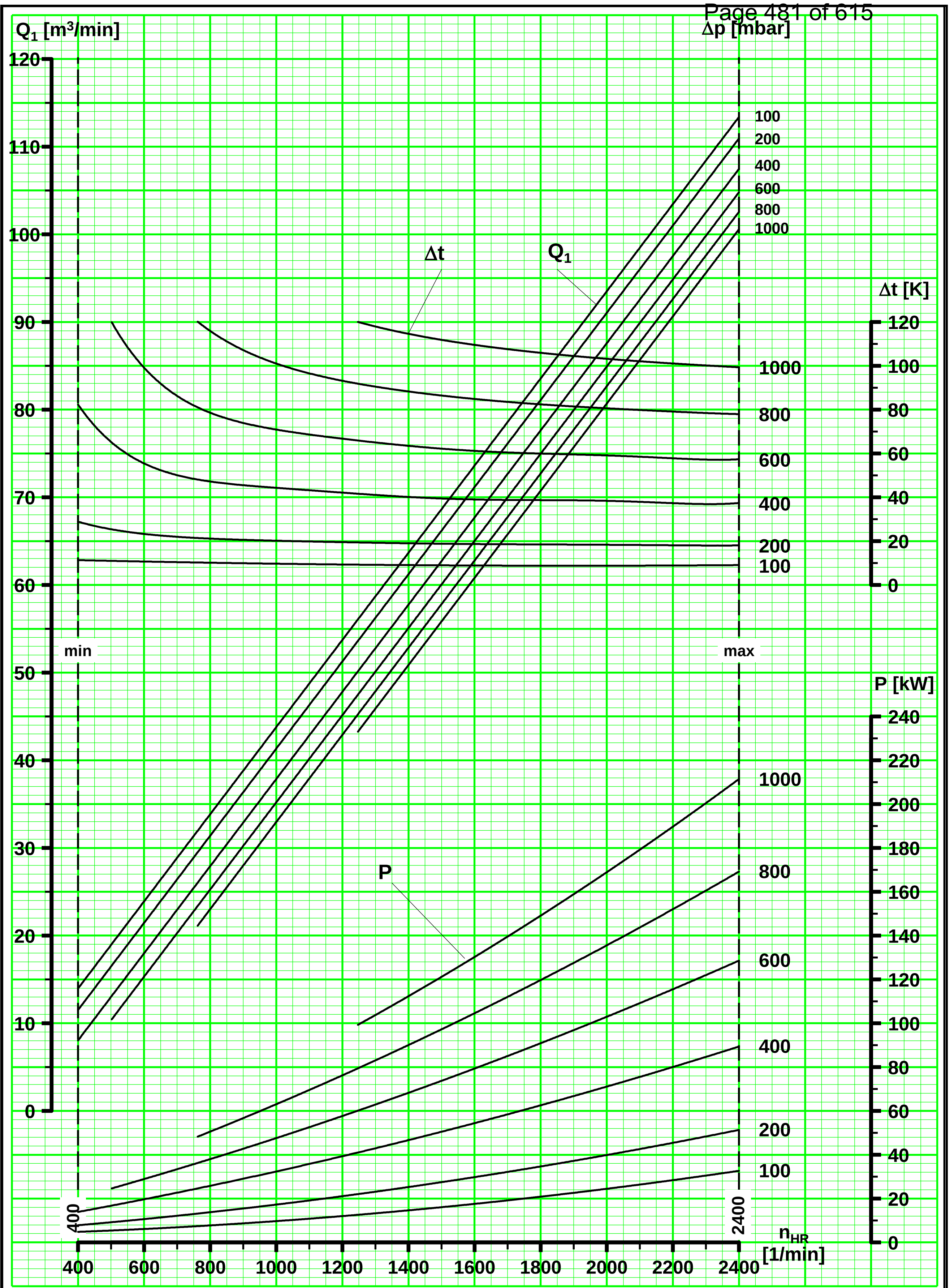
TERMS AND CONDITIONS

INCOTERMS:	EXW - Aerzen Canada
Delivery:	Collect
Start-up Assistance / Operator Training:	As noted - page 2
Funds:	CAD
Payment terms:	TBD Subject to credit approval and final destin
Payment Schedule:	TBD - Suggestion below: 15% on submittal of approval drawings 85% on readiness to ship - Aerzen Canada
Taxes:	G.S.T. extra, P.S.T. charged in Quebec only
Prices firm until:	2024-06-20
Packing:	Heavy duty wooden skid with polyethylen Crown Frame * Special packing can be quoted upon request.
Warranty:	12mo / max 18mo after delivery
Estimated Delivery:	36 Weeks

- to avoid warranty conflicts, we recommend that our start-up services be ordered and the inspection and operation procedures in our manual be respected.
- The goods remain the property of Aerzen Canada until full payment. Extended payment delays may void the warranty.
- Past due invoice amounts carry an interest charge calculated at 24% apr.

Aerzener Maschinenfabrik GmbH
Reherweg 28 - D-31855 Aerzen - Telefon (0 51 54) 81 0 - info@aerzener.de - www.aerzener.com

AERZEN



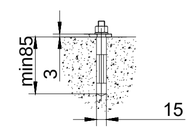
Q_1 : Ansaugvolumenstrom (Luft) bei p_1 = 1,0 bar und t_1 = 20°C	intake volume flow (air) at p_1 = 1.0 bar and t_1 = 20°C	débit aspiré (air) pour p_1 = 1,0 bar et t_1 = 20°C
n_{HR} : Hauptrotordrehzahl	main rotor speed	vitesse du rotor principal
n_V : Antriebswellendrehzahl	drive shaft speed	vitesse de l'arbre d'entraînement
P : Leistungsbedarf an der Kupplung	power required at the coupling	puissance absorbée à l'accouplement
Δt : Temperaturerhöhung	temperature rise	élévation de température
Δp : Druckerhöhung	pressure difference	pression différentielle

Leistungsdiagramm - Überdruck - für Drehkolbengebläsestufe
performance diagram - overpressure - for stage of rotary piston blower
courbes de fonctionnement - fonctionnement en pression - pour étage de surpresseur à pistons rotatifs

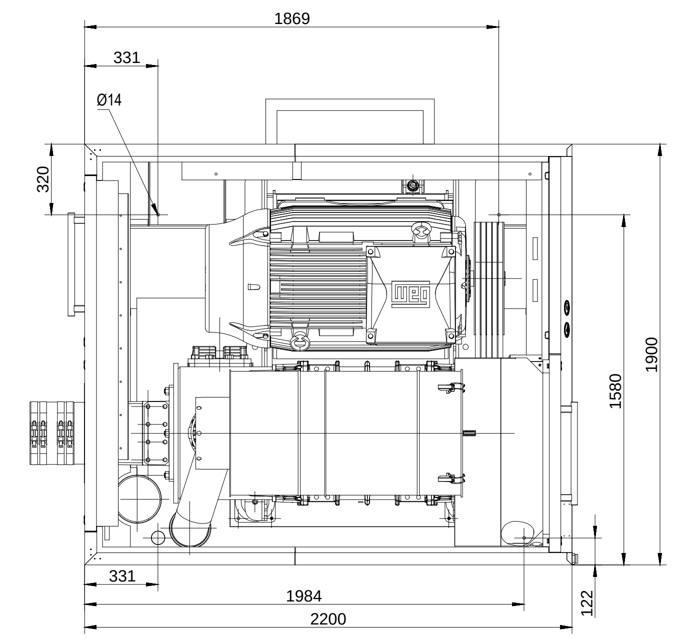
GM 100 S

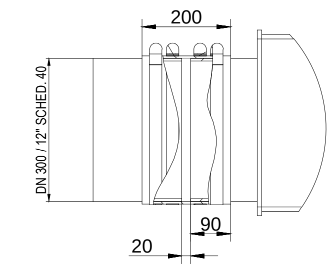
nV / nHR = 1	**03/2020** **TRD / Evers**	**4000556899**

CAUTION
BLOWER PACKAGES MUST BE CAREFULLY LEVELED. USE OIL LEVEL ON SIGHT GLASSES OF THE BLOWER STAGE. USE SHIMS TO ADJUST LEVEL IF NECESSARY. PLEASE REFER TO THE OPERATING AND INSTALLATION INSTRUCTIONS MANUAL (DOCUMENT # G4-006) FOR MORE DETAILS.

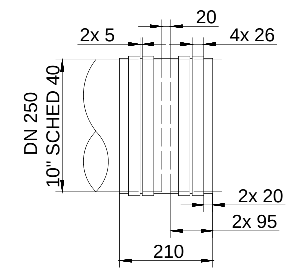


ANCHORING DETAILS

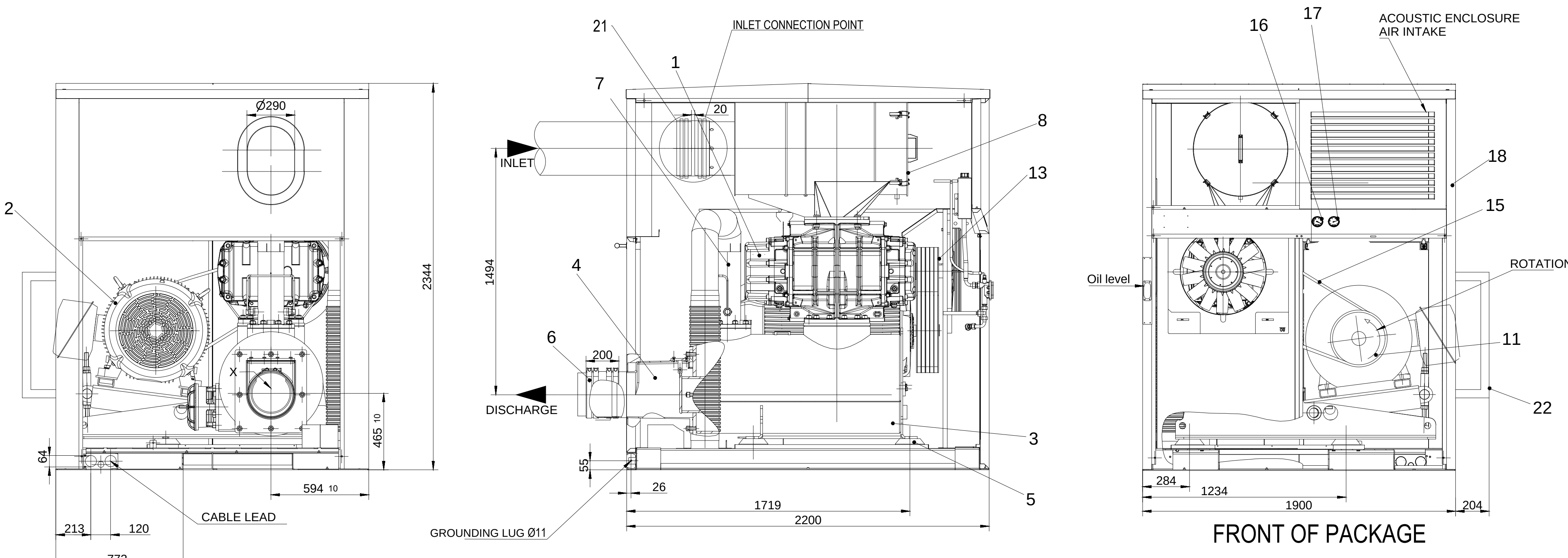




INLET CONNECTION DETAILS



DISCHARGE CONNECTION DETAILS



FRONT OF PACKAGE

NOTE	QTY.	POS	DESCRIPTION
G	1	1	BLOWER - GM 100S - 690 KG
D	1	2	MOTOR: ?? ?? - ?? HP - ??00 RPM - ???T
	1	3	BASEFRAME / DISCHARGE SILENCER - DN 250
	1	4	CONNECTION HOUSING WITH CHECK VALVE - DN 250
	1	5	SET OF VIBRATION ISOLATORS - DN 250
	1	6	DISCHARGE FLEXIBLE SLEEVE - WITH 4 CLAMPS - DN 250
	1	7	PRESSURE RELIEF VALVE - DN 150 - SET TO ??? mbar
	1	8	INLET FILTER / SILENCER - DN 300
E	1	9	INLET FILTER ELEMENT - DN 300
E	1	10	BELT GUARD - DN 250
	1	11	MOTOR SHEAVE
E	1	12	MOTOR BUSHING
	1	13	BLOWER SHEAVE
E	1	14	BLOWER BUSHING
	1	15	V-BELT SET
	1	16	FILTER MAINTENANCE INDICATOR - WIKA
	1	17	DISCHARGE PRESSURE GAUGE WITH BALL VALVE - WIKA
	1	18	ACOUSTIC ENCLOSURE - DN 250
E	1	19	FAN - MOUNTED ON BLOWER SHAFT - DN 250
E	1	20	FAN ADAPTOR - GM 100S
	1	21	INLET FLEXIBLE SLEEVE - WITH 4 CLAMPS - DN 250
	1	22	
	1	23	

NOTES:

A. UNIT ASSEMBLY WEIGHT: 2238+ *MOTOR KG*
B. PAINT: PACKAGE - AERZEN STANDARD BLUE
C. 1M CLEARANCE IS RECOMMENDED AT THE FRONT & REAR OF THE PACKAGE FOR MAINTENANCE ACCESS
D. MOTOR: ?? ??, ??HP, ????RPM, TEFC, ???/3/60, PREMIUM EFFICIENCY, SF=1.15, INVERTER DUTY RATED
E. INCLUDED BUT NOT SHOWN ON DRAWING
F. FOR VARIABLE SPEED APPLICATIONS, CONSTANT TORQUE VFD ARE REQUIRED

PERFORMANCE DATA	SCFM	100%	VFD MIN
INLET CAPACITY	m³/min ICFM		
INLET PRESSURE	bar ab PSIA		
PRESSURE RAISE	mbar		
	PSI	###	###
INLET TEMPERATURE	°C		
	°F	###	###
DISCHARGE TEMPERATURE	°C		
	°F	###	###
BLOWER SPEED	RPM		
POWER CONSUMPTION	KW		
	BHP	#####	####
VFD FREQUENCY	Hz		
SOUND LEVEL	dB(A)		

REVISION DETAILS

REV	DRAWN BY	DATE	REVIEWED	DATE	DETAILS	AREA
A	-	-	-	-	RELEASE	-

AERZEN

AERZEN CANADA
980 VALOIS STREET, SUITE# 100, VAUDREUIL QC J7V 8P2
(450) 424-3966 PH, (450) 424-3985 FX

THIRD ANGLE PROJECTION

GEN 5 - GM 100S
DN 250 - PRESSURE

DWG NO. ZG-01515-????

DRAWN BY: -
REVIEWED BY: -
DATE: (MONTH DD, YYYY)
REV: A
SCALE: NONE
SIZE: B
SHEET: 1 OF 1

AERZEN REF: ???-????
CLIENT REF: ??

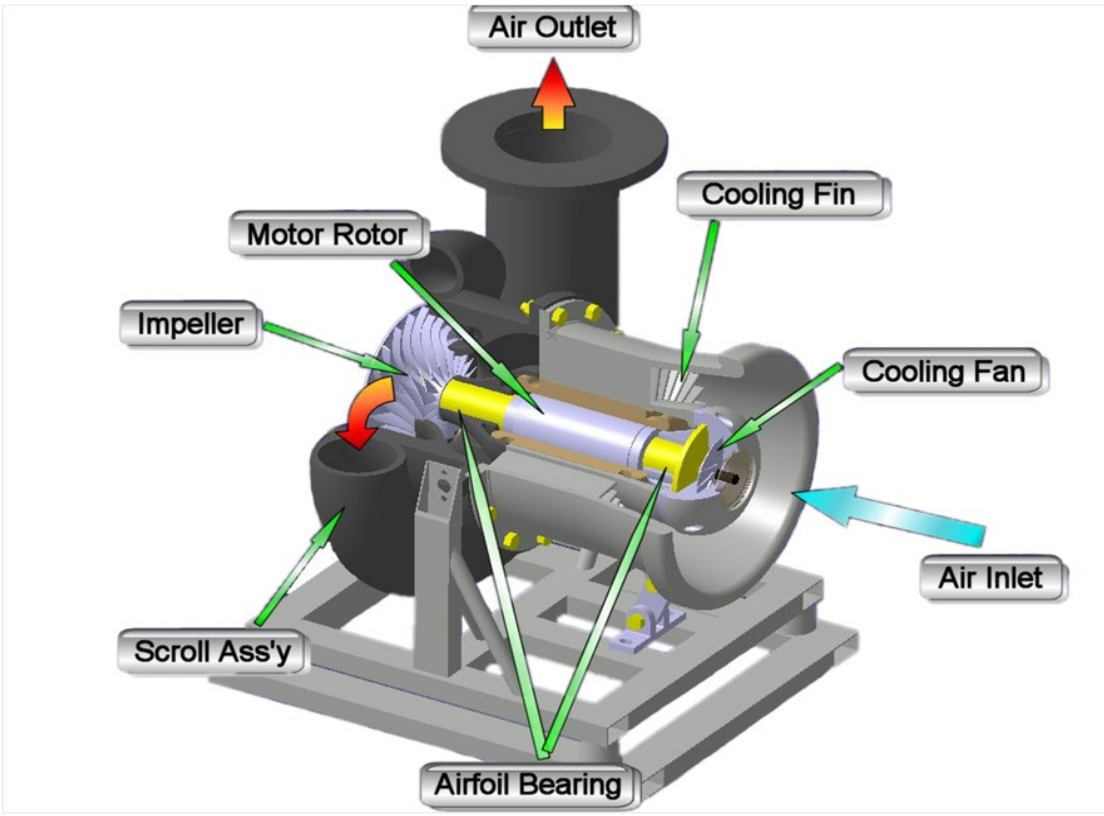
APG-Neuros Turbo Blower Scope of Supply Proposal

City of Hamilton - Dundas WWTP

Prepared By APGN Inc. *dba* APG-Neuros

May 24, 2024

Proposal Reference# 012736-4816



APGN Inc.
1270 Michele-Bohec, Blainville, QC, J7C-5S4
Tel: 450-939-0799 Fax: 450 939 2115
www.apg-neuros.com

City of Hamilton - Dundas WWTP - APG- Neuros Turbo Blower - Performance Data			
Ambient Conditions			
Application	Aeration		
Blower Installation Location	Indoor		
Working Fluid	Air		
Elevation	79		m
Ambient Pressure	100.40		kPa
Customer Design Requirements	DP1	DP2	
Inlet Pressure	99.00	99.00	kPa
Inlet Temperature	40.0	-35.0	°C
Relative Humidity	95	0	%
Duty Discharge Pressure	**70.00**	**70.00**	kPa
System Flow Rate	13,200	13,200	Sm^3/h
Flow Rate per Blower	4,400	4,400	Sm^3/h
Blower Units on Duty	3	3	Units
Blower Units Stand By	1	1	Units
Available Blower Performance			
Model	**NX150S-C080A**		
Rated Motor Output Power	**150**		HP
Power @ Design Condition per Blower	**136**	**105**	**bhp**
Wire-to-Air Power @ Design Condition per Blower	**109**	**84**	**kW**
Maximum Air Flow @ Duty Discharge Pressure per Blower	5,126	5,815	Sm^3/h
Minimum Air Flow @ Duty Discharge Pressure per Blower	2,035	2,308	Sm^3/h
Turndown from Maximum to Minimum	60.3%	60.3%	%
Discharge Temperature @ Design Condition	104.0	13.9	°C
Maximum Discharge Pressure	91.09	91.09	kPa
Rise-to-Surge	21.09	21.09	kPa

Note:
Sm^3/h defined at 20 Deg C,101.3 kPa and 36% relative humidity
Wire power figures are reported based on ASME PTC-13 Performance Test Code standard
Noise Level : +/- 2dB

APGN Inc.
1270 Michèle-Bohec, Blainville, QC, J7C-5S4
Tel: 450-939-0799 Fax: 450 939 2115
www.apg-neuros.com

City of Hamilton - Dundas WWTP - APG- Neuros Turbo Blower - Performance Data		
Dimensions and Specification		
Blower Inlet Air Entry type	Flanged	
Inlet Flange Size (Optional, if louvered inlet does not apply)	350	mm
Discharge Flange Size	250	mm
Maximum Noise Level @ 3 feet	80	dBA
Input Voltage/Phase/Frequency	600/3/60	V/Phase/Hz
Full Load Amperage	137	Amps

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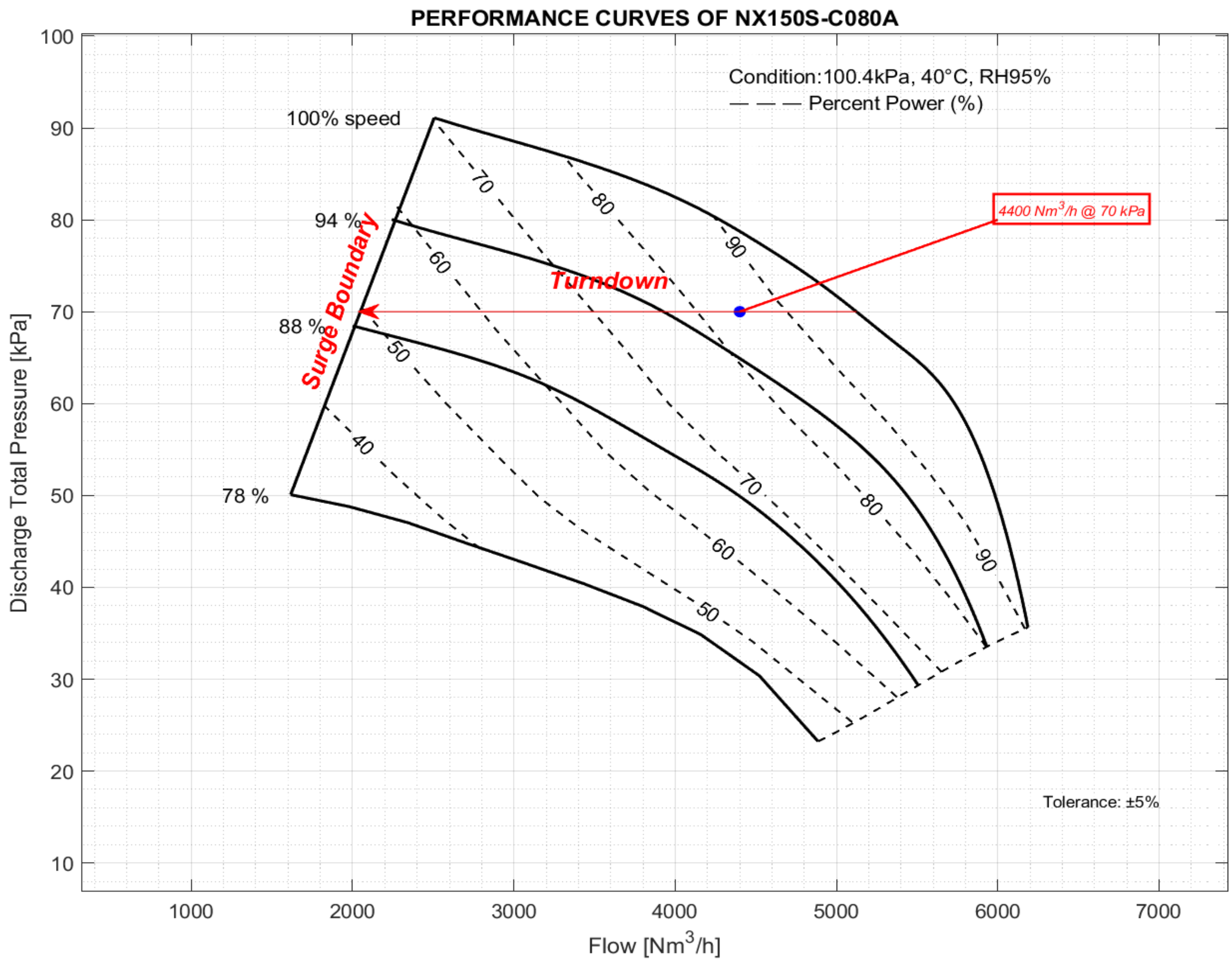
Tel: 450-939-0799 Fax: 450 939 2115
www.apg-neuros.com

City of Hamilton - Dundas WWTP - APG - Neuros Turbo Blower - Performance Curves



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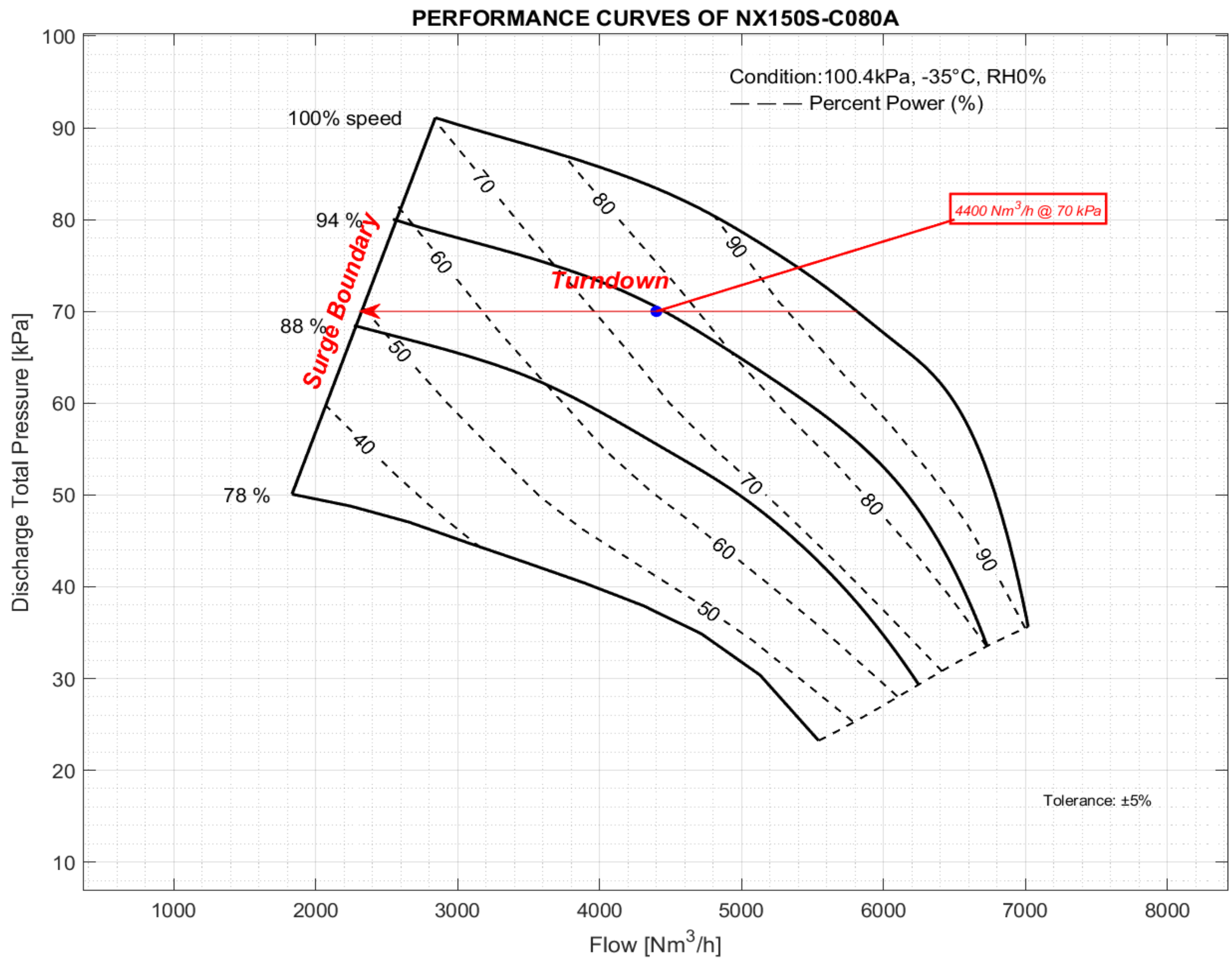
City of Hamilton - Dundas WWTP - APG - Neuros Turbo Blower - Performance Curves



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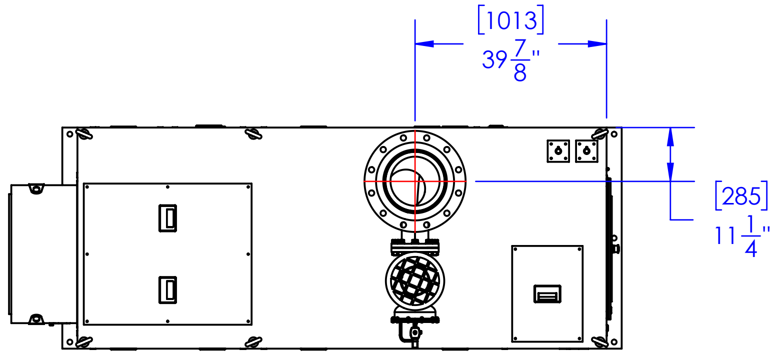
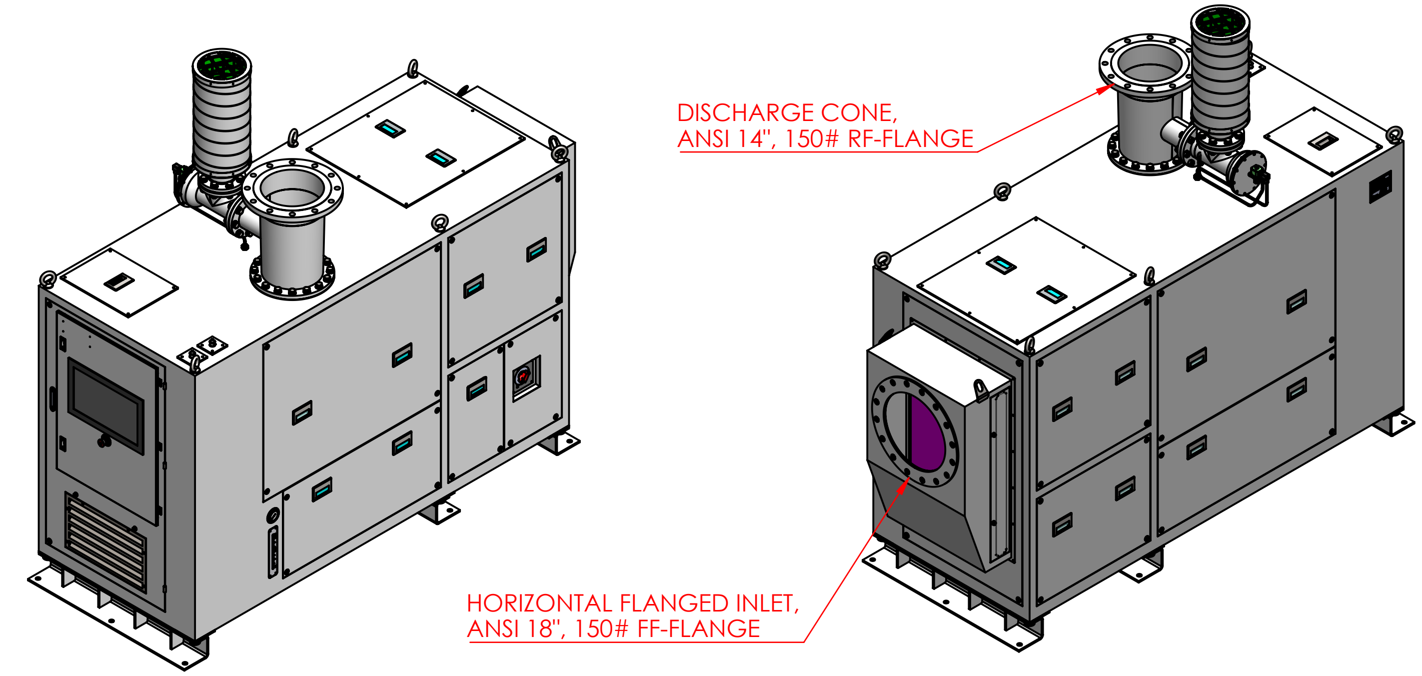
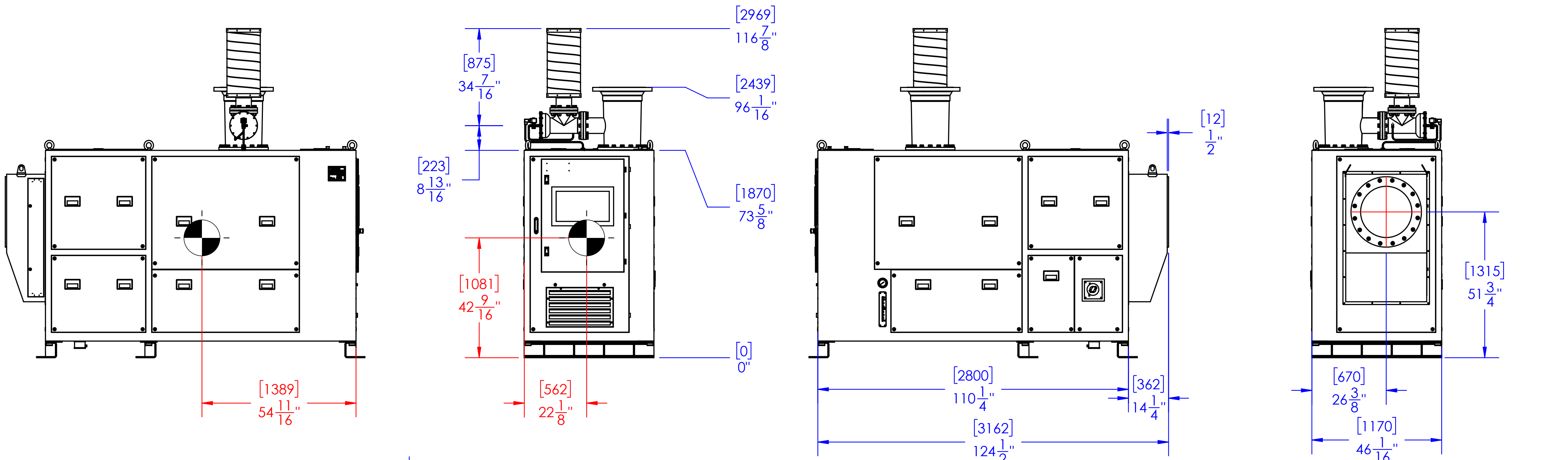
www.apg-neuros.com

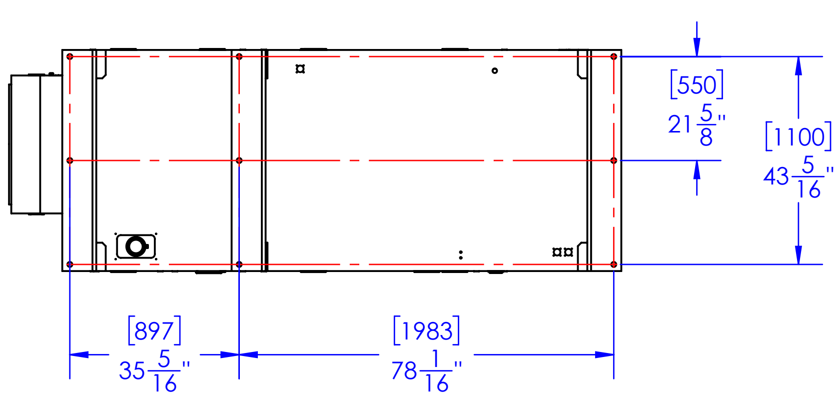
NOTE 1

1. MATERIAL : CARBON STEEL
2. PAINT : PRIMER PAINTING : POWLAC EY ZINC (Chokwang-Paint), FILM THICKNESS more than 50 μm.
3. FINAL PAINTING : POWLAC PE100 LIGHT GRAY TX (FRZ089) (Chokwang-Paint), FILM THICKNESS more than 50 μm.
4. LIFTING ONLY FROM LATERAL SIDE OR USE LIFTING SLINGS, NEVER FRONT OR BACK SIDE.
5. SYMBOL " ⊕ " INDICATES CENTER OF GRAVITY
6. THE CENTER OF GRAVITY FOR THIS DRAWING IS A NOMINAL VALUE
7. MINIMUM CLEARANCE REQUIRED FOR FILTER REMOVAL AND MAINTENANCE: 3.5 FT.
8. COOLING SYSTEM : CLOSED LOOP WATER-GLYCOL AND FORCED AIR CONVECTION
9. FOR CABLING, REFER TO ELECTRICAL RATING SHOWN ON BLOWER NAMEPLATE
10. WEIGHT APPROX.: 5000 Lbs. INCLUDES ONLY THE COMPONENTS INSIDE THE BLOWER ENCLOSURE, BLOWER ACCESSORIES (DISCHARGE CONE, PNEUMATIC BOV, BOV SILENCER AND CHECK VALVE) ARE NOT INCLUDED









NOTE 2

1. ALL DIMENSIONS ARE IN FEET & INCHES
2. DUAL DIMENSIONS ARE IN MILLIMETERS

APGN INC.
1270, Michèle-Bohec, Blainville,
Québec, CANADA, J7C 5S4
Tel: (450) 939-0799
Fax : (450) 939-2115

UNLESS OTHERWISE NOTED :
ALL DIMENSIONS ARE IN IN/[MM]
PROJECTION

FOR :	
TITLE :	NX150/NX200 TURBO BLOWER ANCHORING FEET - HORIZONTAL INLET
PROJECT NO. : 23-0014	DRAWING NO. : G-200242006
DRAWN BY. : S. RAINVILLE	DRAWN DATE : 15-05-2024 / REV : A-00
CHECKED BY. : L. STURZU	CKD. DATE : 15-05-2024 / SCALE : 1:40
APPROVED. BY. : C. MENDEZ	APPD. DATE : 15-05-2024 / SIZE : B
FILE NAME : 23-0014_NX200(C050)-AF-IFH18-DC14_A-00	SHEET 1 OF 1

City of Hamilton - Dundas WWTP - APG - Neuros Turbo Blower - Price & Summary

Budgetary Price (CAD Dollars, 2024 Economy Year)

May 24, 2024

Proposal Number# 012736-4816

Item	Equipment Item *(See Scope for more information)*	QTY		Unit Price (CAD)	Total Price (CAD)
1	NX150S-C080A High Speed Turbo Blower	4	*Included*	$ 158,760.00	$ 635,040.00
	Warranty One (1) Year on Blower equipment	1			
	FOB Job Site	1			
	Additional Equipment Adders				
2	Integrated AutoTransLineator (Step-Down Transformer 600V/480V + Harmonic Filter)	4	*Included*	$ 37,320.00	$ 149,280.00
	250 mm Discharge Check Valve	4	*Included*	$ 1,610.00	$ 6,440.00
	250 mm Discharge Butterfly Valve (Manual c/w Handwheel)	4	*Included*	$ 1,110.00	$ 4,440.00
	250 mm EPDM Discharge Expansion Joint	4	*Included*	$ 1,360.00	$ 5,440.00
	350 mm EPDM Inlet Expansion Joint	4	*Included*	$ 1,680.00	$ 6,720.00
	Manufacturer Services *(See Scope for more information)*				
3	Start-up and Training services including travel and expenses (4 trips for a total of 8 days on site)	1	*Included*	$ 17,300.00	$ 17,300.00
				Total Price (CAD)	**$ 824,660.00**

Notes:

Taxes and Duties are Not Included.

APGN Inc.
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Tel: 450-939-0799 Fax: 450 939 2115
www.apg-neuros.com

City of Hamilton - Dundas WWTP - APG - Neuros Turbo Blower - Scope of Supply

APGN Inc., agrees to sell to the Buyer, the equipment designated as included in this proposal subject to the Seller's General Terms and Conditions of Sales available upon request and special conditions outlined herein in this proposal.

1. Standard Turbo Blower Equipment *(Included)*

1.1 Blower Package

1. Blower Core with Permanent Magnet Synchronous Motor, Air Bearing and Forged Impeller
2. High Performance Variable Speed Drive / Inverter
3. PLC Based Local Control Panel for Control and Monitoring
4. Sinewave (Sinus) Filter
5. Built In Inlet Air filter

2. Standard Documentation *(Included)*

Submittal Information & Shop Drawings: PDF Electronic File

1. Bill of Material
2. Installation Drawings
3. Electrical and Control Drawings
4. Operation and Maintenance Manual
5. Commissioning Instructions

3. Standard Tests (Included)

1. Standard Blower Package Functional Acceptance Test
2. Unwitnessed Factory Performance Test
3. Witnessed Factory Performance Test to be provided extra upon request.

4. Quality Assurance and Control and Product Certification

A. APG-Neuros Quality Assurance program is ISO 9001 certified
B. APG-Neuros Turbo Blower is UL / CSA/ CE certified

5. Proposal Validity and Seller Terms and Conditions

A. Unless otherwise specified elsewhere in the Sales Agreements, the prices in this proposal are valid for ninety (90) days from the issue date on the cover page.

B. This proposal, unless otherwise specified herein this document, is subject to the Seller Standard Terms and Conditions available upon request.

C. The final selling price is subject to change contingient on final scope

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City of Hamilton - Dundas WWTP - APG - Neuros Turbo Blower - Scope of Supply

6. Payment Terms:

10% on approval of Purchase Order
10% on issuance of Shop drawings
40% on release for production for material procurement
30% on equipment delivery to site
5% on issuance of preliminary O&M Manual
5% on completion of start-up and acceptance by owner
All invoices are to be paid Net 30 days

1.5% Interest charge per month will be added to past due accounts of 45 days and over

Letter of Credit listing draw of payments against above deliverables will apply for Sales outside US and Canada.

100 % of invoice amount shall be payable by bank wire transfer without deduction and to be paid Net 30 days after invoice date.

Payment shall not be dependent on the buyer being paid by any third parties or equipment acceptance by owner.

7. Delivery Lead time:

Submittal package will be provided within 1-2 weeks of acceptance of Order.
Shipment will be made 16-20 weeks after approval of Submittals

Add Five percent (5%) escalation to Price for each partial or full quarter that shipment is extended beyond one year after order acceptance.
APG-Neuros will bill if delivery does not occur within 45 days after completion of production and will store the equipment at no extra charge.

8. Warranty

A. Standard Warranty (INCLUDED)

One (1) year from commissioning date or Eighteen (18) months from delivery, whichever occurs first.
Warranty will begin upon successful completion of start-up and certification for full-scale operation by APG-Neuros, or Six (6) months after shipment, whichever occurs first.

Under no circumstances will the warranty begin upon "beneficial use", completion of the project, or acceptance of the equipment as determined by the Engineer or End User.

APGN Inc.
1270 Michèle-Bohec, Blainville, QC, J7C-5S4
Tel: 450-939-0799 Fax: 450 939 2115
www.apg-neuros.com

NOTE 1

1. MATERIAL : CARBON STEEL
2. PAINT : PRIMER PAINTING : POWLAC EY ZINC (Chokwang-Paint), FILM THICKNESS more than 50 μm.
3. FINAL PAINTING : POWLAC PE100 LIGHT GRAY TX (FRZ089) (Chokwang-Paint), FILM THICKNESS more than 50 μm.
4. LIFTING ONLY FROM LATERAL SIDE OR USE LIFTING SLINGS, NEVER FRONT OR BACK SIDE.
5. SYMBOL " ⊕ " INDICATES CENTER OF GRAVITY
6. THE CENTER OF GRAVITY FOR THIS DRAWING IS A NOMINAL VALUE
7. MINIMUM CLEARANCE REQUIRED FOR FILTER REMOVAL AND MAINTENANCE: 3.5 FT.
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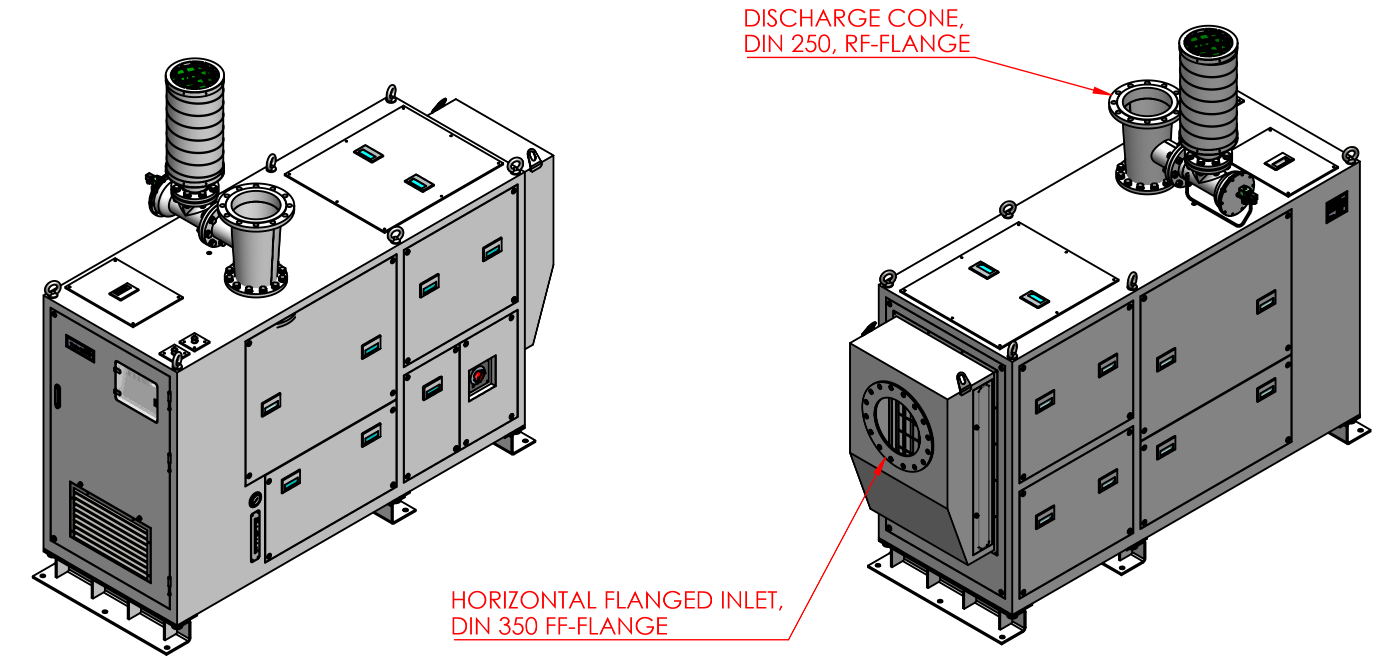
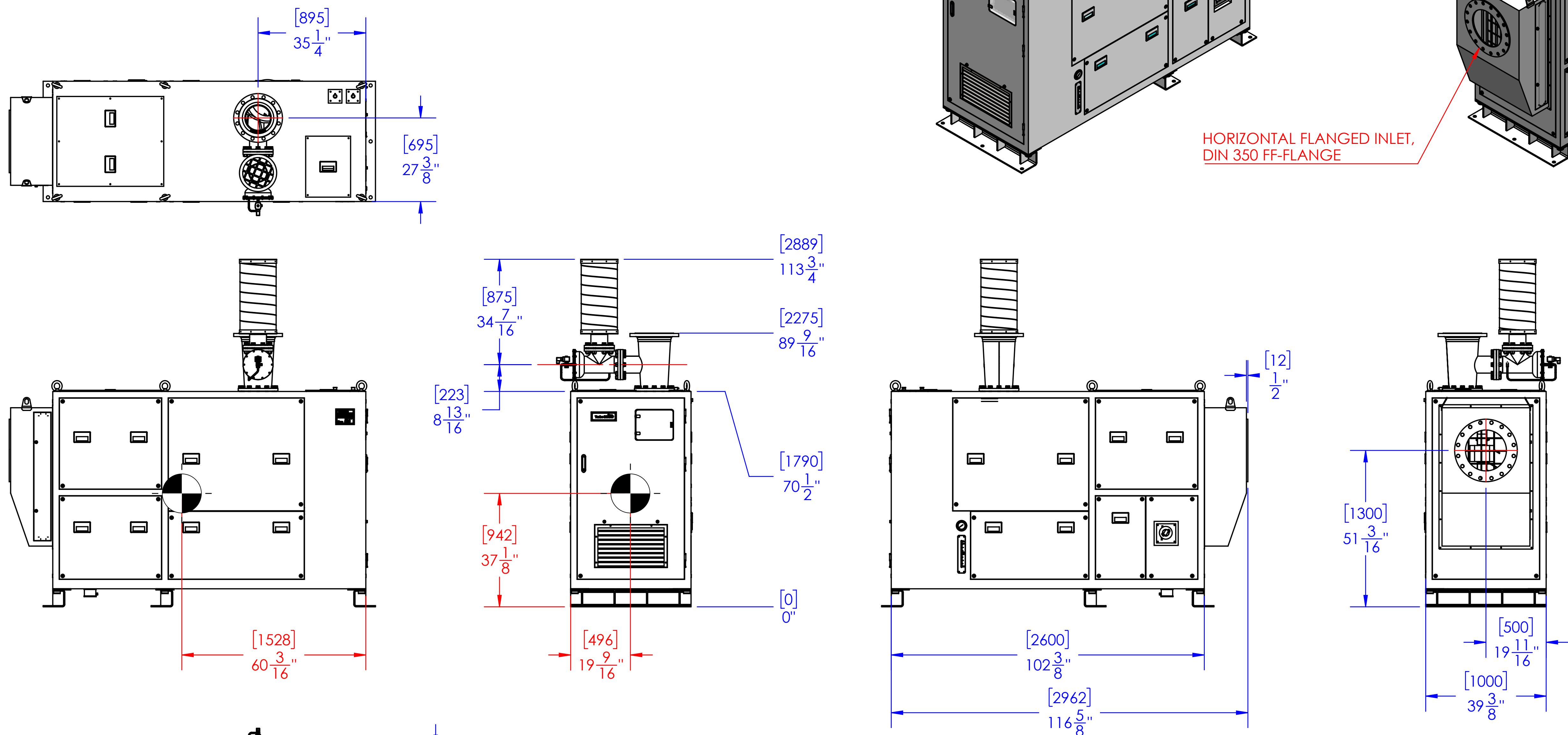
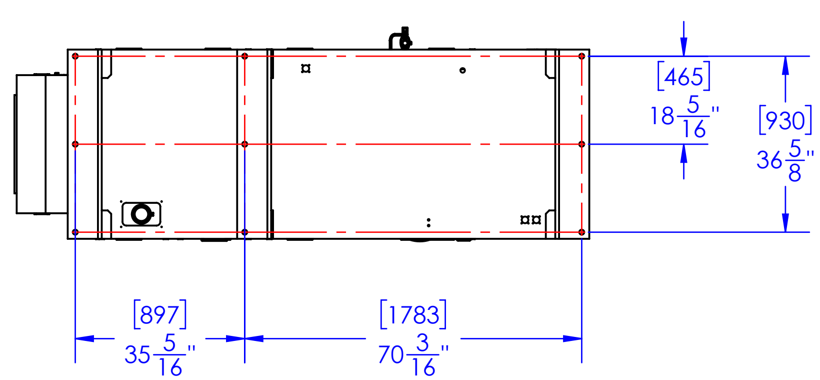






NOTE 2

1. ALL DIMENSIONS ARE IN FEET & INCHES
2. DUAL DIMENSIONS ARE IN MILLIMETERS

APGN INC. 1270, Michèle-Bohec, Blainville, Québec, CANADA, J7C 5S4 Tel: (450) 939-0799 Fax : (450) 939-2115	FOR : COMMERCIAL DRAWING		
	TITLE : NX200 TURBO BLOWER ANCHORING FEET - HORIZONTAL INLET		
	PROJECT NO. : 23-0014	DRAWING NO. : G-200242203	
UNLESS OTHERWISE NOTED :	DRAWN BY. : S. RAINVILLE	DRAWN DATE : 30-05-2024	REV : A-00
ALL DIMENSIONS ARE IN IN/[MM]	CHECKED BY. : L. STURZU	CKD. DATE : 30-05-2024	SCALE : 1:40
PROJECTION	APPROVED. BY. : A. HAMMOUD	APPD. DATE : 30-05-2024	SIZE : B
This drawing is the property of APG-Neuros Inc. Information and know-how hereon are confidential and may not be reproduced in whole or in part except with the written permission of APG-Neuros Inc.	FILE NAME : 23-0014_NX200-AF-IFH350-DC250_A-00		SHEET 1 OF 1

SANITAIRE
a xylem brand

Diffused Aeration Equipment

Dundas WWTP - Aeration

Aeration Tanks 1 - 3

Prepared for:
Dundas WWTP

Sanitaire Representative:

32783-24sc
06/03/2024
Sam Plevin

Design Inputs

Sanitaire Project Name: Dundas WWTP - Aeration
Date: 06/03/2024
Sanitaire Project Number: 32783-24sc

Tank Geometry

3lines each consisting of

Parameter	Unit	Tank 1
Tank Geometry		Rectangular
Floor length	m	50
Floor width	m	10
Water depth	m	6
Submergence	m	5.7
Tank volume (1)	m^3	3000

Zones and Oxygen/Air Distribution

Parameter	Unit	Tank 1 Swing Zone	Tank 1 Aerobic Zone
Zone Length	m	10	40
Distribution			
Swing Off	%		100
Swing On	%	20	80

Oxygenation

Parameter	Unit	Minimum	Average	Peak
Design based on		SOR	SOR	SOR
Distribution		Swing Off	Swing Off	Swing On
No of lines in operation		3	3	3
Water Depth	m	6	6	6
SOR	kg/day	2853	5705	12030
Safety Factor	%	0	0	0
Mixing Criteria	m^3/hm^2@10°C	2.11	2.11	2.11
Standard Oxygen Correction Factor Parameters				
Site Elevation	masl	100	100	100
Ambient Pressure	kPa	100.13	100.13	100.13
Water Temperature	°C	***20***	***20***	***20***

Notes:

(1) By default, Xylem calculates basin volume based on basin footprint and water depth. For basin with irregular geometries, a specified volume is used

(2) BOD refer to $cBOD_5$

Bold, italicized text indicate assumptions made by Xylem

If the AOR/SOR parameter is not given, its value will be evaluated later
if suitable values for alpha, beta, theta, dissolved oxygen, pressure and temperature data is supplied.

Design summary

Sanitaire Project Name: Dundas WWTP - Aeration

Date: 06/03/2024

Sanitaire Project Number: 32783-24sc

Design: Solution 1

Performance data

For all lines in operation

Parameter	Unit	Minimum Swing Off	Average Swing Off	Peak Swing On
No of lines in operation		3	3	3
No of operating diffusers		960	960	1440
AOR required	kg/day			
SOR required	kg/day	2853	5705	12030
SOR delivered	kg/day	5675.64	5705.01	12030
SOTE delivered (1)	%	32.3	32.3	30.2
Total Airflow (2)	m^3/h@10°C	2535.6	2550.4	5750.3
Min Airflow per diffuser	m^3/h@10°C	2.64	2.66	1.98
Max Airflow per diffuser	m^3/h@10°C	2.64	2.66	5
Max pressure at top of dropleg (3)	kPa	58.46	58.47	60.77
Max Dropleg velocity (4)	m/s	4.7	4.7	8.7
Estimated power consumption of blower				
Estimated hydraulic efficiency	%	70	70	70
Estimated motor efficiency	%	90	90	90
Estimated blower input power (5)	Hp	71.6	72.1	167.7
Est Standard Aeration Efficiency	kg/Hp/h	3.3	3.3	2.99

Equipment and grid design information:

3lines each consisting of

Parameter	Unit	Tank 1 Swing Zone	Tank 1 Aerobic
Product		9” SSLP	9” SSLP
Grid Count		1	1
Diffuser Count per grid		160	320
Header Count per grid		8	8
AtAd		16.41	32.82
Diffuser density	%	6.1	3
Manifold Diameter	inch	4" PVC	8" PVC
Manifold Location		Center	Center
Dropleg Location		Bottom	Bottom

Notes:

(2) Air Flow defined at 10°C

(2) Air Flow defined at 20°C

(3) The pressure at top of dropleg is defined above the water surface, including a 90' elbow

(4) Droplegs sized based on a maximum velocity of 15 m/s Velocity calculated for air temperature of 37.8 C

(5) Blower input power based on adiabadic compression and estimated blower and motor efficiency

Detailed equipment and grid design information

Sanitaire Project Name: Dundas WWTP - Aeration
Date: 06/03/2024
Sanitaire Project Number: 32783-24sc

Design: Solution 1

3lines each consisting of

Parameter	Unit	Tank 1 Swing Zone	Tank 1 Aerobic Zone
Grid Count		1	1
Diffuser Count per grid		160	320
Header Count per grid		8	8
Grid layout			
Manifold length	m	9.08	9.08
Header length	m	7.54	37.87
Header spacing	mm	1193.8	1193.8
Diffuser spacing	mm	355.6	965.2
Manifold Location		Center	Center
Dropleg Location		Bottom	Bottom
Headers parallel to		Length	Length
Manifold Elevation	m	Inline	Inline
Product selections			
Diffuser		9” SSLP	9” SSLP
Holder		1633 Holder	1633 Holder
Orifice size	inch	13/64"	13/64"
Header pipe material		PVC	PVC
Manifold pipe material		PVC	PVC
Dropleg Diameter	inch	4" PVC	8" PVC
Manifold Diameter	inch	4" PVC	8" PVC
Dropleg connection		Flange	Flange
Manifold connection		Flange	Flange
Purge type 1		Manual	Manual
Stainess steel grade		316 SS	316 SS
Support anchors		Expansion	Expansion

Detailed performance data per zone

Sanitaire Project Name: Dundas WWTP - Aeration
Date: 06/03/2024
Sanitaire Project Number: 32783-24sc

Design: Solution 1
Condition: Peak: Swing On

For each line, single zone operating data:

Parameter	Unit	Tank 1 Swing Zone	Tank 1 Aerobic Zone
Water Depth	m	6	6
Submergence	m	5.7	5.7
Zone Volume	m^3	600	2400
Oxygen Transfer Requirement			
SOR requried	kg/day	802	3208
Performance			
Airflow requried for mixing (1)	m^3/h@10°C	211.3	845.2
Airflow required for process	m^3/h@10°C	316.9	1599.9
Design Airflow (2)	m^3/h@10°C	316.9	1599.9
Airflow per diffuser	m^3/h@10°C	1.98	5
Actual distribution	%	20	80
SOR delivered (3)	kg/day	802	3208
SOTE delivered (4)	%	36.53	28.94
Dropleg velocity (5)	m/s	6.7	8.7
Grid Pressure			
Orifice Diameter	inch	13/64"	13/64"
Static Header Pressure Differential	kPa	0.093	0.083
Average Header Pressure	kPa	58.034	60.617
A: Average Headloss from Top of Dropleg To Headers	kPa	0.152	0.157
B: Diffuser Orifice Headloss	kPa	0.409	2.686
C: Diffuser Dynamic Wet Pressure	kPa	1.733	2.04
D: Static Pressure	kPa	55.892	55.892
Pressure at Top of Dropleg (A+B+C+D) (6)	kPa	58.186	60.774
Friction Headloss (A+B)	kPa	0.561	2.843

Notes:

(1) Airflow required for mixing based on mixing criteria
(2) Design Airflow is the maximum of the airflow required for mixing and process
(3) Delivered SOR based on Design Airflow
(4) Performance based on diffuser density (AT/AD), submergence and diffuser unit airflow.
(5) Droplegs sized based on a maximum velocity of 15 m/s. Velocity calculated for air temperature of 40 C
(6) Blower Pressure Capability also requires consideration of:
1) The air main headloss (piping, fittings, valves etc.) between the blower and the aeration assembly dropleg connections
2) Potential for increased headloss resulting from diffuser fouling and/or aging.
Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13, and other technical publications for a detailed discussion on this subject. Note that this headloss consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.
3) Increased diffuser submergence during Peak Flow conditions.

Detailed performance data per zone

Sanitaire Project Name: Dundas WWTP - Aeration Date: 06/03/2024
Sanitaire Project Number: 32783-24sc

Design: Solution 1
Condition: Minimum: Swing Off

For each line, single zone operating data:

Parameter	Unit	Tank 1 Aerobic Zone
Water Depth	m	6
Submergence	m	5.7
Zone Volume	m^3	2400
Oxygen Transfer Requirement		
SOR requried	kg/day	951
Performance		
Airflow requried for mixing (1)	m^3/h@10°C	845.2
Airflow required for process	m^3/h@10°C	374.2
Design Airflow (2)	m^3/h@10°C	845.2
Airflow per diffuser	m^3/h@10°C	2.64
Actual distribution	%	100
SOR delivered (3)	kg/day	1891.9
SOTE delivered (4)	%	32.3
Dropleg velocity (5)	m/s	4.7
Grid Pressure		
Orifice Diameter	inch	13/64"
Static Header Pressure Differential	kPa	0.024
Average Header Pressure	kPa	58.415
A: Average Headloss from Top of Dropleg To Headers	kPa	0.044
B: Diffuser Orifice Headloss	kPa	0.736
C: Diffuser Dynamic Wet Pressure	kPa	1.786
D: Static Pressure	kPa	55.892
Pressure at Top of Dropleg (A+B+C+D) (6)	kPa	58.459
Friction Headloss (A+B)	kPa	0.781

Notes:
(1) Airflow required for mixing based on mixing criteria
(2) Design Airflow is the maximum of the airflow required for mixing and process
(3) Delivered SOR based on Design Airflow
(4) Performance based on diffuser density (AT/AD), submergence and diffuser unit airflow.
(5) Droplegs sized based on a maximum velocity of 15 m/s. Velocity calculated for air temperature of 40 C
(6) Blower Pressure Capability also requires consideration of:
1) The air main headloss (piping, fittings, valves etc.) between the blower and the aeration assembly dropleg connections
2) Potential for increased headloss resulting from diffuser fouling and/or aging.
Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13, and other technical publications for a detailed discussion on this subject. Note that this headloss consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.
3) Increased diffuser submergence during Peak Flow conditions.

Detailed performance data per zone

Sanitaire Project Name: Dundas WWTP - Aeration
Date: 06/03/2024
Sanitaire Project Number: 32783-24sc

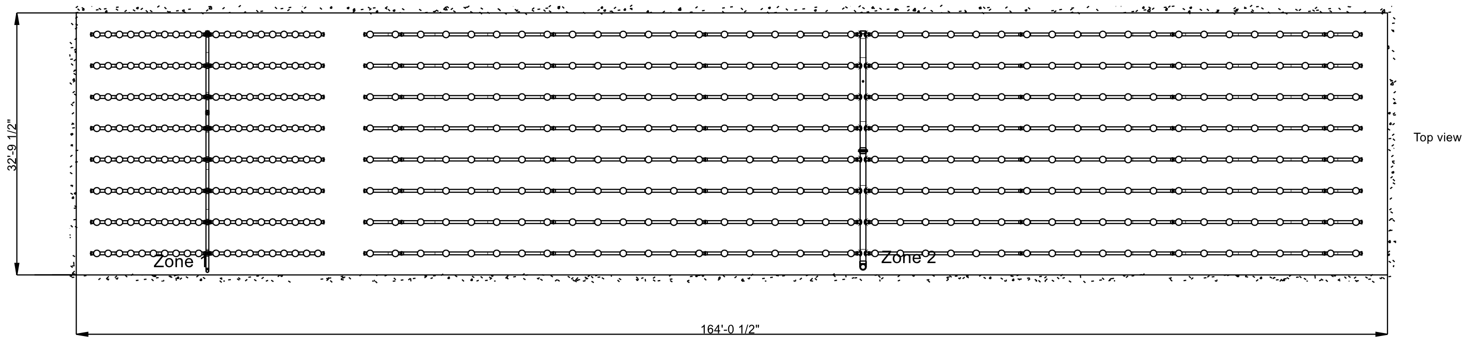
Design: Solution 1
Condition: Average: Swing Off

For each line, single zone operating data:

Parameter	Unit	Tank 1 Aerobic Zone
Water Depth	m	6
Submergence	m	5.7
Zone Volume	m^3	2400
Oxygen Transfer Requirement		
SOR requried	kg/day	1901.7
Performance		
Airflow requried for mixing (1)	m^3/h@10°C	845.2
Airflow required for process	m^3/h@10°C	850.1
Design Airflow (2)	m^3/h@10°C	850.1
Airflow per diffuser	m^3/h@10°C	2.66
Actual distribution	%	100
SOR delivered (3)	kg/day	1901.7
SOTE delivered (4)	%	32.28
Dropleg velocity (5)	m/s	4.7
Grid Pressure		
Orifice Diameter	inch	13/64"
Static Header Pressure Differential	kPa	0.024
Average Header Pressure	kPa	58.425
A: Average Headloss from Top of Dropleg To Headers	kPa	0.045
B: Diffuser Orifice Headloss	kPa	0.745
C: Diffuser Dynamic Wet Pressure	kPa	1.788
D: Static Pressure	kPa	55.892
Pressure at Top of Dropleg (A+B+C+D) (6)	kPa	58.47
Friction Headloss (A+B)	kPa	0.79

Notes:

(1) Airflow required for mixing based on mixing criteria
(2) Design Airflow is the maximum of the airflow required for mixing and process
(3) Delivered SOR based on Design Airflow
(4) Performance based on diffuser density (AT/AD), submergence and diffuser unit airflow.
(5) Droplegs sized based on a maximum velocity of 15 m/s. Velocity calculated for air temperature of 40 C
(6) Blower Pressure Capability also requires consideration of:
1) The air main headloss (piping, fittings, valves etc.) between the blower and the aeration assembly dropleg connections
2) Potential for increased headloss resulting from diffuser fouling and/or aging.
Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13, and other technical publications for a detailed discussion on this subject. Note that this headloss consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.
3) Increased diffuser submergence during Peak Flow conditions.



SECAD™ 5.2.6.13 (5.2) Standard

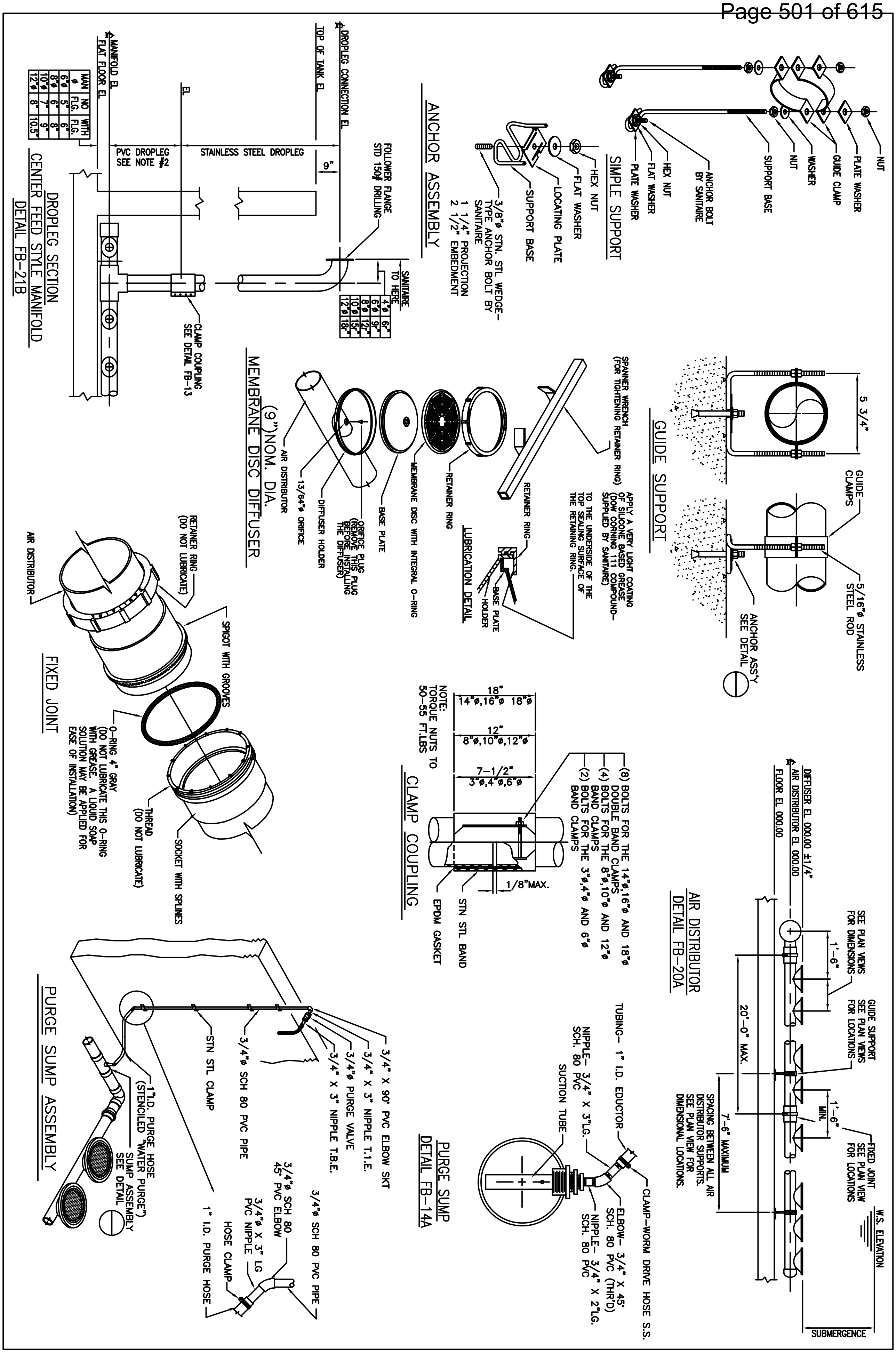
SECAD Aeration			
Product	Diffuser	Header Pipe	SS Grade
A	9" SSII LP 1633, 13/64" orifice	4" PVC	SS 316

Zone	Product	Diffusers	Total Diffuser Area [ft²]	Nominal Header Spacing [inch]	Nominal Diffuser Spacing [inch]	Manifold	Zone Length
1	A	160	66	47	17	4"	32'-9 3/4"
2	A	320	131	47	38	8" flange	131'-2 7/8"

Disclaimer
The accuracy of the output is based on the accuracy of the input data, and it is the responsibility of those supplying that information to verify that this data is correct. The drawing is supplied for reference only, based on Flygt equipment, and is meant for preliminary sump design and system evaluation. A professional engineer, licensed in the appropriate field of engineering, should always conduct the final evaluation of the application if there are liabilities involved.

A1

Designed by	EX approved by	Draft	Weight	A-class	M-class
Checked by	Date 6/3/2024	Denomination: Conceptual drawing		Material	
Drawn/Redrawn by				Blank	
Applicable to				Treatment	
xylem Let's Solve Water		This document may not, without our permission, be copied, shown or handed out to competitors or any other unauthorized persons.		Scale 1/8"=1'	
		Approval	Drawing No: Dundas WWTP - Aeration	Rev	


SIMPLE SUPPORT
NUT
PLATE WASHER
GUIDE CLAMP
WASHER
NUT
SUPPORT BASE
ANCHOR BOLT BY SANITAIRE
HEX NUT
FLAT WASHER
PLATE WASHER
GUIDE SUPPORT
5 3/4"
GUIDE CLAMPS
5/16"ø STAINLESS STEEL ROD
ANCHOR ASS'Y SEE DETAIL
AIR DISTRIBUTOR
DETAIL FB-20A
DIFFUSER EL 000.00 ±1/4"
AIR DISTRIBUTOR EL 000.00
FLOOR EL 000.00
SEE PLAN VIEWS FOR DIMENSIONS
GUIDE SUPPORT SEE PLAN VIEWS FOR LOCATIONS
FIXED JOINT SEE PLAN VIEW FOR LOCATIONS
W.S. ELEVATION
SUBMERGENCE
1'-6"
1'-6" MIN.
20'-0" MAX.
7'-6" MAXIMUM SPACING BETWEEN ALL AIR DISTRIBUTOR SUPPORTS. SEE PLAN VIEW FOR DIMENSIONAL LOCATIONS.
ANCHOR ASSEMBLY
HEX NUT
FLAT WASHER
LOCATING PLATE
SUPPORT BASE
3/8"ø STN. STL WEDGE-TYPE ANCHOR BOLT BY SANITAIRE
1 1/4" PROJECTION
2 1/2" EMBEDMENT
SPANNER WRENCH (FOR TIGHTENING RETAINER RING)
APPLY A VERY LIGHT COATING OF SILICONE BASED GREASE (DOW CORNING 111 COMPOUND-SUPPLIED BY SANITAIRE) TO THE UNDERSIDE OF THE TOP SEALING SURFACE OF THE RETAINING RING.
RETAINER RING
BASE PLATE HOLDER
LUBRICATION DETAIL
MEMBRANE DISC WITH INTEGRAL O-RING
BASE PLATE
ORIFICE PLUG (REMOVE THIS PLUG BEFORE INSTALLING THE DIFFUSER)
DIFFUSER HOLDER
13/64"ø ORIFICE
AIR DISTRIBUTOR
(9")NOM. DIA.
MEMBRANE DISC DIFFUSER
DROPLEG CONNECTION EL
TOP OF TANK EL
EL
MANIFOLD EL
FLAT FLOOR EL
STAINLESS STEEL DROPLEG
PVC DROPLEG SEE NOTE #2
FOLLOWER FLANGE STD 150# DRILLING
9"
SANITAIRE TO HERE
CLAMP COUPLING SEE DETAIL FB-13
DROPLEG SECTION
CENTER FEED STYLE MANIFOLD
DETAIL FB-21B
(8) BOLTS FOR THE 14"ø,16"ø AND 18"ø DOUBLE BAND CLAMPS
(4) BOLTS FOR THE 8"ø,10"ø AND 12"ø BAND CLAMPS
(2) BOLTS FOR THE 3"ø,4"ø AND 6"ø BAND CLAMPS
18"
14"ø,16"ø 18"ø
12"
8"ø,10"ø,12"ø
7-1/2"
3"ø,4"ø,6"ø
1/8"MAX.
STN STL BAND
EPDM GASKET
NOTE: TORQUE NUTS TO 50-55 FT.LBS
CLAMP COUPLING
RETAINER RING (DO NOT LUBRICATE)
AIR DISTRIBUTOR
SPIGOT WITH GROOVES
O-RING 4" GRAY (DO NOT LUBRICATE THIS O-RING WITH GREASE. A LIQUID SOAP SOLUTION MAY BE APPLIED FOR EASE OF INSTALLATION)
THREAD (DO NOT LUBRICATE)
SOCKET WITH SPLINES
FIXED JOINT
TUBING- 1" I.D. EDUCTOR
NIPPLE- 3/4" X 3"LG. SCH. 80 PVC
SUCTION TUBE
CLAMP-WORM DRIVE HOSE S.S.
ELBOW- 3/4" X 45° SCH. 80 PVC (THR'D)
NIPPLE- 3/4" X 2"LG. SCH. 80 PVC
PURGE SUMP
DETAIL FB-14A
3/4" X 90° PVC ELBOW SKT
3/4" X 3" NIPPLE T.1.E.
3/4"ø PURGE VALVE
3/4" X 3" NIPPLE T.B.E.
3/4"ø SCH 80 PVC PIPE
STN STL CLAMP
1"I.D. PURGE HOSE (STENCILED "WATER PURGE")
SUMP ASSEMBLY SEE DETAIL
3/4"ø SCH 80 PVC PIPE
3/4"ø SCH 80 45° PVC ELBOW
3/4"ø X 3" LG PVC NIPPLE
HOSE CLAMP
1" I.D. PURGE HOSE
PURGE SUMP ASSEMBLY

SSI Aeration
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May 29th, 2024. File: Dundas WWTP Expansion (ACG Envirocan) _BP-052924

ACG ENVIROCAN
131 Whitmore Road, Unit 7
Woodbridge, ON L4L 6E3

Attention: Dale Jackson
(C): (647) 746-1569
Email: dale@acg-envirocan.ca

Ref.: Dundas WWTP – **Budget Proposal**

Sir/Madam,

In response to your email and based on the information provided, SSI as an ISO-9001 certified corporation is pleased to submit this proposal for the design, manufacture & supply of aeration equipment for **Three (3) Aeration Tanks** with POD270-E-2mm (9") Fine bubble disc diffusers with EPDM Membranes.

Unless otherwise noted equipment supplied will meet or exceed any engineer specified performance requirements and/or called in the RFP/Email.

Included are the design calculations & preliminary drawing showing general arrangement of diffuser layout. (Refer below)

A. Scope of supply is complete with all components from the downstream of air supply line *(±150mm above water level)* starting with 304SS Vanstone and loose follower flange c/w Drop pipes *(Isolation valves and other components are not included in SSI supply limit).*

Each Tank (Aerobic) is 40 x 10 x 6m (SWD) and consists of **Two (2) Identical Grids** and Aeration equipment supplied **Per Grid** is as listed below:

10" 304SS Sch.10 Drop pipe ±6m		10" PVC Sch.40 Manifold ±10m		4" PVC Sch.40 Header's ±140m c/w Factory installed diffusers		POD270-E-2mm Diffusers
304SS Supports	SS Coupling	304SS Supports	PVC Coupling	304SS Supports	PVC Unions	
3	1	7	1	70	28	392

Number of POD270-E-2mm diffusers in One (1) Tank (392/Grid) * 2 = **784**

COMMON FOR THREE (3) TANKS

Total Number of POD270-E-2mm diffusers (784/Tank) * 3 = **2,352**

B. Recommended Spares:

- POD270-E-2mm diffuser membranes – **20**
- 4" 304SS Supports – **4**
- 4" 304SS repair couplings – **3**

C. Site Services: Three (3) Days in Three (3) Trips

D. Carriage FOB: Dundas, ON L9H 1C6, Canada *(Subject to change at actuals)*

E. TOTAL LUMP SUM PRICE: *(for all listed above)* ....**$*200,000 CAD***

F. GENERAL:

- SS pipe work is cleaned, degreased, and acid washed for following the fabrication.
- Piping sections are supplied in 6m (20') lengths (maximum) connected with suitable connections.
- All SS/PVC welding/gluing etc. is done in the factory, site welding/gluing is not required for installation of equipment.
- Each Grid is supplied with One (1) MPS c/w its related accessories.
- **Spares:** Included as above.
- **Site Services:** Included
- SSI's diffusers are manufactured in compliance with ISO9001.
- **Warranty:** Unless otherwise noted SSI's standard warranty/guarantee on the equipment supplied is for 18 months from the date of shipment or 12 months after the start-up, whichever occurs first. The warranty covers the workmanship and material of the listed items only. Any costs direct or indirect, site work, site repair/adjustments etc., are not covered under the warranty. Further warranty is valid only when SSI or Its Representative/Associates approve and/certifies the installation. However, as the inspection is done randomly certification on installation does not make SSI liable or responsible for any direct or indirect installation failure(s).

G. PRICES IS:

1. **Canadian Funds**
2. Valid for **90** days
3. Above price does not consider Buy America products and if it is needed, price might change accordingly.
4. **Approval Submittals:** c/w O & M Manual in electronic/digital files with general & installation drawings, applicable calculations, and product cut sheets & data sheets, production procedure & Quality control etc.,**3-4 weeks** after receipt of P.O and all information that is needed for preparation of installation/shop drawings.
5. Completion and ready to ship **14-16** weeks after receipt of approved submittal.
6. **FOB**: Dundas, ON L9H 1C6
7. Manufacturer's Service days are not included above.
8. Unless otherwise specified all items are supplied loose for field assembly if any. Field assembly, Installation, relevant site work, field tests etc. are by others.
9. Exclusions:*(unless noted otherwise)*
    - Offloading upon delivery to site.
    - Any items and services not itemized within the above scope of supply.
    - Mixers, VFD's, wall sleeves, valves, Air main piping, Etc.
    - Brokerage, taxes etc. if any.
10. Payment Terms:
    a. For Municipal and Government Projects in the US: Equipment - 30% with PO, 30% with Approved submittals, and 40% before shipment.
    b. Private projects in the US and all overseas jobs: 30% with PO, 30% with approved submittals and balance 40% prior shipment (subject to credit approval).
11. Cost Escalation Clause: SSI Aeration, Inc. has priced the job according to existing market conditions and costs at the time of quote. Due to wide fluctuations and increases in the price of stainless steel, carbon steel, PVC

components, we are experiencing in very short time frames, the sales price of the equipment might be subject to escalation in price in the event there are delays approving submittal, delays in delivery schedule and/or release to manufacture beyond what was quoted and beyond Seller's control. If there is a significant increase of material or freight occurring during the performance of the contract, the contract sums and/or time of completion shall be equitably adjusted by Change order. A price change will be considered significant when the overall cost of the system increases by 10% or higher.

12. Escalation shall be based upon the increase in the Producer Price Index, U.S Department of Labor, Bureau of Labor Statistics-Group: Machinery and Equipment: Special Industry Machinery and Equipment, Series Id-WPU116 9the "Index"). The escalation shall be calculated based upon the percentage increase of the monthly index between the date of quotation and the date of receipt of the order and submittal approval/release to manufacture (i.e.: the index of the month of when the order is received and released to manufacture minus the index for the month of quotation divided by the index for the month of quotation, multiplied by the quoted price). Note there is an approximately 2–4-month delay in the publishing and finalizing of these indexes by the U.S. Federal Government. Therefore, the escalation will be calculated at the time the index for both months has been published and finalized.

If you have any questions, need clarification, or any additional information, please feel free to contact us. We would be glad to assist further.

Yours truly,
Stamford Scientific International Inc.

Kiran Kumar Banala,
Director of Application Engineering [Ext 308]
Email: kiran@ssiaeration.com

DESIGN CALCULATIONS:

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SMART IDEAS FOR WATER

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DIFFUSED AERATION SYSTEM

Doc #	**SD00018507**	Revision #	**1**
Project	**Dundas WWTP, Hamilton (ACG)**	Date	**5-29-2024**
Process Type	**MBR**	Units	**Metric**

Aeration Tanks design for 3 tank(s)

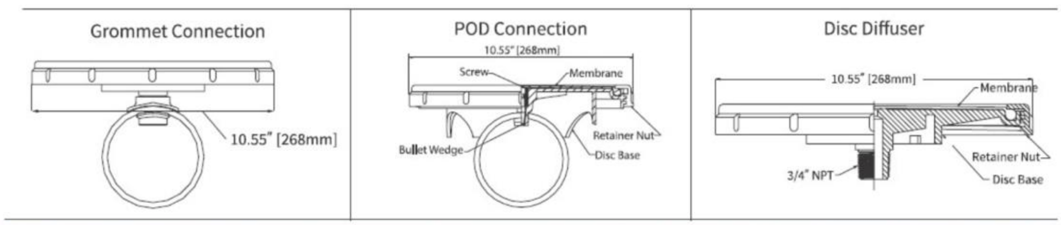
Tank Type	**Aeration**	Tank Shape	**Rectangular**	
Type of Input	**AOR**	Diffuser Type	**AFD270-2mm**	
	Units	**Minimum**	**Average**	**Peak**
Design Scenario		**Standard**	**Standard**	**Standard**
AOR	(kg O_2 /day)	2,853	5,705	12,030
AOR	(Kg O_2/hr)	118.88	237.71	501.25
Site Elevation	(m)	273	273	273
Aeration Tanks Length per tank	(m)	40	40	40
Aeration Tanks Width per tank	(m)	10	10	10
Diffuser Water Depth	(m)	5.7	5.7	5.7
SOR	**(kg O_2/hr)**	**321.39**	**642.65**	**1,355.13**
Total Airflow	**(Nm^3/hr)**	**2,905.92**	**6,123.69**	**14,770.65**
Airflow Per Diffuser	**(Nm^3/hr)**	**1.24**	**2.60**	**6.28**
Diffuser Quantity	**(pcs)**	**2,352**	**2,352**	**2,352**
Diffuser Density	**(%)**	**7.45**	**7.45**	**7.45**
SOTE	**(%/m)**	**6.48**	**6.14**	**5.37**
Total SOTE	**(%)**	**36.9**	**35.02**	**30.6**
Blower Pressure	(mbar)	670	670	670
Pressure @ Top Of Dropleg	(mbar)	593.57	597.21	626.54

Aeration Tanks design for 3 tank(s)

	Units	Minimum	Average	Peak
AOR	(kg O_2/day)	2,853	5,705	12,030
AOR	(kg O_2 /hr)	118.88	237.71	501.25
MLSS	(mg/l)	6,000	6,000	6,000
Aeration Time	(hrs)	24	24	24
Liquid Temperature	(°C)	20	20	20
Ambient Air Temperature	(°C)	25	25	25
Site Elevation	(m)	273	273	273
Barometric Pressure	(mbar)	980.59	980.59	980.59
O_2 Uptake Rate	(mg/l/hr)	16.49	32.96	69.51
Minimum Diffuser Density	(%)	5	5	5
Alpha Factor	(α)	0.5	0.5	0.5
Fouling Factor	(F)	1	1	1
Beta Factor	(ß)	0.95	0.95	0.95
Theta Factor	(θ)	1.024	1.024	1.024
Dissolved Oxygen	(mg/l)	2	2	2
Aeration Tanks Length per tank	(m)	40	40	40
Aeration Tanks Width per tank	(m)	10	10	10
Side Water Depth	(m)	6	6	6
Diffuser Water Depth	(m)	5.7	5.7	5.7
Total Area of 3 tank(s).	(m^2)	1,200	1,200	1,200
Tank Volume	(m^3)	7,200	7,200	7,200
C *, Surface Saturation, Std., Meth	(mg/l)	9.09	9.09	9.09
Csw, Site Basin Saturation	(mg/l)	10.55	10.55	10.55
Css, Std., Basin Saturation	(mg/l)	10.84	10.84	10.84
SOR	(kg O_2 /hr)	321.39	642.65	1,355.13
KLa20 - /hr		4.09	8.17	17.23

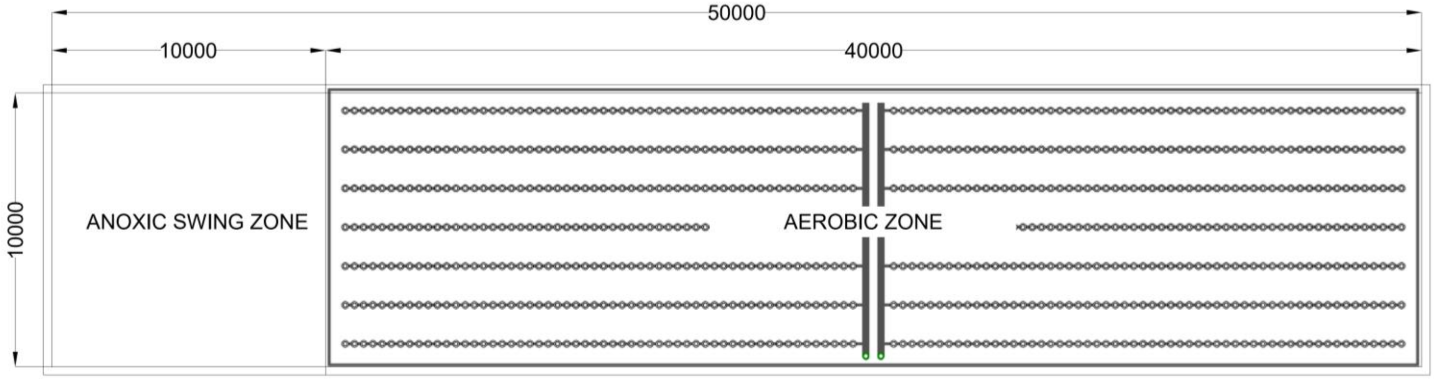
Minimum Diffuser Quantity	(pcs)	1,579	1,579	1,579
SP O_2Transfer Rate	gr O_2/Nm^3-m	19.4	18.41	16.1
SAE	(kg O_2/kWh)	4.83	4.59	4.01
Blower Efficiency	(%)	70	70	70
Blower Power	(kW)	66.49	140.11	337.94
Estimated cost per kWh	(kWh)	0.11	0.11	0.11
Annual Operating Cost	(USD)	64,069.76	135,010	325,638.98

SSI 9" Disc Diffuser Systems



Limitation of Liability: The information contained in this Design is provided as a service exclusively to SSI clients and is intended to use with SSI products for Proposal/Quotation purpose only to be stamped or embossed with the SSI corporate seal for validation/approval. We accept no liability for the accuracy of self-generated designs.

PRELIMINARY LAYOUT:



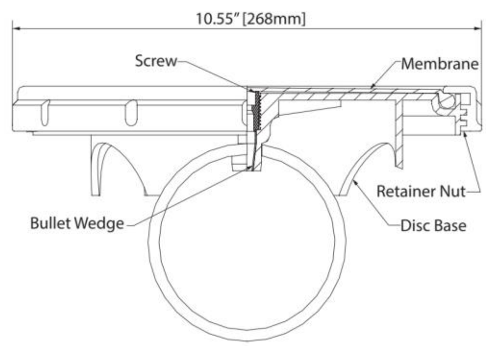
AERATION TANK LAYOUT PLAN

ONE (1) SHOWN THREE (3) REQUIRED

POD270-2 9" Disc Diffuser

SSI Aeration
SMART IDEAS FOR WATER

What Makes the **SSI POD270-2 9" Disc Diffuser** an Expert Choice?



The POD™ is an excellent option for municipal and industrial wastewater treatment plants interested in saving time and expense in labor involving installations, routine operational maintenance and the need to investigate the source of recurring problematic leaks.

Factory assembled diffusers mounted on laterals save contractors up to 30% on assembly time. PODS are a viable solution if you want to tank down for a minimum period, if your labor costs are high, or if you have a field labor shortage. For engineers unsure about the skill set of a contractor's field labor, SSI PODS are worry free with fewer field connections, and most connections created in controlled factory settings by trained personnel and automatic machines.

SSI Aeration

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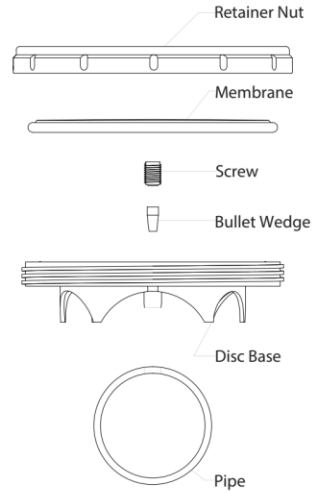
POD270-2 9" Disc Diffuser

Unique System Strengths

Complete product line – creating the system that fits your needs
SSI manufactures disc diffusers and coarse bubble diffusers, and we mount these products on a wide range of piping materials including PVC, CPVC, PP and Stainless Steel. We have the ability to attach diffusers to pipe using saddles, grommets, or pre-assembled PODS. We can provide retrievable systems or fixed grids, and systems in kit form or mostly factory assembled. We try to understand and anticipate your needs, and fit our recommendations to your situation.

Piping system integrity – thicker wall pipe and double anchors for fewer breakages
Our piping is 38% thicker and has double rod support stands as standard – two anchors for each support location means twice the resistance to hydraulic and thermal loads. Most often supports fail due to temperature and water velocity. SSI locates two anchors where support is needed most, helping to increase product longevity.

Comprehensive design service and after sales support
SSI provides full design services, including biological and mixing calculations, process simulations and hydraulic studies. We maintain a full drafting department with 3D and animation capabilities and we can assist with specifications and CAD drawings. Our service and installation crew can hold your hand during the early stages of the project and our worldwide multilingual staff is dedicated to your complete satisfaction.



EXPLODED DRAWING

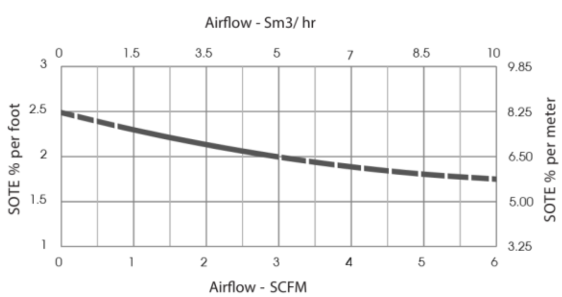
Pods Installation Procedure

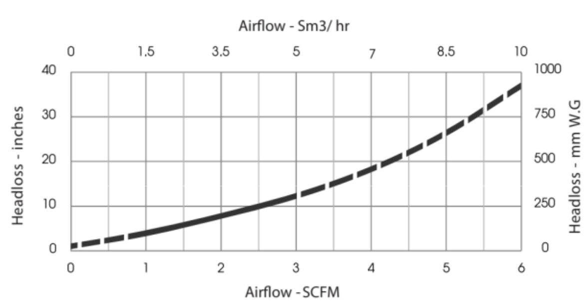
Insert POD diffuser into the pipe hole (17mm). Then insert wedge bullet in to the base. Insert wedge screw and rotate set screw after that place membrane over the base plate. Then hand tighten retainer nut on to the base until unable to be turned further. Then use Spanner Wrench tighten the retaining nut further 1/4 turn to complete installation.

Intelligent Upgrade Options

Patented PTFE membranes prolong efficiency and reduce whole-life costs
SSI's patented PTFE membrane barrier properties not only reduce plasticizer extraction, shrinking, and membrane hardening but also limit dynamic changes that can result from swell, such as creep. Compared with uncoated products that are more susceptible to increases in DWP due to more aggressive fouling and changes in physical properties and weight, the PTFE coated membrane improves consistency of DWP (Headloss) values over the product life. This directly impacts long-term power costs and the ability of the system to distribute air uniformly across the tank floor.

SSI Telemetry – the inside story solves maintenance problems
At the click of a mouse, you will know the DWP of your diffuser membranes, airflow rate to those monitored diffusers, and air temperature in the submerged piping system. You can sense vibration, pipe roll over, and water in the grid. Automatic moisture purging and automatic acid dosing systems are available. Through multiple cameras, you can see both inside the grids, and surface bubble patterns. Wet probes are also available for DO and WW temperature. Tracking all this data on a user-friendly online dashboard facilitates communication between consultant and client, manufacturer and rep. This smart technology lets you locate problem areas and allocate resources more efficiently. SSI Telemetry is your preventive maintenance hub in the heart of the plant.





SSI
www.ssiaeration.com

ANAB ACCREDITED Certified to ISO 9001: 2015 TÜVRheinland Precisely Right.

TECHNICAL DATA SHEET

SSI™ ACCESSORIES

NPT & CLAMP SADDLES

Quick Connect NPT Saddles mount on nominal US 3" or metric 88.9mm, 90mm OD, US 4" or 114.3mm and 110mm OD pipe. They allow retrofit of 12" to 9"discs without changing the piping system. Quick Connect NPT Saddles are made of polypropylene, and install into a 5/8" (16mm) hole.

NPT Saddle

Clamp Saddle

EXPANSION JOINT OPTIONS

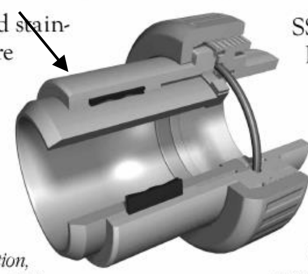
Rigid Bolted SS

Expansion Joints are available in three types: Flexible PVC with SS Shell, Rigid Bolted SS, and Anti-rotation, Telescoping PVC. The flexible expansion joints are recommended for disc installations and the positive locking type for tube diffuser projects.

Flexible PVC w/SS shell

Slotted band joints with stainless steel shear rings are suitable for disc-type fine bubble and cap-type coarse bubble lateral plastic piping systems, in conjunction with SSI's fixed and guide support stand system to manage thermal expansion and contraction.

Positive locking bolted stainless steel couplings are suitable for drop pipes, stainless joints, and for all tube diffuser piping systems to restrict header pipe rotation.



Anti-rotation, Telescoping PVC

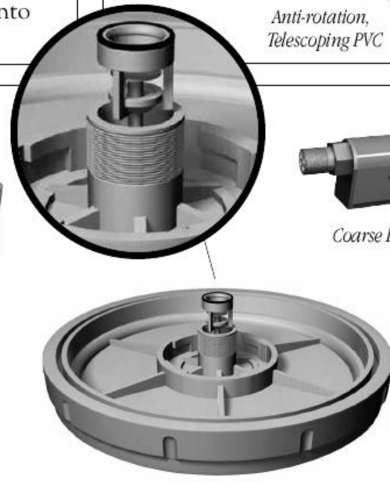
SSI's Sliding Expansion Joint is an anti-rotational telescopic union which absorbs pipe expansion and contraction to up to 1.5" (38mm).

GROMMETS

Grommets are available for round plastic or square stainless steel pipes in US or Metric dimensions. Installation is simple. Multiple sizes are available based on pipe wall thickness. Grommets install into a 1-1/4" (32mm) chamfered hole.

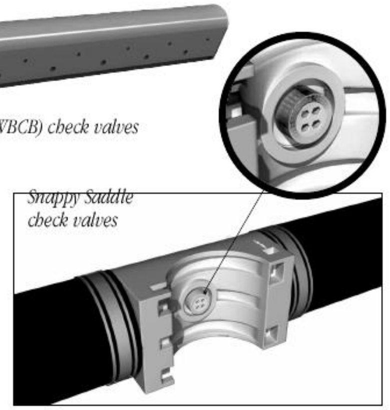
CHECK VALVES

SSI fine and coarse bubble diffusers are available with optional check valves. These are not required for proper operation since most diffusers are self-checking, but they may give peace of mind to the designer or operator.



Disc showing check valve installation

Coarse Band (WBCB) check valves



Snappy Saddle check valves

Tube Diffuser check valves

Please see reverse for additional technical data

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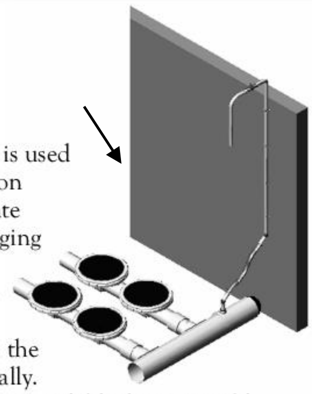
TECHNICAL DATA SHEET

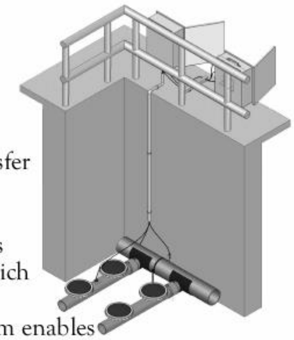
SSI™ ACCESSORIES *continued*

MOISTURE PURGE SYSTEM



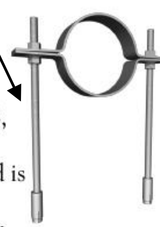
An airlift type purge system is used in all SSI fine bubble aeration systems to remove condensate from the piping system. Purging entrained water helps ensure even air distribution to all diffusers in a grid. A ball valve is supplied with the system and is opened manually. Continuous purge systems are available for retrievable-type aeration systems, or where it is not possible to fasten a purge line to a tank wall.

PRESSURE MONITORING SYSTEM

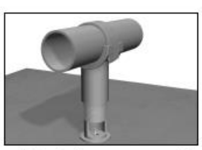


Throughout the life of an aeration system, oxygen transfer efficiency may decline somewhat when diffusers become fouled, but headloss can increase dramatically which in turn increases energy costs. A pressure monitoring system enables the operator to better determine the optimal cleaning frequency of the membranes. The fouling rate can vary by aeration zone, hence it is recommended to install at least one system in each zone.

SUPPORT STANDS



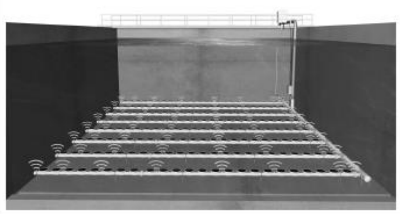
Support Stands are available in 304SS, 316SS or in ABS plastic. SSI's standard is 304SS with drop-in anchor bolts. In our aeration piping systems, support stands fulfill the dual role of anchoring pipes to the floor and controlling thermal expansion and contraction. Special support stands for uneven tank floors, for installing into concrete ballast forms, and for tanks with significant channel velocity (with lateral supports) are also available. ABS support stands are primarily used with disc diffusers and plastic pipe, where a low capital cost is the primary objective.



ABS plastic support stand

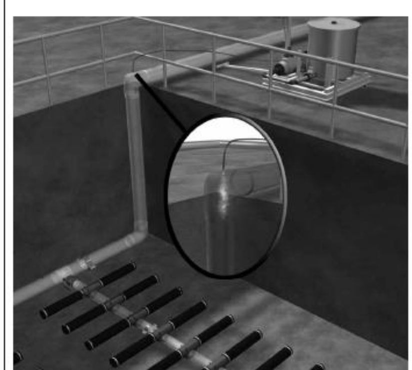
TELEMETRY SYSTEM

Adding a Telemetry System to your aeration system will allow you to remotely monitor factors inside your tank from any PC, tablet or mobile device. Telemetry can be installed in new systems or retrofitted through an end cap into existing systems. Telemetry sensors are available to monitor variables in your system such as temperature, vibration, humidity, water detection, DO, and other environmental factors.



ACID DOSING SYSTEM

In-situ Acid Dosing Systems are available to control calcareous deposits in the perforations which will reduce membrane backpressure.



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Flygt 4320 Mixers

ADJUSTABILITY MADE SIMPLE FOR MAXIMUM EFFICIENCY

FLYGT
a xylem brand

Superior Mixing Made Efficient and Effective

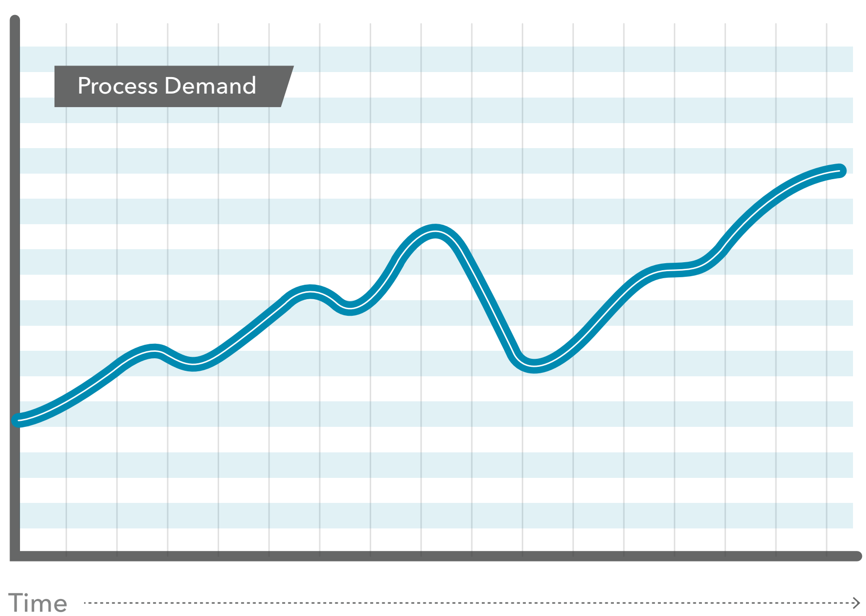
Flygt, the industry leader in municipal wastewater mixing, is proud to raise the standard in high efficiency, low-speed submersible mixers. Flygt 4320's revolutionary design couples a high efficiency mixer and state-of-the-art motor efficiency, with an integrated variable frequency drive (VFD). The result is a submersible mixer that delivers superior mixing with adjustability and simplicity, for unsurpassed energy savings.

Adjustable Simplicity and Efficiency by Design

- Integrated drive dramatically simplifies variable speed mixing. Coupling an integrated drive with a synchronous motor, the Flygt 4320 eliminates the need for an external VFD.
- The Flygt 4320 mixer comes in a variety of ratings and propeller options to meet a broad range of thrust and tank layout requirements. The propeller comes in two or three-bladed options, and in a range of diameters from 1.4 to 2.5 meters (4.6 to 8.2 feet). Flygt engineers can assist you in evaluating your mixing requirements to determine the best possible fit.
- With a motor efficiency equivalent to the Super Premium Efficiency IE4 levels and fully adjustable speed, the Flygt 4320 delivers unparalleled energy efficiency, for lowest life cycle mixing energy costs.
- Flygt 4320's speed controls can easily be adjusted with a small operator panel, which can be mounted tankside or in the control room for easy accessibility. Control can also be accessed from central control systems, via remote communications. Either way, adjustments are as easy as setting a clock.

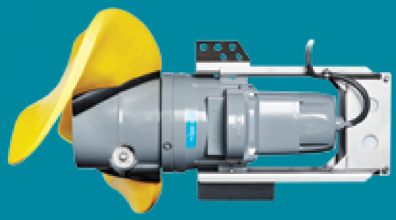
Exceptional mixer efficiency + adjustable thrust to match needs **= unparalleled energy efficiency.**

- Potential savings over 50%
- Soft start
- Soft stop
- High power factor
- Status information and alarms



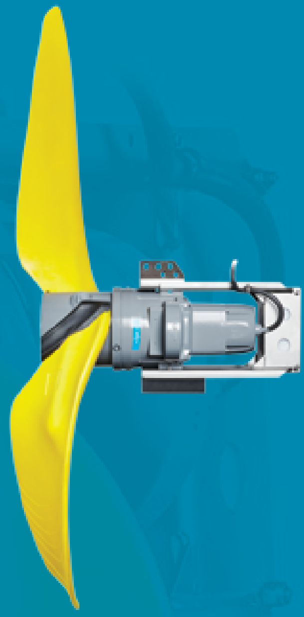
Adjust for Today, Adjust for Tomorrow, Adjust for Efficiency

The Flygt 4320 allows you to adjust for today's flows and loadings, quickly change to meet seasonal fluctuations, and be prepared for future increases – all without wasting energy.



- Adjusting thrust to meet changing loads or seasonal variations can save up to 50% on energy costs.
- Use only the energy you need today, while having the mixing power reserve you need to meet future demands.

System Optimization. Flygt 4320's ease of adjustability empowers you to find the sweet spot, that spot that meets all treatment objectives with the minimal amount of energy consumption.



Process modifications can change thrust requirements by up to 50% by:

- Changing inlet screen type
- Changing average bulkflow velocity
- Adjusting the aeration system, or changing to a different aeration system
- Adjusting the mixed liquor suspended solids level
- Adding, removing or turning on or off different zones, for instance anoxic, anaerobic or aerobic zones.

Adjust for low life cycle costs and quick payback.

- Energy savings may often provide payback in as little as a couple of years, as high efficiencies and easily adjustable thrust can minimize energy consumption while still meeting process objectives.
- Installation is simplified, with no external VFD, for quicker construction, quicker startup and lower construction costs.
- Soft starts and stops reduce wear and fatigue on mechanical and electrical components, extending life and reducing maintenance.
- Adjusting for actual thrust requirements reduces wear and stress on the mixer during lower power periods, for longer life and reduced maintenance.
- Easy to handle, install, maintain and control – simplicity by design.

Reliability and service are a given.

Backed by more than 50 years of mixing R&D expertise and innovation, the Flygt 4320 delivers the robust performance and reliability you expect from the trusted leader in mixing technology. At Flygt, we design and engineer every component in-house, from propellers and shaft seals, to motors and gearboxes, so you are assured of quality and reliability. With our extensive worldwide service network, professional assistance and genuine spare parts are always nearby.

Reliable. Adjustable. Simple. Efficient. Flygt 4320 delivers.

Together, let's mix efficiently. Let's solve water.

FB216-2290 • Flygt 4320 Mixers • 9/2015 • NACT

Technical data

Rated Power 50/60 Hz, kW (hp)	2.0 (2.7)	4.0 (5.4)	8.0 (10.7)
Propeller diameter, m (in.)		1.4-2.5 (55-98)	
Propeller speed, rpm		variable, up to 70	
Maximum thrust, N*			
1.4 m (55 in.)	1,260	2,110	3,470
2.0 m (79 in.)	1,910	3,210	5,210
2.5 m (98 in.)	2,530	4,110	6,150
Maximum efficiency, N/kW*			
1.4 m (55 in.)		over 600	
2.0 m (79 in.)		over 1,000	
2.5 m (98 in.)		over 1,500	
Rated current, A	4.0	7.5	15
Starting current, A	4.0	7.5	15
Power factor (cos phi)		up to 0.94 (0.999)	

*According to ISO 21630:2007 and depending on product configuration

xylem
Let's Solve Water

Flygt is a brand of Xylem, whose 12,000 employees are addressing the most complex issues in the global water market.

Xylem, Inc.
14125 South Bridge Circle
Charlotte, NC 28273
Tel 704.409.9700
Fax 704.295.9080
855-XYL-H2O1 (855-995-4261)
www.xyleminc.com

www.xyleminc.com/treatment

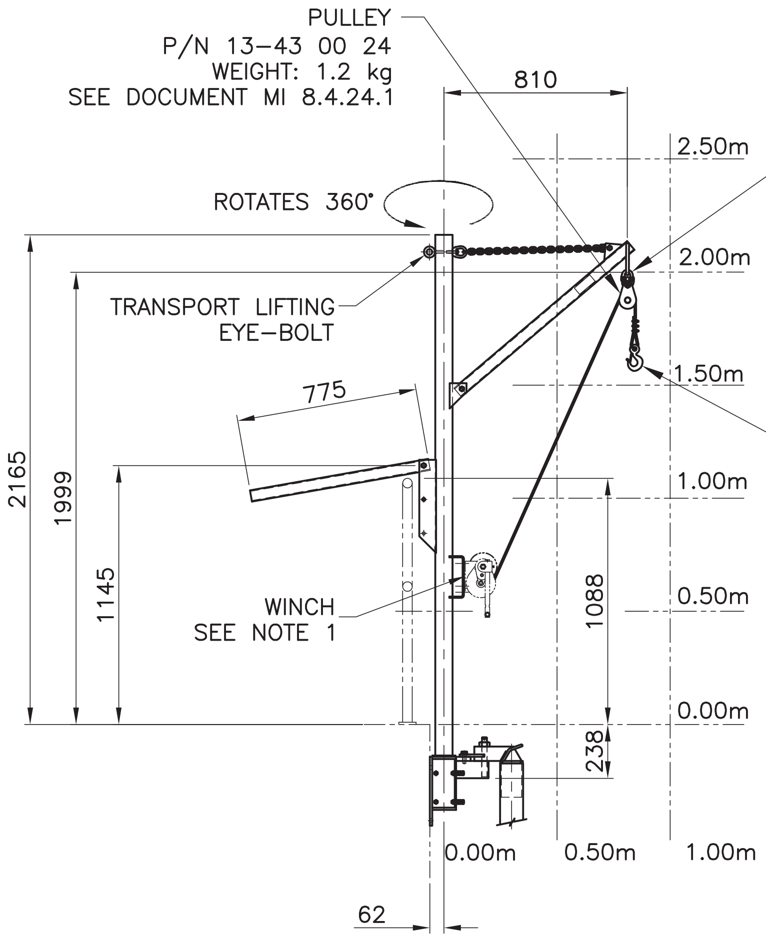
xylem

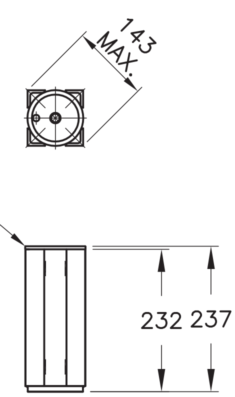
Mixers Equipment	DOCUMENT NO.
	MI 8.4.3.2

Lifting Davit Rated for 226 kg (500 lbs)

4" Mast System 4 Davit Receptacle Option, P/N 13-50 05 60

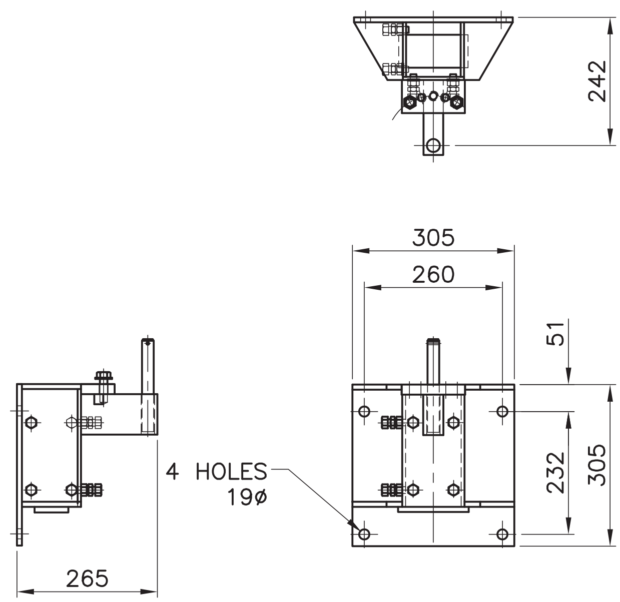
SUPERSEDES	ISSUED
-	12/2009





SQUARE SOCKET TO ROUND DAVIT MAST ADAPTOR (P/N 13–50 05 66) GALVANIZED STEEL

SHIPPING WEIGHT: 54 kg. (119 lbs) WITHOUT WINCH



UPPER GUIDE BAR HOLDER WITH DAVIT RECEPTACLE (P/N 14–58 79 49) GALVANIZED STEEL

NOTES:

1– CABLE WINCH OPTIONS :
   A) MANUAL WINCH P/N 13–52 05 95
      SEE DOCUMENT NO. MI 8.4.20.2
   B) MANUAL/ELECTRIC P/N 13–43 00 21
      SEE DOCUMENT NO. MI 8.4.21.1

2– POWER ASSISTED DRILL KIT P/N 13–40 01 99
   SEE DOCUMENT NO. MI 8.4.21.3

3– LIFTING CABLE SEE DOCUMENT NO. MI 8.4.23.1

4– FINISH: GALVANIZED STEEL

DIMENSIONS ARE IN mm

N.T.S.

VEOLIA

ZeeWeed* Membranes
for Municipal Wastewater Treatment Systems

Dundas WWTP Expansion Project
Updated Design Report

Submitted To
Kang-Young Ko
CIMA
900-101 Frederick Street
Kitchener, ON N2H 6R2

Submitted By
Veolia Water Technologies & Solutions
Geoff Totten - Regional Sales Manager
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Veolia Proposal Number: 559679
May 24, 2024

Table of Contents

1 Design Parameters

The proposed ZeeWeed Membrane system is based on using the parameters summarized in the following sections.

1.1 Influent Flows and Quality

The influent design flows and their durations are summarized in the table below.

Table 1: Influent Flows and Durations

Flow Condition	Duration	Value	Units
ADF	Indefinitely	18,200	m^3/day
MMF	≤ 30 days	22,750	m^3/day
MDF	≤ 24 hours	31,850	m^3/day
PHF (equivalent flow in m^3/day)	≤ 2 hours	488 (42,200)	L/s
Maximum flow with one train offline	Indefinitely	22,750	m^3/day

Note 1: The flow conditions as specified above are defined below:

- Average Day Flow (ADF) – The average flow rate occurring over a 24-hour period based on annual flow rate data.
- Maximum Month Flow (MMF) – The average daily flow rate occurring during the 30-day period with the highest flow based on annual flow rate data.
- Maximum Day Flow (MDF) – The maximum flow rate occurring over a 24-hour period based on annual flow rate data.
- Peak Hour Flow (PHF) – The maximum flow rate sustained over a 2-hour period based on annual flow rate data

The design solution proposed is based on the wastewater characteristics detailed below. The concentrations listed are specific to the flow used for the biological design as listed in the

System Design.

Table 2: Influent Wastewater Quality

Influent Parameter	Assumed or Provided	Value	Units
Flow basis of biological design	Provided	22,750	m^3/day
Design influent temperature	Provided	10	ºC
BOD_5	Provided	182	mg/L
TSS	Provided	301	mg/L
TKN	Provided	42	mg/L
TP	Provided	6.2	mg/L
Alkalinity as $CaCO_3$ [1]	Assumed	250	mg/L

Below are the membrane system influent characteristics that were used for this design.

Table 3: Design Properties of Mixed Liquor Entering Membrane Tanks

Design Parameter	Acceptable Range	Units
Operating temperature	10	ºC
MLSS concentration [1]	≤ 8,000	mg/L
pH	6.5 – 7.5	SU
Soluble $cBOD_5$ concentration	≤ 5	mg/L
NH_3-N concentration	≤ 1.0	mg/L
Colloidal TOC (cTOC) concentration [2]	≤ 10	mg/L
Soluble alkalinity as $CaCO_3$	50 – 150	mg/L
Time to filter (TTF) [3]	≤ 200	seconds
Material greater than 2 mm in size [4]	≤ 1	mg/L
Fats, oil & grease (FOG) concentration	Refer to Note 6	mg/L

Note 1: Per Veolia's standard, MLSS concentration at the tail-end of membrane tanks of up to 12,000 mg/L is permissible during MDF, PHF and short (up to 24 hours) N-1 events only. MLSS concentration at the tail end of membrane tanks to be ≤10,000 mg/L during all other flow conditions.

Note 2: Colloidal TOC (cTOC) is the difference between the TOC measured in the 1.5-µm filter paper filtrate and the TOC measured in the ZeeWeed membrane permeate.

Note 3: Per seller's standard Time to Filter (TTF) Procedure (available upon request).

Note 4: Per seller's standard Sieve Test Procedure (available upon request).

Note 5: Chemicals incompatible with the ZeeWeed PVDF membrane are not permitted.

Note 6: Total FOG shall not contain more than 150 mg/L of emulsified FOG and more than 10 mg/L of mineral or non-biodegradable oil. Free oil should be non-detect.

1.2 Effluent Quality

The following or better effluent quality is expected upon equipment start-up and once the biological system has stabilized.

Table 4: Effluent Quality

Effluent Parameter	Value	Units
BOD_5	≤ 3	mg/L
TSS	≤ 3	mg/L
TP	≤ 0.05	mg/L
TAN		mg/L

May 1- Oct. 31 Nov. 1 – Apr. 30	0.30 0.50	
Turbidity	≤ 1	NTU

VEOLIA

2 System Design

2.1 Biological System Design

Major bioreactor design parameters are summarized in table below.

Table 5: Biological System Design

Design Parameter	Value	Units
Flow basis for biological design	22,750	m^3/day
Number of biological trains	3	-
Total aerobic working volume (w/o membrane space)	12,750	m^3
Total bioreactor volume (w/o membrane space)	12,750	m^3
Aerobic SRT (excluding membrane space)	20	days
Design MLSS concentration in bioreactor	8,000	mg/L
Design liquid depth in aerobic zone	5.49	m

Note 1: Tank volumes are preliminary only and may change once final detail design commences.

2.2 Membrane System Design

Major membrane and membrane tank characteristics are summarized in table below.

Table 6: Membrane System Design

Design Parameter	Value	Units
Membrane tanks/trains per plant	4	-
Cassette spaces per train	6	-
Cassettes installed per train	6	-
Type of cassette	ZW500EV	-
Module area	530	ft^2
Maximum modules per cassette	64	
Module design per train	4x64 + 1x56 + 1 spare space	-
Modules installed per train	312	-
Modules installed per plant	1,248	-
Spare space	18.8	%
Membrane tank internal dimensions (L x W x H)	42.5 x 9 x 13	ft

VEOLIA

3 Preliminary Equipment Sizing

The table below details preliminary equipment sizing based on the influent flow and quality detailed in Section 1.1. Please note the assumptions provided for each item that is subject to change the model and the HP as design progresses. The data detailed below is for information purposes only.

Permeate Pumps (also providing Backpulse Duty)

	ADF	MMF	MDF	PHF	MMF (N-1)
Net Flow, m^3/day	18,200	22,750	31,850	42,200	22,750
Number of Trains	4	4	4	4	3
Instantaneous Permeate Flow used for Sizing, Per Train, gpm (L/s)	1,002 (63)	1,252 (79)	1,753 (111)	2,323 (147)	1,669 (105)
Number of Pumps	4 Duty				
Equipment Size, HP	75				
Make, Model	Boerger EL 3050				

Assumptions:

- Minimum TDH: 5’
- Maximum TDH: 35’

RAS/Was/Drain Pumps

	ADF	MMF	MDF	PHF	MMF (N-1)
Net Flow, m^3/day	18,200	22,750	31,850	42,200	22,750
Number of Trains	4	4	4	4	3
RAS Rate	4Q	4Q	2Q	2Q	4Q
RAS Flow, per Train, gpm (L/s)	3,339 (211)	4,174 (263)	2,921 (184)	3,871 (244)	5,565 (351)
Number of Pumps	4 Duty				
Equipment Size, HP	40				
Make, Model	Sulzer APT 52-14				

Assumptions:

- Minimum TDH: 8’
- Maximum TDH: 12’

Membrane Blowers

	ADF	MMF	MDF	PHF	MMF (N-1)
Net Flow, m^3/day	18,200	22,750	31,850	42,200	22,750
Number of Trains	4	4	4	4	3
Airflow Mode	Leap-Lo	Leap-Lo	Leap-Hi	Leap-Hi	Leap-Lo
Airflow, per Train, scfm	645	645	1,290	1,290	645
Number of Blowers	4 Duty + 1 Standby				
Equipment Size, HP	100				
Make, Model	Aerzen GM 80L				

Process Blowers

	MMF
Net Flow, m^3/day	22,750
Number of Trains	3
Total AOR, kg/hr	325
Number of Blowers	3 Duty + 1 Standby
Equipment Size, HP	100
Make, Model	Aerzen GM 80L

Assumptions:

- Assumed airflow provided from BioWin modelling. For actual airflow requirements, Veolia requires a design from our diffuser vendors based on the Biological basin dimensions.

ZeeWeed* 500 for Large Municipal MBR

FACT SHEET

Experience, Expand, Evolve with ZeeWeed

Addressing the everchanging needs of Municipal customers looking to:

- Lower the CAPEX associated with expanding capacity
- Increase treatment capacity in a smaller footprint
- Reduce annual energy and maintenance costs
- Enjoy longer membrane life with simplified maintenance

Performance

- High flux dedicated MBR membrane chemistry since 2007 with permeability > 900 lmh/bar
- True UF membrane for over 25 years with proven 0.035 μm nominal pore size
- Patented LEAPmbr aeration providing exceptional energy consumption savings
- Superior fiber strength, 60x greater than non-reinforced PVDF membranes

Reliability

Exceptional membrane reliability and product life with many municipal customers achieving 12 to 16 years operation; longest proven life 21 years!

Veolia stands by its product offering Peace of mind with warranties up to 15 years in duration.

Proven Experience

Nearly 2500 MBRs globally running with ZeeWeed 500 membranes. More than 1.3 million operating modules treating over 27000 MLD (7200 MGD) daily.

Flexibility & Simplicity

Configurable product to provide plant layout versatility for easy future expansion even for those with footprint constraints.

Demonstrated simple retrofit solutions for conventional upgrades and more than 15 other MBR membrane suppliers.

ZeeWeed 500 in Action

Henriksdal WWTP, Sweden

ADF 536 MLD (142 MGD)

MDF 864 MLD (228 MGD) PH1

Commissioned 2020

Luo Fang WWTP, China

ADF 400 MLD (106 MGD)

MDF 462 MLD (122 MGD)

Commissioned 2018

Seine Aval WWTP, France

ADF 218 MLD (59 MGD)

MDF 348 MLD (92 MGD)

Commissioned 2017

Euclid WWTF, USA

ADF 83 MLD (22 MGD)

MDF 250 MLD (66 MGD)

Commissioned 2018

Beijin Shunyi WWTP, China

ADF 180 MLD (48 MGD)

MDF 234 MLD (62 MGD)

Commissioned 2016

Brussels Sud WWTP, Belgium

ADF 86 MLD (23 MGD)

MDF 190 MLD (44 MGD)

Commissioned 2018

Oxford WWTP, Canada

ADF 13 MLD (3.6 MGD)

MDF 25 MLD (6.8 MGD)

Commissioned 2008

Proven membrane life 14 years

Traverse City WWTP, USA

ADF 27 MLD (7.1 MGD)

MDF 64 MLD (17 MGD)

Commissioned 2005

Proven membrane life 16 years

Brescia WWTP, Italy

ADF 30 MLD (8 MGD)

MDF 60 MLD (16 MGD)

Commissioned 2002

Proven membrane life 14 years

Cassette Properties

Table 1: Cassette Dimensions

Product	Width (A) mm (in)	Length (B) mm (in)	Height (C) mm (in)
500EV-64M	1,744 (68.7)	2,136 (84.1)	2,735 (107.7)
500D-52M			2,562 (100.9)

Table 2: Cassette Tie Points and Weights

Application	Product	Max. # of Modules	Min. # of Modules	Permeate Connection	Air Connection	Max. Shipping Weight [1] kg (lb)	Wet Weight [2] kg (lb)	Lifting Design Weight [3] kg (lb)	Cassette Material [4]
LEAPmbr	EV-64M	64	32	1 x 8" vert. pipe	1 x 3" FNPT half coupling	2,091 (4,610)	2,329 (5,135)	4,536 (10,000)	316L SS frame with engineered plastics
	D-52M	52	26	1 x 6" vert. pipe	1 x 3" FNPT half coupling	1,892 (4,172)	2,184 (4,816)	4,536 (10,000)	

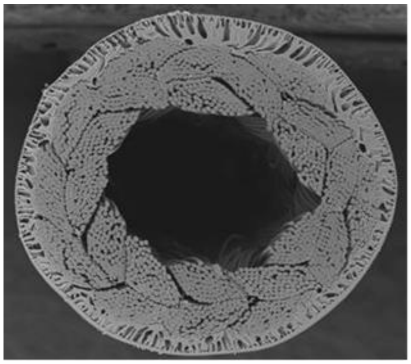
[1] Crated with maximum number of modules

[2] Wet weight of a clean, fully populated cassette. Lower module population will reduce this value. Cassette support method and lifting module can also vary this weight, depending on design. An estimate is used based on several standard designs.

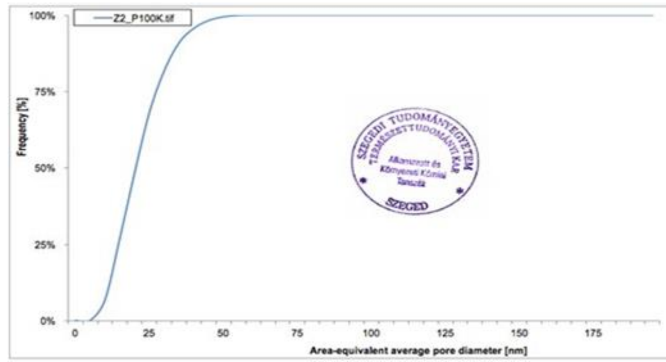
[3] Product lifting design weight assumes a fully populated cassette with solids accumulation, standard lifting module and hanging arms. Alternative support and lifting methods could vary this value.

[4] Alternative grades of stainless steel offered for cassettes are 304L, 2205 and SMO254 as required.

Membrane Properties



Membrane cross-section



3rd party certified UF pore size

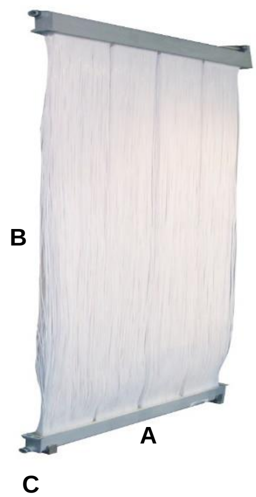


Table 3: module dimensions

Application	Product	Width – A mm (in)	Length - B mm (in) Header-to-Header	Depth – C mm (in)
MBR	500EV	861 (33.9)	2,051 (80.7)	51 (2.0)
	500D	844 (33.2)	1,940 (76.4)	49 (1.9)

Table 4: Module Properties

Application	Membrane Surface Area m² (ft²)	Lifting Weight [1] kg (lb)	Material	Nominal Pore Size [2] (µm)	Fiber Diameter [3] (mm)	Surface Properties	Fiber Tensile Strength [4] (N)	Flow Path
MBR	500EV 49.2 (530)	29 (64)	PVDF	0.04	2.2	Non-ionic & Hydrophilic	>600	Submerged, Outside-In
	500D 40.0 (430)	28 (61)						

[1] Clean wet weight excluding any solids accumulation

[2] Nominal pore size is often rounded to 40nm (0.04 micron) for simplicity.

[3] Fiber dimensions have been rounded to the nearest decimal place for simplicity.

[4] Tensile strength measured using a modification of ASTM protocol (D 3822)

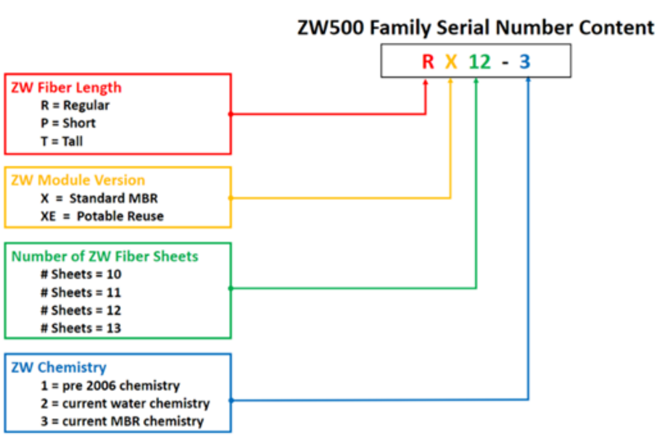
Table 5: Operating & Cleaning Specifications [1]

Application	TMP Range kPa (psig)	Typ. Aeration Nm^3/h/cassette (scfm/cassette)	Max. Operating Temp. °C (°F)	Operating pH Range	Backpulse Type	Max. Cleaning Temp. °C (°F)	Cleaning pH Range	Max. lifetime exposure Cl2 (ppm)
MBR	-55 to 55 (-8 to +8)	500EV 222-445 Nm^3/h (132-264 SCFM) 500D 182-363 Nm^3/h (108-215 SCFM)	40 (104)	5.0-9.5	Relax Aeration (Standard) Backpulse-capable (as-required)	40 (104)	2.0 – 10.5 (<30°C) 2.0 -10.0 (30-40°C)	1,000,000

[1] Cassettes can be populated with 26 to 52 modules (500D), or 32 to 64 modules (500EV). Normalized ADF flow for fully populated cassette at 150m ASL, 20°C wastewater temperature. Delivered value at modules will differ based on site conditions. Lower cassette populations will have a lower aeration rate.

ZeeWeed 500 Series Products

The ZeeWeed 500 series of membranes have been applied to MBR applications since 1997 when the ZW500A was introduced. There are four products within the current 5th generation – the ZW500M (laboratory use), ZW500S, ZW500D and ZW500EV. All ZeeWeed 500 series MBR products use the same PVDF chemistry formulation, designed specifically for membrane bioreactor application.



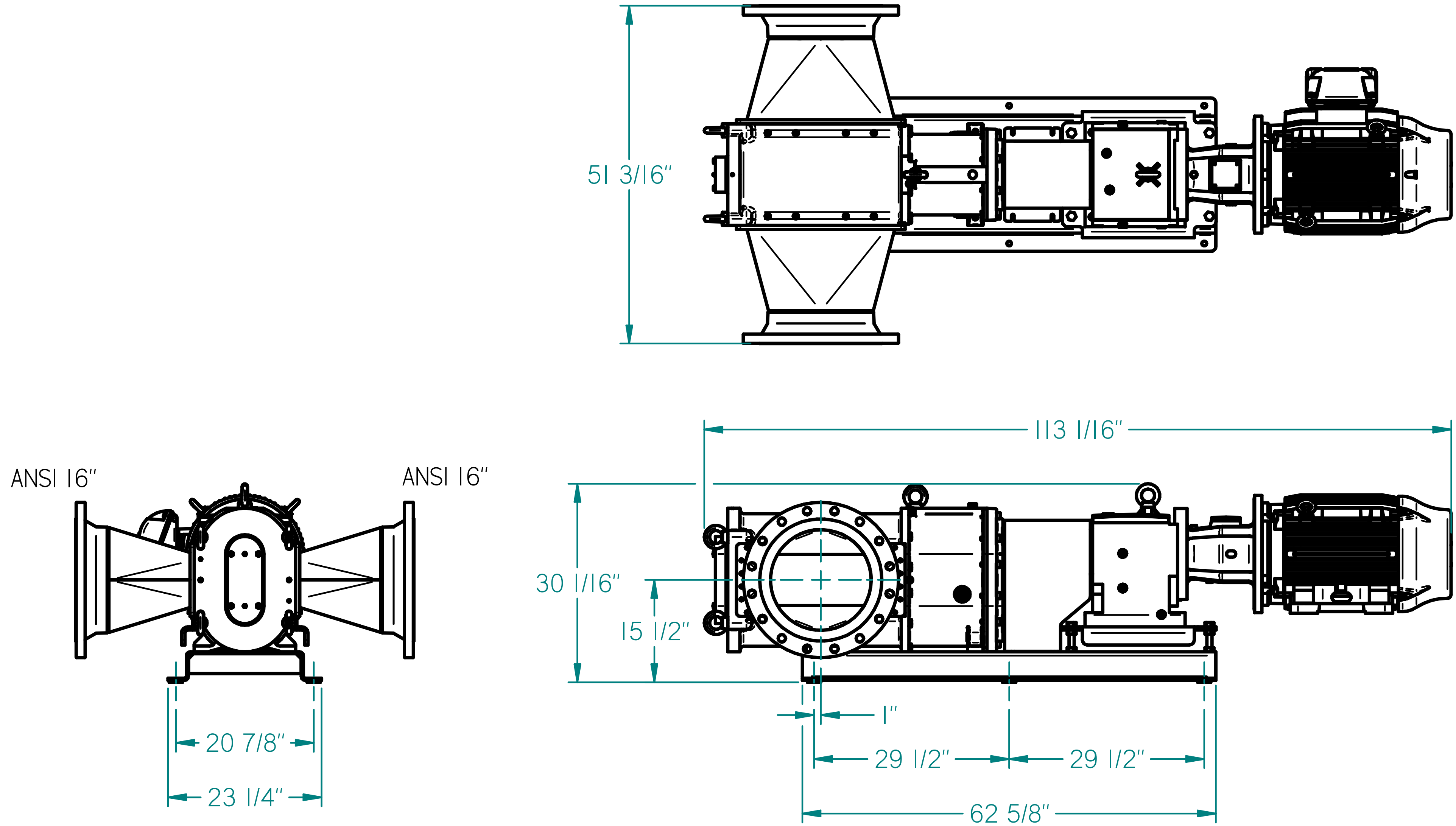
ZeeWeed 500 Product Identification

All ZeeWeed 500 series products have a product type identification code tied to the product specification. The code provides information on the version of the module, the fiber length, the number of sheets, and the membrane chemistry. It is typically found with the module serial number and takes the format of 1 to 3 letters, a number, and usually, but not always, a dash and third number.

Contact Us

If you would like to learn more about how Veolia can provide MBR solutions for your large municipal projects, contact your Veolia representative or visit our website.

Veolia Water Technologies
Please contact us via:
www.veoliawatertechnologies.com



NOTE:
1. TOTAL WEIGHT = 4,099 LBS

PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF Boerger, LLC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF Boerger, LLC IS PROHIBITED.	BOERGER, LLC 2860 Water Tower Place Chanhassen, MN 55317 TEL: 612-435-7300 FAX: 612-435-7301		THIRD-ANGLE PROJECTION	BÖRGER
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED		NAME	DATE	Model: EL 3050 Gear: Nord - In-Line SK72-AN360TC Power: 75 HP
	DRAWN	mlindquist	01/16/24	
TOLERANCES ± 1/2"	CHECKED			SIZE A / DWG. NO. SD-034-839 / REV 0
DO NOT SCALE DRAWING	SHEET 1 OF 1			

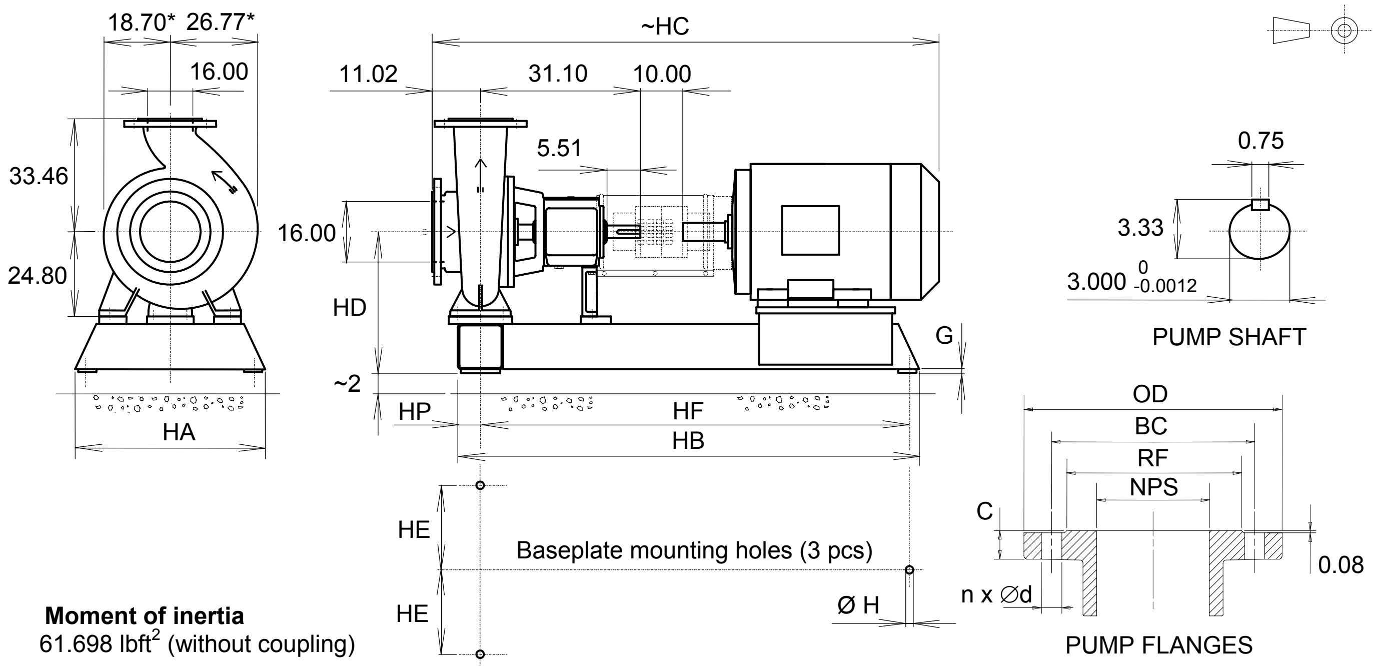
SULZER

Series 3.15	Page
DIMENSIONS	US
June 2012	D

DIMENSIONAL DATA –AHLSTAR
General Arrangement – Pump + Motor + Baseplate – US Units

SPP id: Version 04 > / 120601 / Replaces 981115 / en / **P20045** / 2

Product scope: Assembly (ASSE.0)
Pump type and size: APT52-16
Motor standard: NEMA motor, NEMA
Drive type: Direct drive, DD
Baseplate type: Baseplate for pump and motor, SLP
Pump mounting size: 56



Moment of inertia
61.698 lbft^2 (without coupling)

*) If sealing unit type = Air separating pump, please check the dimensions from bare pump dimensional drawing.

Dimensions in inches

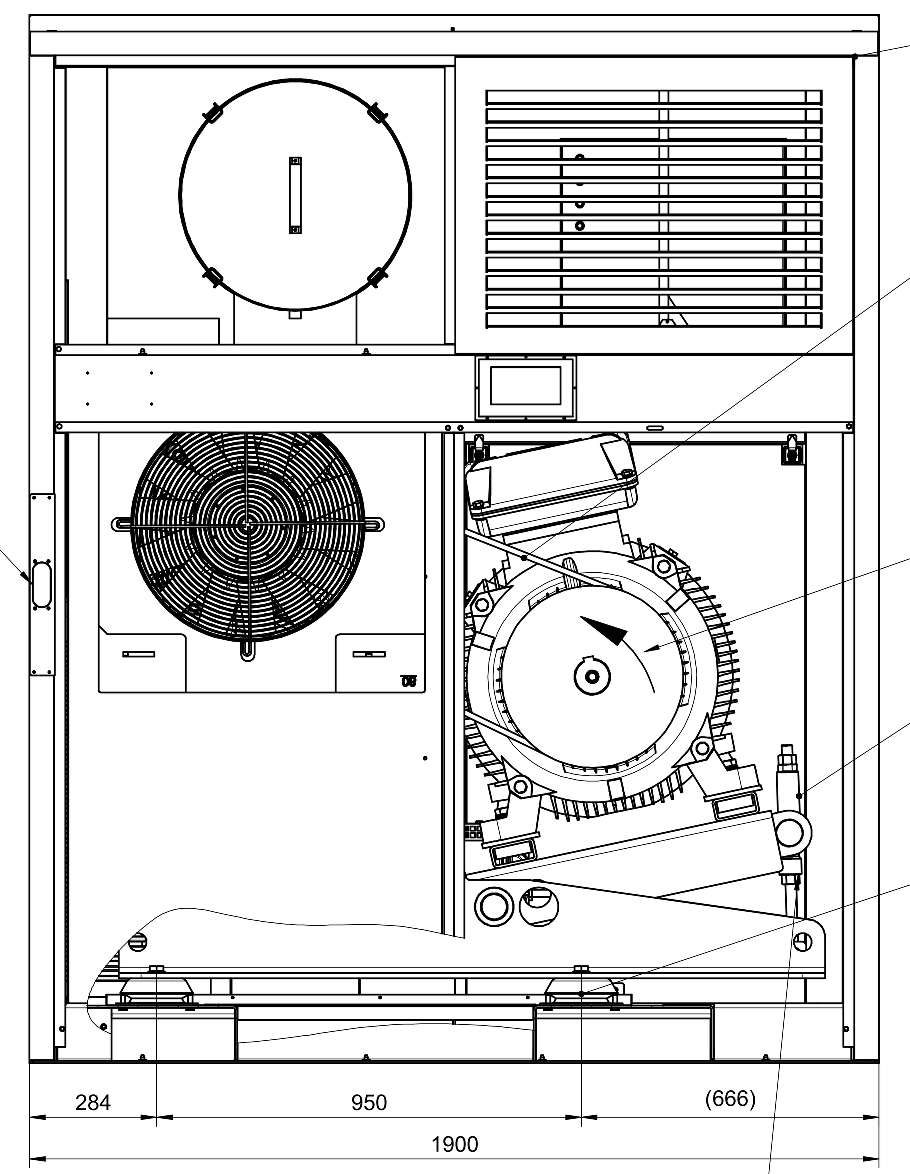
DIMENSIONS													
Primary motor frame	Max motor frame (1	(2	Baseplate	HD	HC	HB	HP	HF	HA	HE	H	G	Weight lbs (3
445T	509LL	449T	12	36.50	97.00	106.25	5.00	99.00	52.75	24.00	1.50	0.69	3020
447T	5011LL	449T	12	36.50	100.00	106.25	5.00	99.00	52.75	24.00	1.50	0.69	3110
447TS	509LS	449TS	12	36.50	98.00	106.25	5.00	99.00	52.75	24.00	1.50	0.69	3020
449T	5011LL	-	12	36.50	106.00	106.25	5.00	99.00	52.75	24.00	1.50	0.69	3110
449TS	509LS	-	12	36.50	103.00	106.25	5.00	99.00	52.75	24.00	1.50	0.69	3020

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.

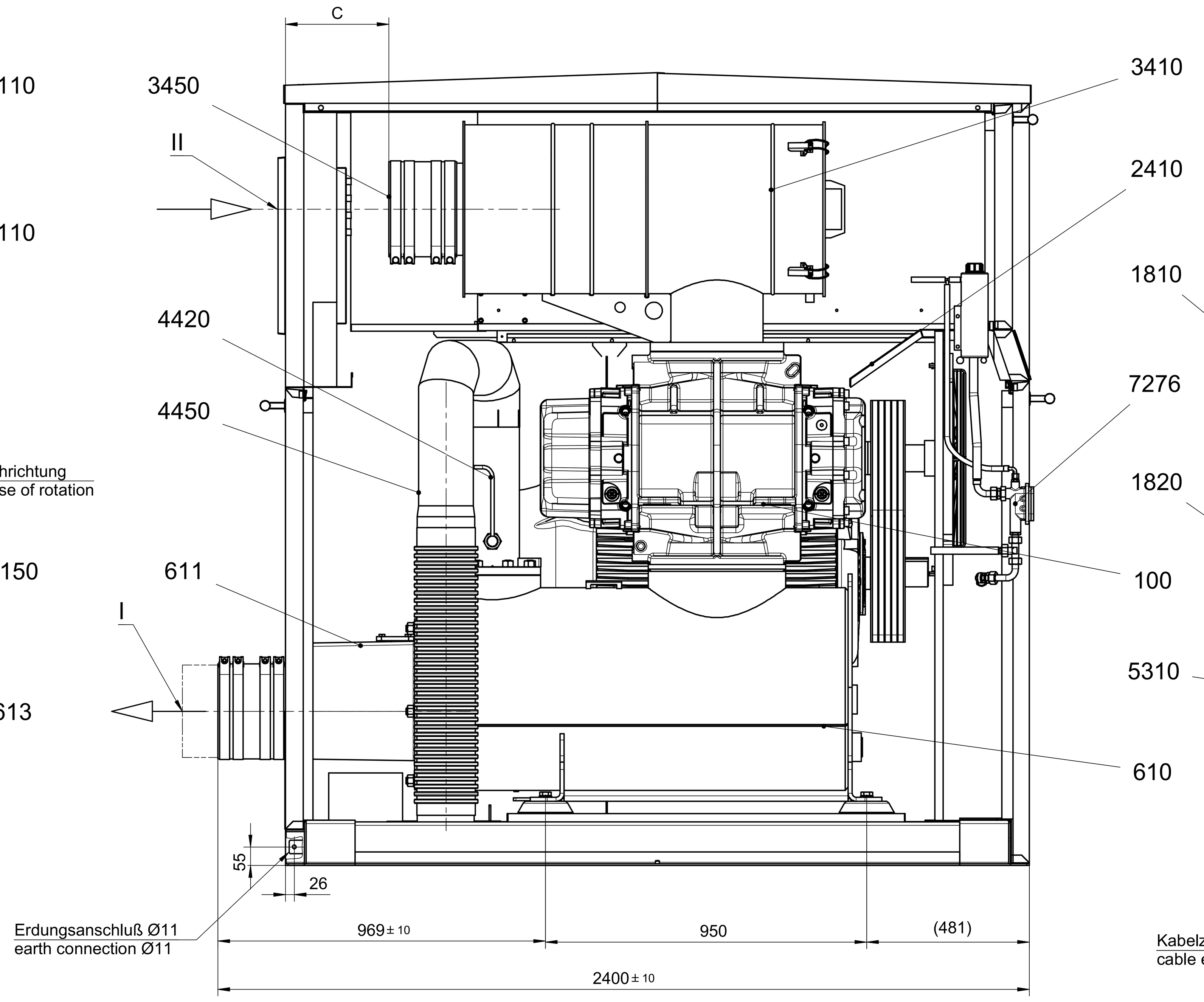
DRILLING OF FLANGES									
				ASME B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	OD	RF	C	BC	d	n	BC	d	n
16.00	23.82	18.98	1.44	21.25	1.12	16	21.25	1.12	16

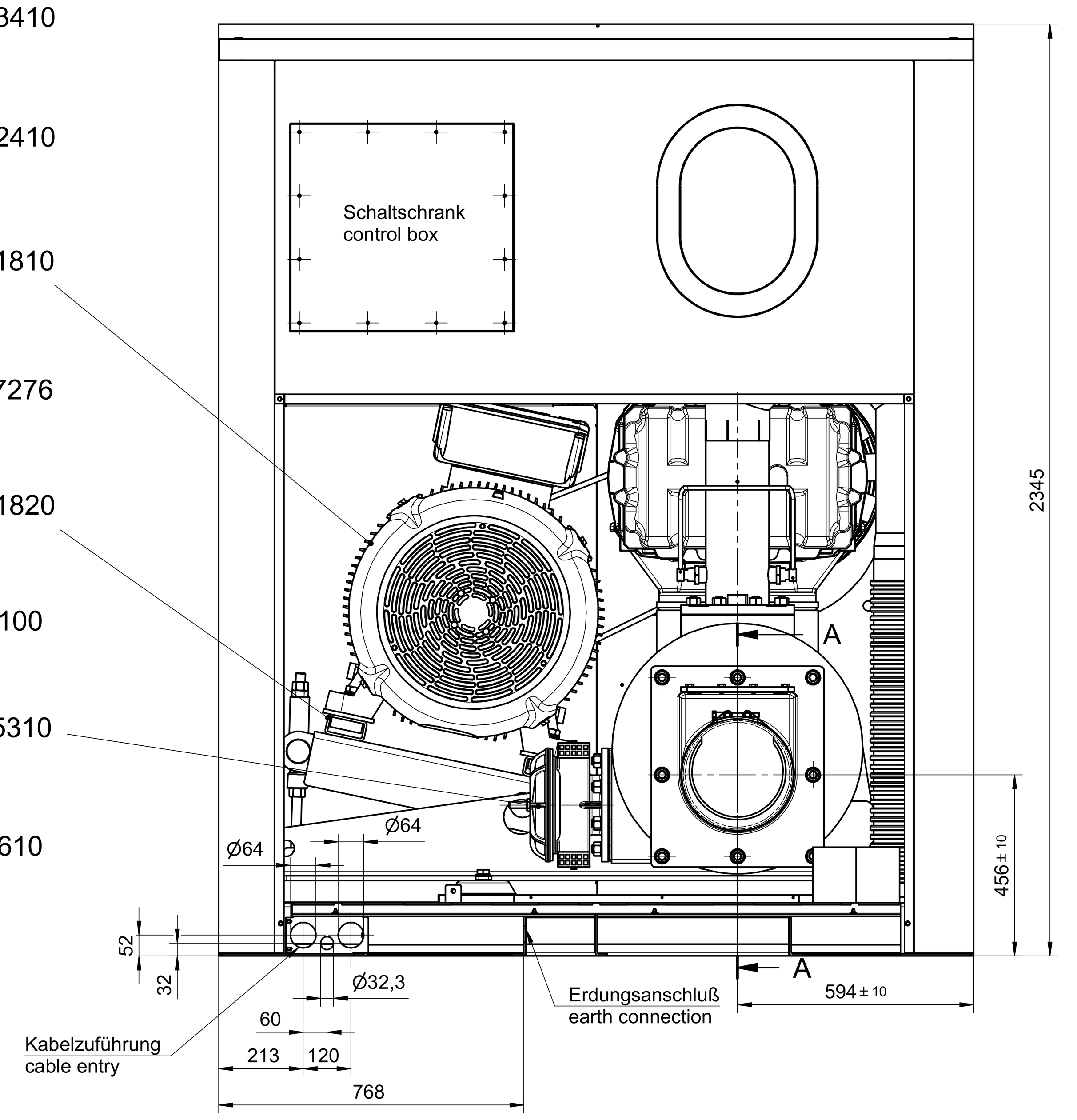
Mit Optionen / with options:

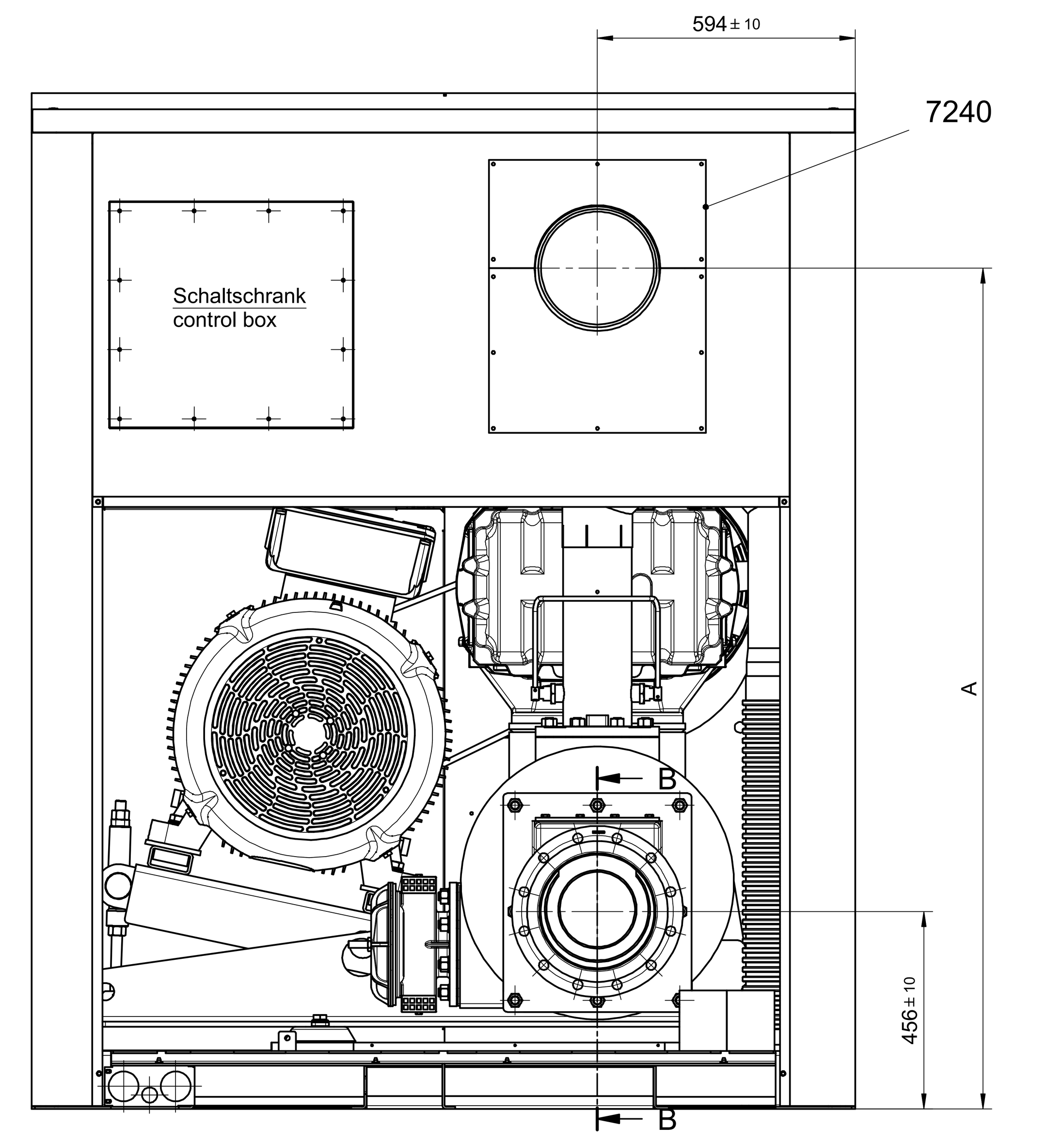
- Rohransaugung + Abdeckblech / pipe suction + cover plate
- Flanschanschluß + Kompensator / flange + compensator



Die Hebevorrichtung ist nach Betriebsanleitung (G4-079) einzustellen!
The lifting equipment must be adjusted to the operating instruktions (G4-079)

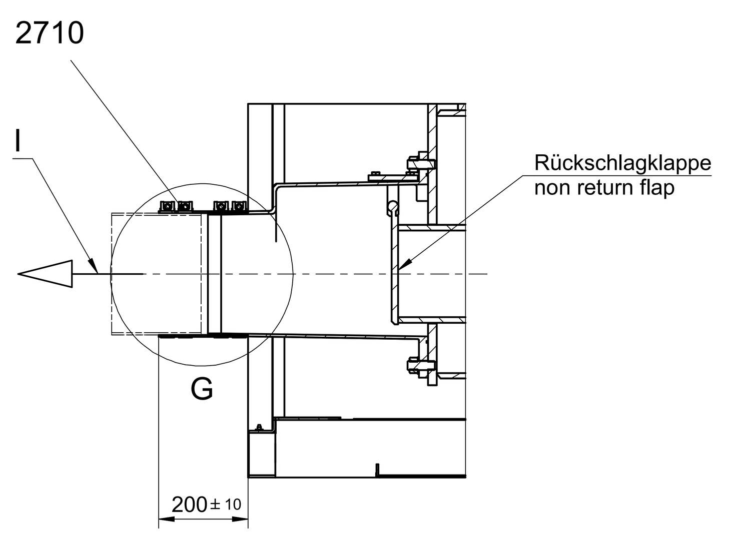


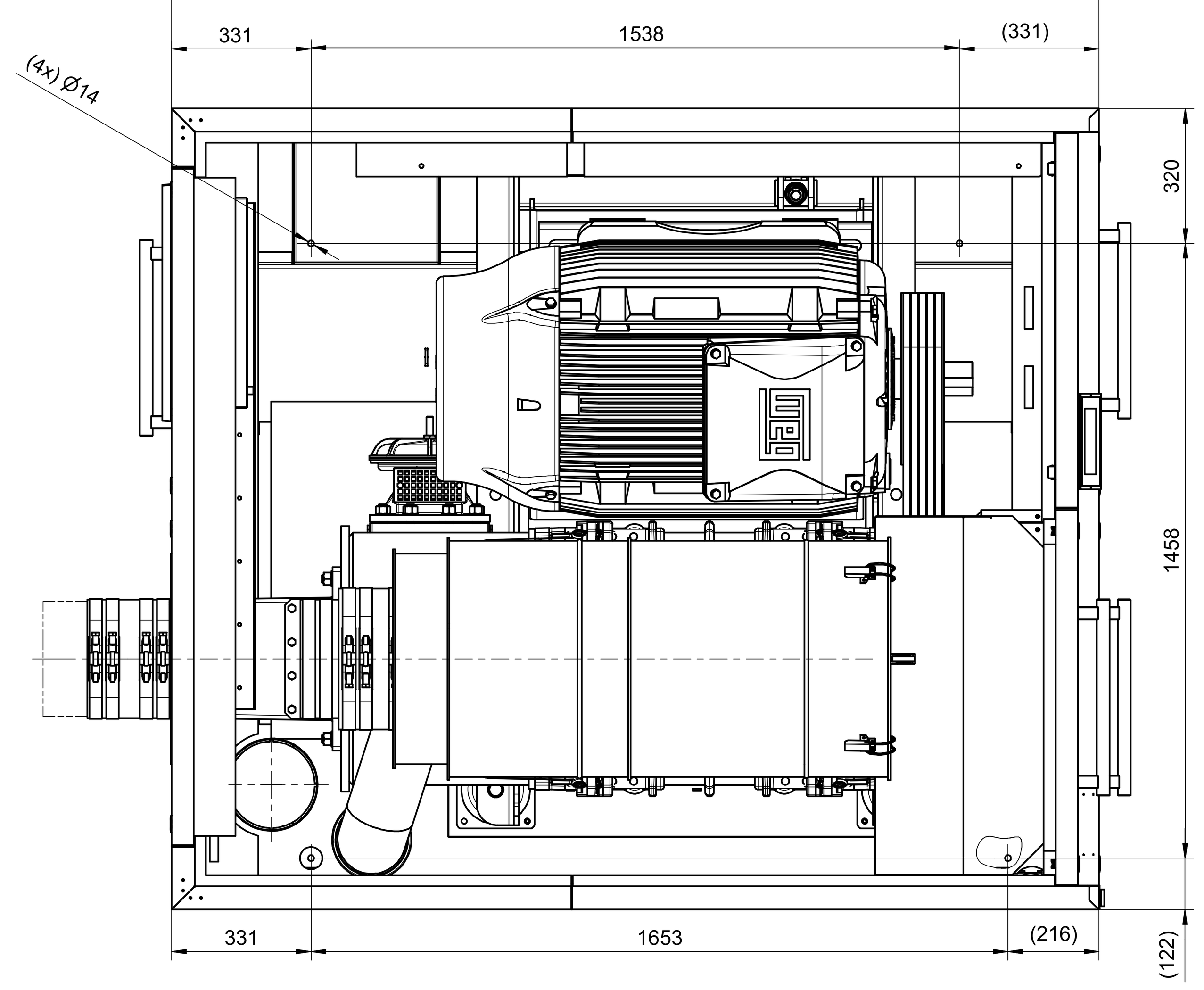




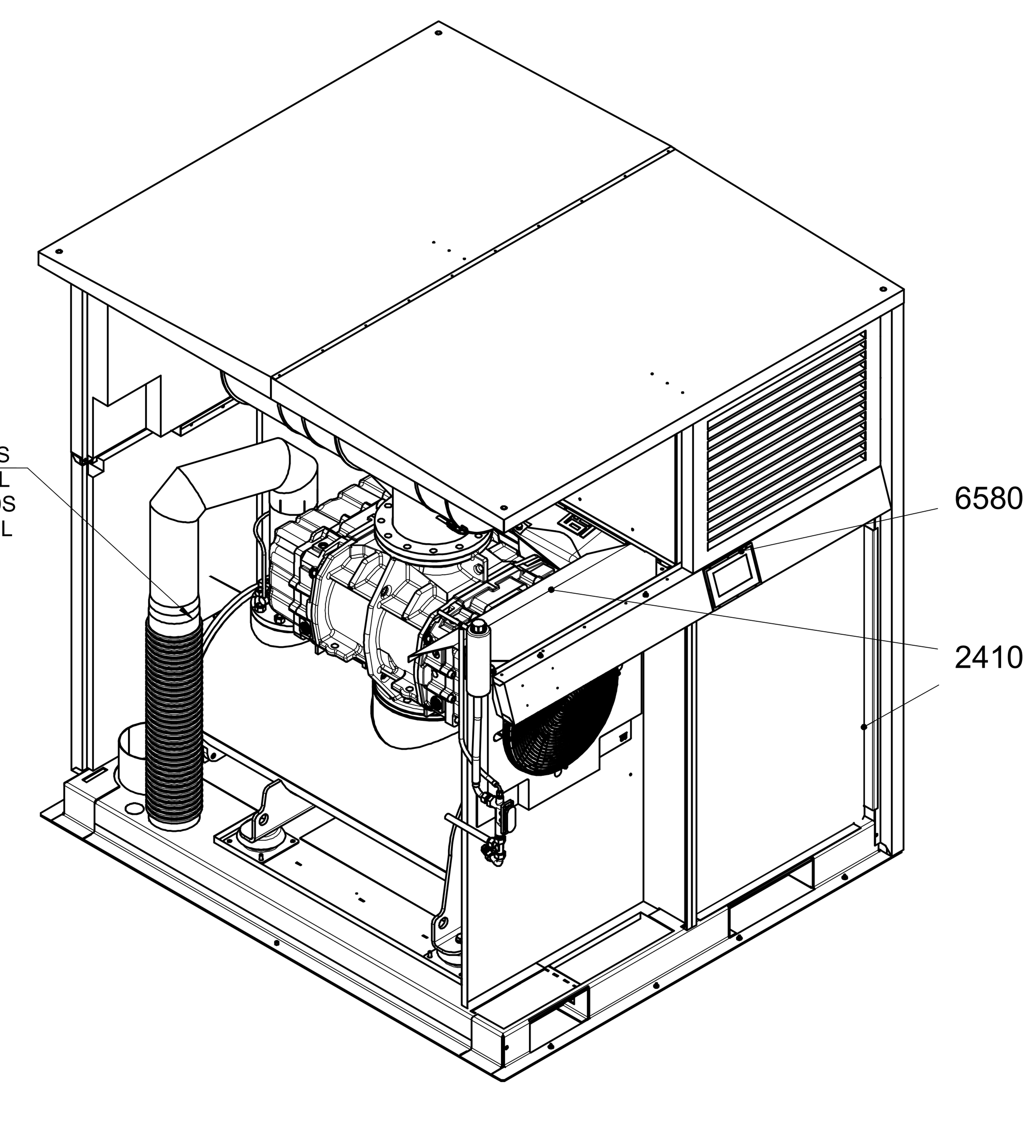
A-A (1 : 10)

Elastische Rohrverbindung mit Muffe
flexible pipe connection with sleeve





3D (1 :15)



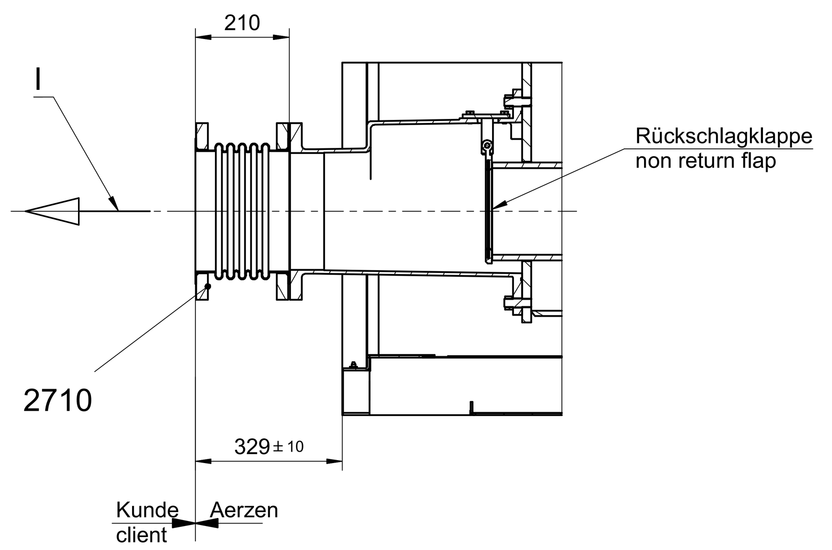
einsetzbar ab 800 mbar bei GM90S
ab 500 mbar bei GM80L
applicable from 800 mbar at GM90S
from 500 mbar at GM80L

	GM80L	GM90S	GM100S
A ± 10	1864	1941	1953
C ± 10	306	306	396

	Stutzentabelle/ socked list	standard		option	option
		GM80L/90S	GM100S		
I	Druckanschluss/ discharge connection	DN250/ Ø273	DN250/ Ø273	DN250 PN10	ANSI 10"- 150lbs.
II	Sauganschluss/ suction connection	DN250/ Ø273	DN300/ Ø323,9	--	--

B-B (1 : 10)

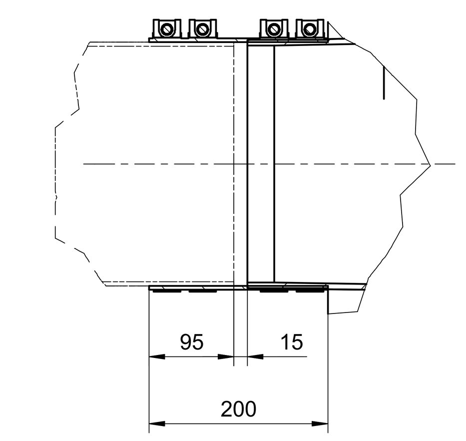
Elastische Rohrverbindung mit Axialkompensator (Option)
flexible pipe connection with axialcompensator (optional)

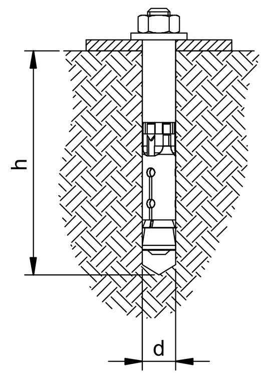


Unabhängig vom Betriebszustand dürfen keine Kräfte und Momente
durch die angeschlossenen Systemrohrleitungen auf die Maschine einwirken.
Alle Systemrohranschlüsse sind an der Liefergrenze als Fixpunkt auszuführen.

Irrespective of the operating condition, no forces and torques
may act on the machine through the connected system piping.
All system pipe connections must be designed as fixed points at the delivery limit.

G (1 : 5)





Aggregatsbefestigung für FH II 15/10B
Fischer Hochleistungsanker
Bohrlochdurchmesser: d = 15mm
min. Bohrlochtiefe: h = 100mm
(nicht Lieferanteil AM)

aggregat mounting for FH II 15/10B
fischer high performance anchor
drill hole diameter: d = 15mm
min. drill hole depth: h = 100mm
(not included in Aerzen's scope of supply)

Freiraum für Wartungsarbeiten Stirnseitig min. 800mm
Free space for maintenance work at front side of unit 800mm min.

Die Fundamentoberfläche muß eben und horizontal sein !
The foundation surface has to be even and horizontal !

Alle kundenseitigen Anschlüsse sind spannungs- & momentenfrei zu montieren!
All connections provided by the customer are to be mounted stress-relieved and moment-free!

Pos	Beschreibung	description
151	Abdeckblech	
7276	Ölstandanzeiger	oil level indicator
7240	Abdeckblech	cover plate
7210	Ventilator	fan
7110	Schallhaube	acoustic hood
6580	Aerzener Steuerung Aertronic	
5310	Anfahrentlastung	no load starting device (soft start)
4450	Rohrverbindung für Ventil	pipe connection for valve
4420	Ventil	valve
3450	Elastische Rohrverbindung SS	flexible pipe connection SS
3410	Filterschalldämpfer	filter silencer
2410	Riemenschutz	belt guard
2150	Hebevorrichtung	lifting device
2110	Riementrieb	belt drive
1820	Motorbefestigung	motor connection
1810	Motor	motor
611	Anschlussgehäuse	connection housing
610	Grundträger	base frame
100	Gebläse	Blower

AERZEN

Allgemeintoleranzen: ISO 2768-mH, ISO 13920, ISO 8015; Schutzvermerk nach ISO 16016
Maßstab: 1 : 10
Option: Rohransaugung
Achtung! Kopie muss nicht maßstäblich sein!
Dokumententyp: Aggregatszeichnung
Dokumentenstatus: Fert. Freigabe
Labor/Büro: 110

Inventor - Zeichnung
Änderung nur mittels Inventor !

	Datum	Name
Erstellt durch:	07.04.2022	JUGAN_N
Genehmigt von:	04.05.2022	FUCHS_T
Änderungs-Nr.:	000000104410	
Alte Dokument-Nr.:		

Delta Blower
DN250 Schallhaube - Aertronic
GM100S | GM80L | GM90S

		Version	Format	Sprache	Blatt
4000435223	000	03	A0	DE	1

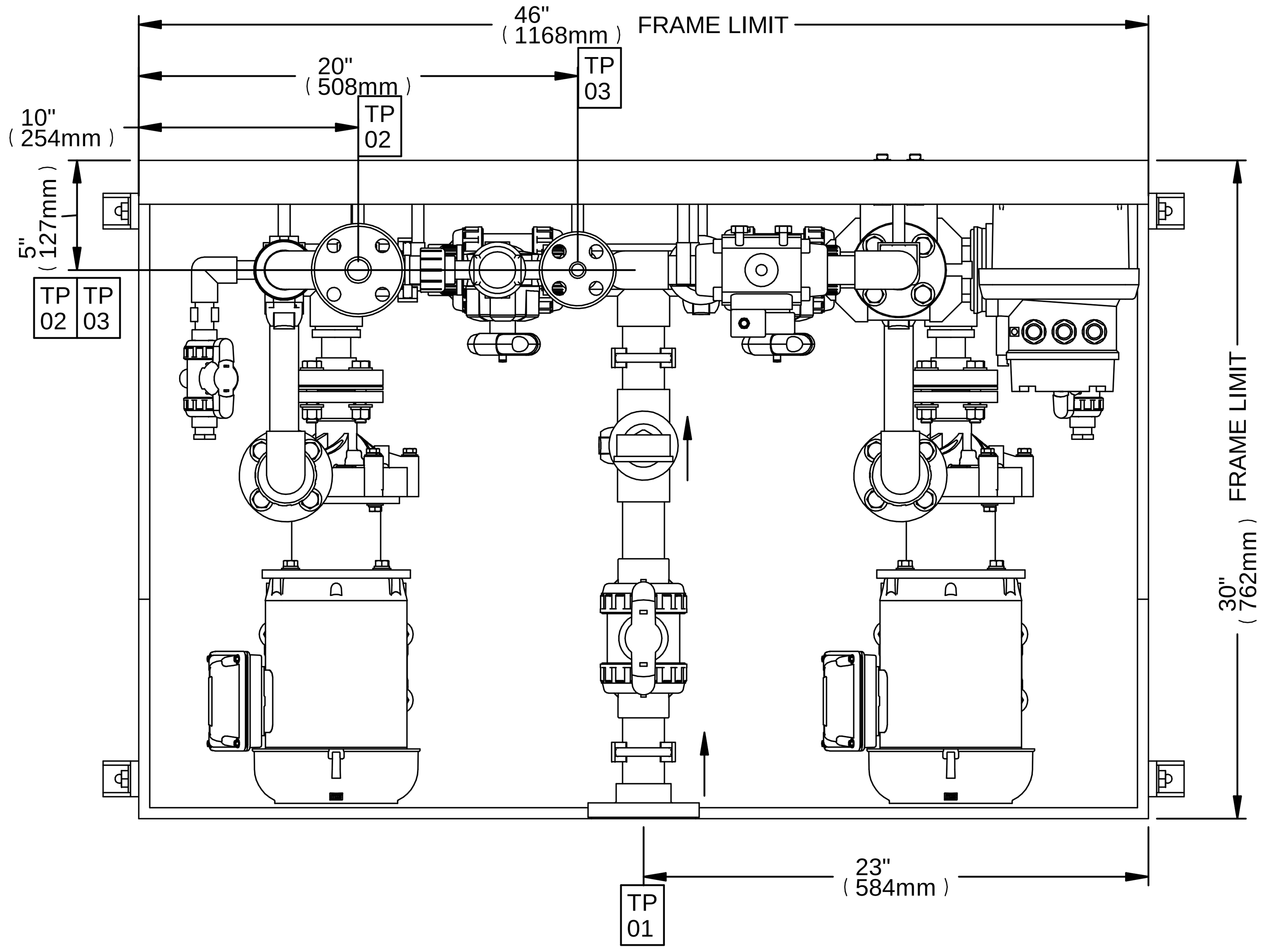
PN: 1122686

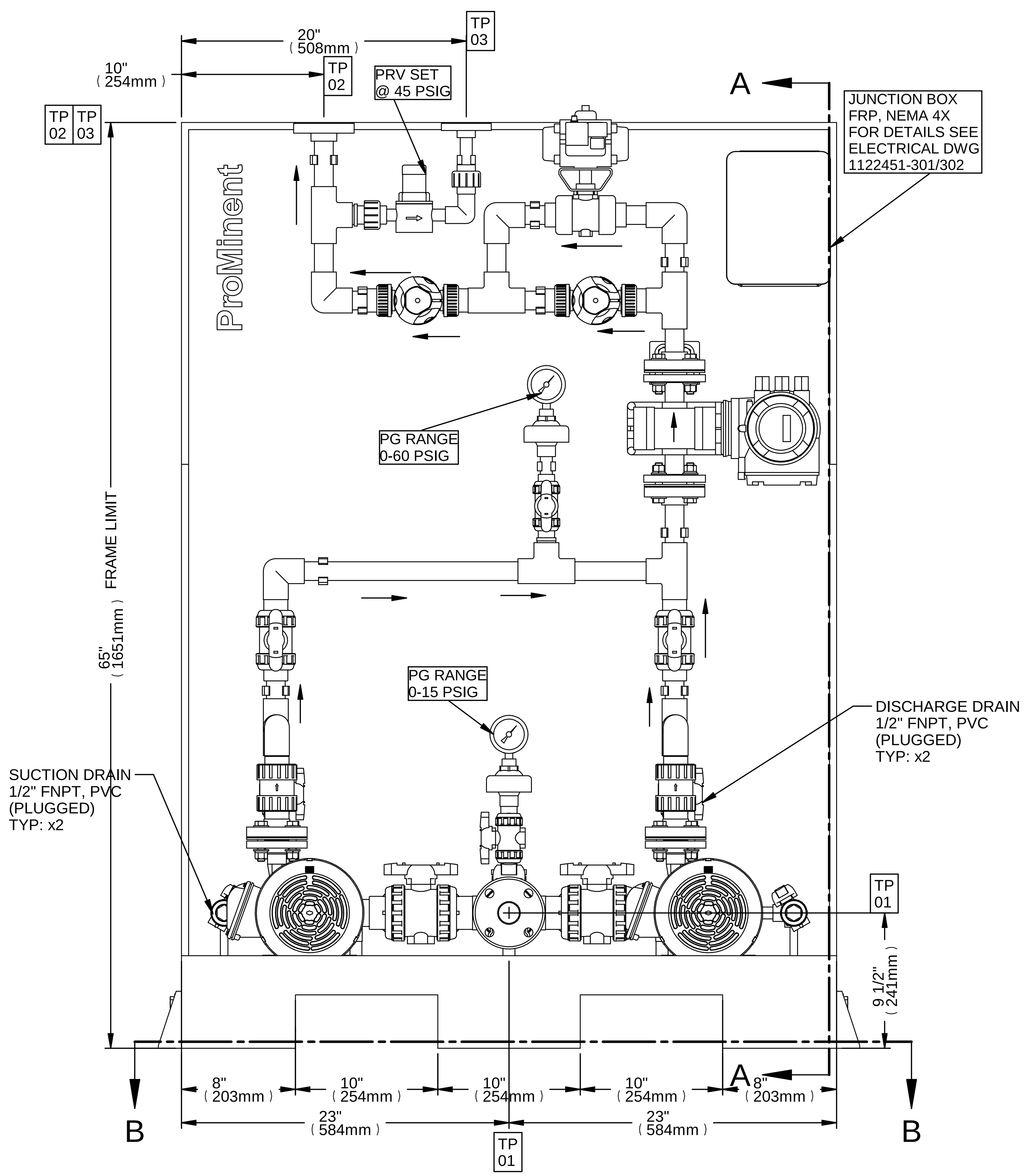
TERMINATION POINT SCHEDULE		
NOZZLE(TP)	SERVICE	CONNECTION
01	SUCTION / INLET	1-1/2" FF FLANGE, 150#, PVC
02	DISCHARGE / OUTLET	1" FF FLANGE, 150#, PVC
03	PSV RELIEF OUTLET	1/2" FF FLANGE, 150#, PVC

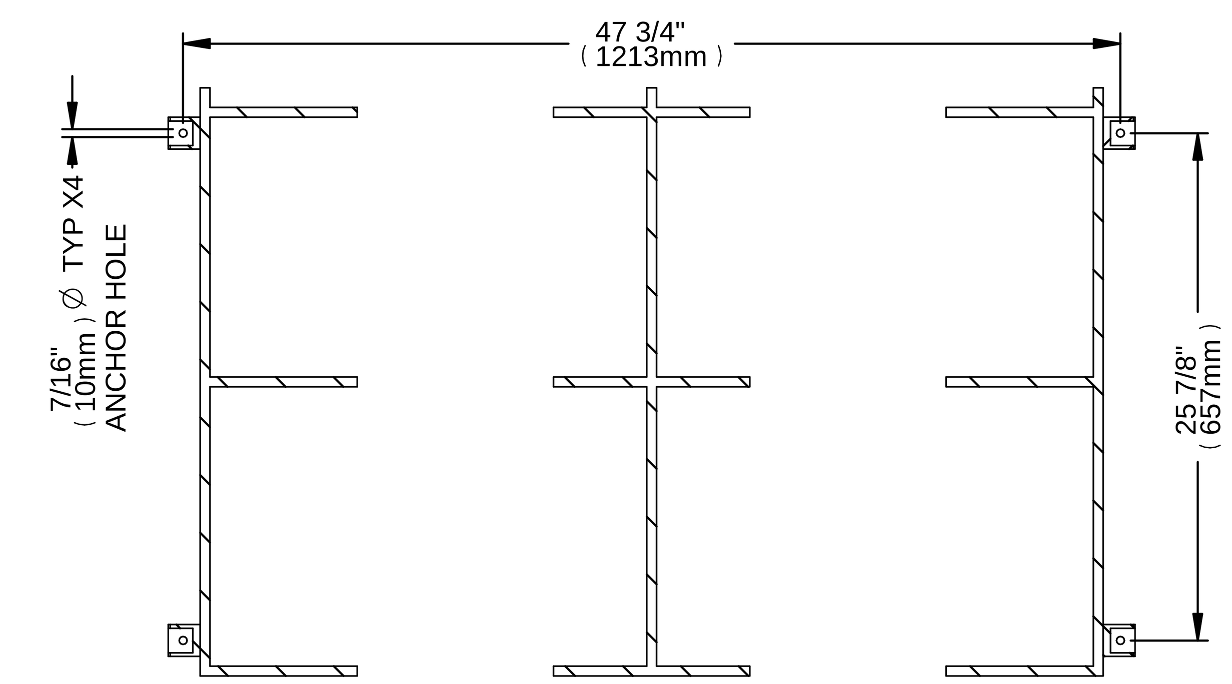
MAG DRIVE CENTRIFUGAL PUMP
MODEL: DB9V-R-E-FF-M272
MAXIMUM FLOW: 46 USGPM @ HEAD 11FT
MINMUM FLOW: 0.5 USGPM @ HEAD 67FT
CONSTRUCTION MATERIALS: PVDF/EPDM O-RING
MOTOR: 3435 RPM,1 HP (0.75 kW), 575V,60 Hz, 3 Ph
TYP: x2 (DUTY / STANDBY)

NOTE:SYSTEM OPERATING CONDITIONS ARE DIFFERENT FROM PUMP PERFORMANCE CURVE.
PLEASE REFER TO DRAWING NOTES ON SECOND PAGE FOR SYSTEM OPERATING & DESIGN CONDITIONS

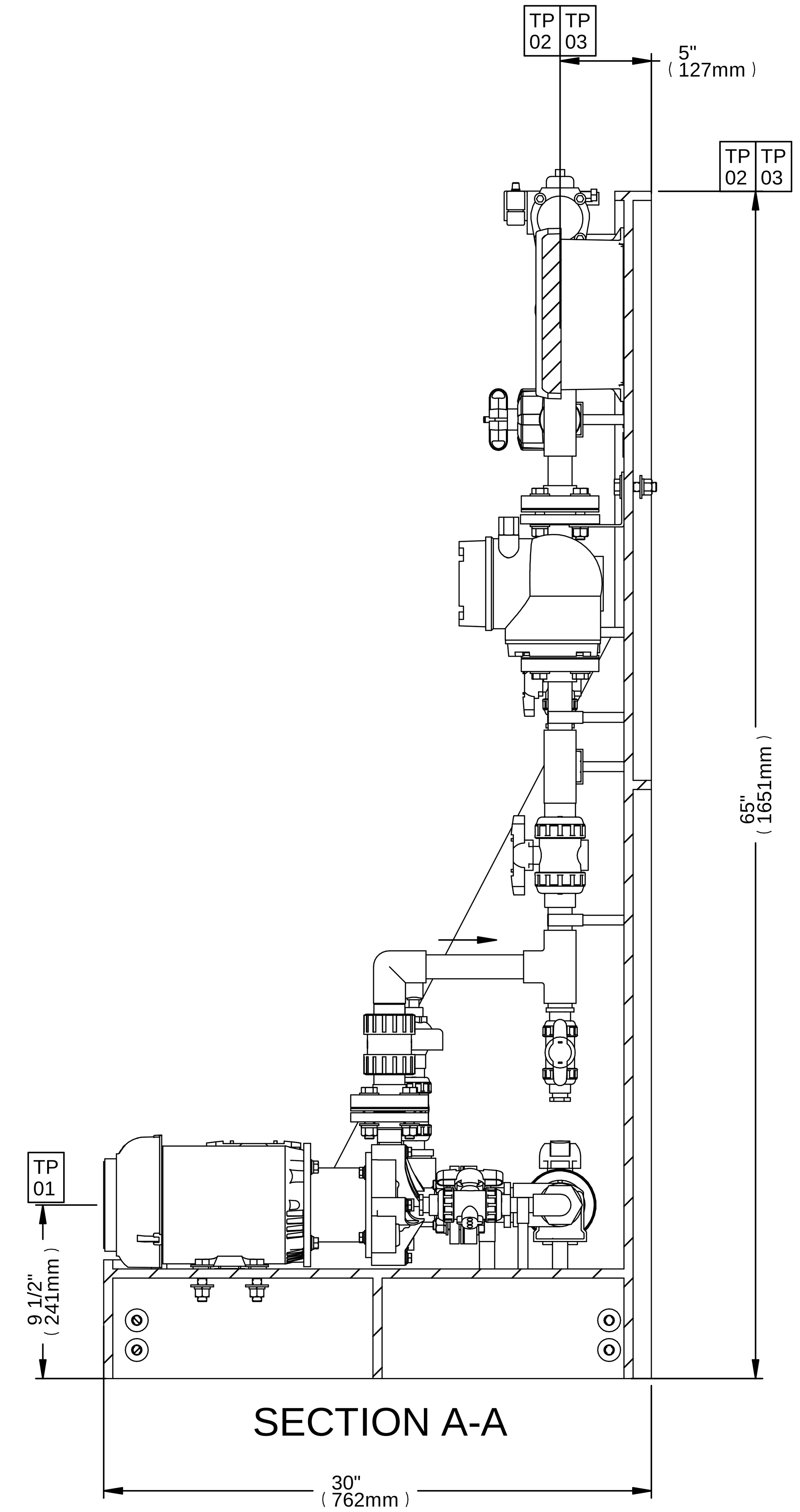
CITRIC ACID SYSTEM



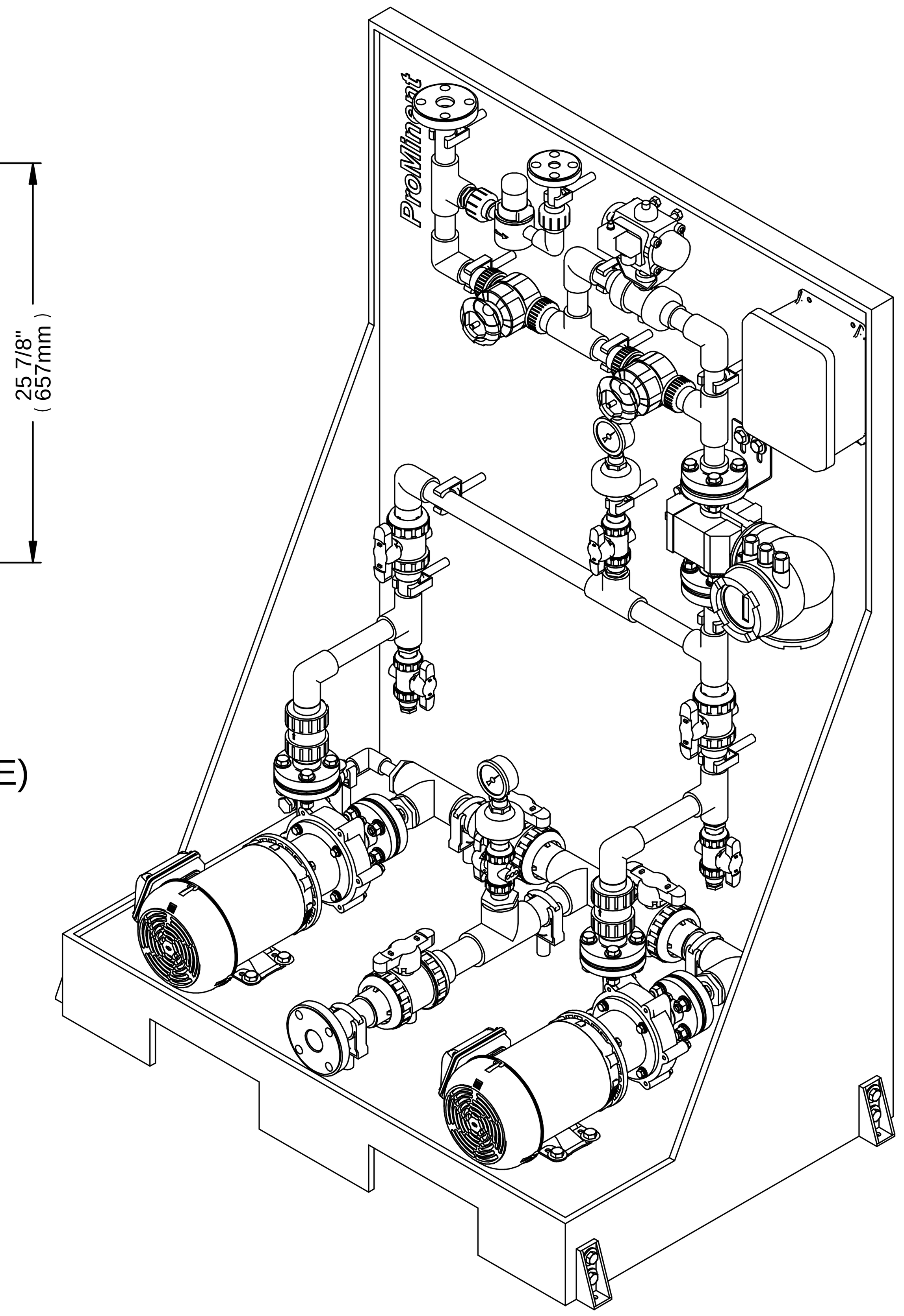




SECTION B-B
FOOTPRINT
USE QTY:4, 3/8" BOLTS
(ANCHOR BOLTS NOT IN PROMINENT SCOPE)



SECTION A-A



REV	DATE (YYYY-MM-DD)	DESCRIPTION	BY	APPD	REVD
2	2023-07-25	UPDATED MAGNETIC FLOW METER	GB	AG	
1	2022-08-19	REVISED NOTE 7	GB	RJ	
0	2022-03-15	INITIAL RELEASE	GB	RJ	

REVISIONS

CUSTOMER
VEOLIA WATER TECHNOLOGIES & SOLUTIONS

SUBJECT: ---
PFC PROSIP No: 1122686
PURCHASE ORDER No: --
PURCHASER'S EQUIP. No

TITLE
VEOLIA MAGDRIVE-F PVC-EPDM, 2P 575V - GENERAL ARRANGEMENT DRAWING -

ENGINEERS SEAL

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490 SOUTHGATE DRIVE.
GUELPH, ONTARIO, CANADA
N1G 4P5
TEL. 519 836 5692 FAX. 519 836 5226

PROMINENT FLUID CONTROLS INC.
136 INDUSTRY DRIVE,
PITTSBURGH P.A., USA.
15275
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	GB	APPROVED	
DRAWN	GB	SCALE	NTS
SHEET No: 1/2	CHECKED RJ	DATE (YYYY-MM-DD)	2022-03-15
CUSTOMER DWG No: ---	PFC DWG No: 1122686-200- 1	REV	2

PN: 1122686

COMPONENT LIST — *PART IS HIDDEN FROM VIEW

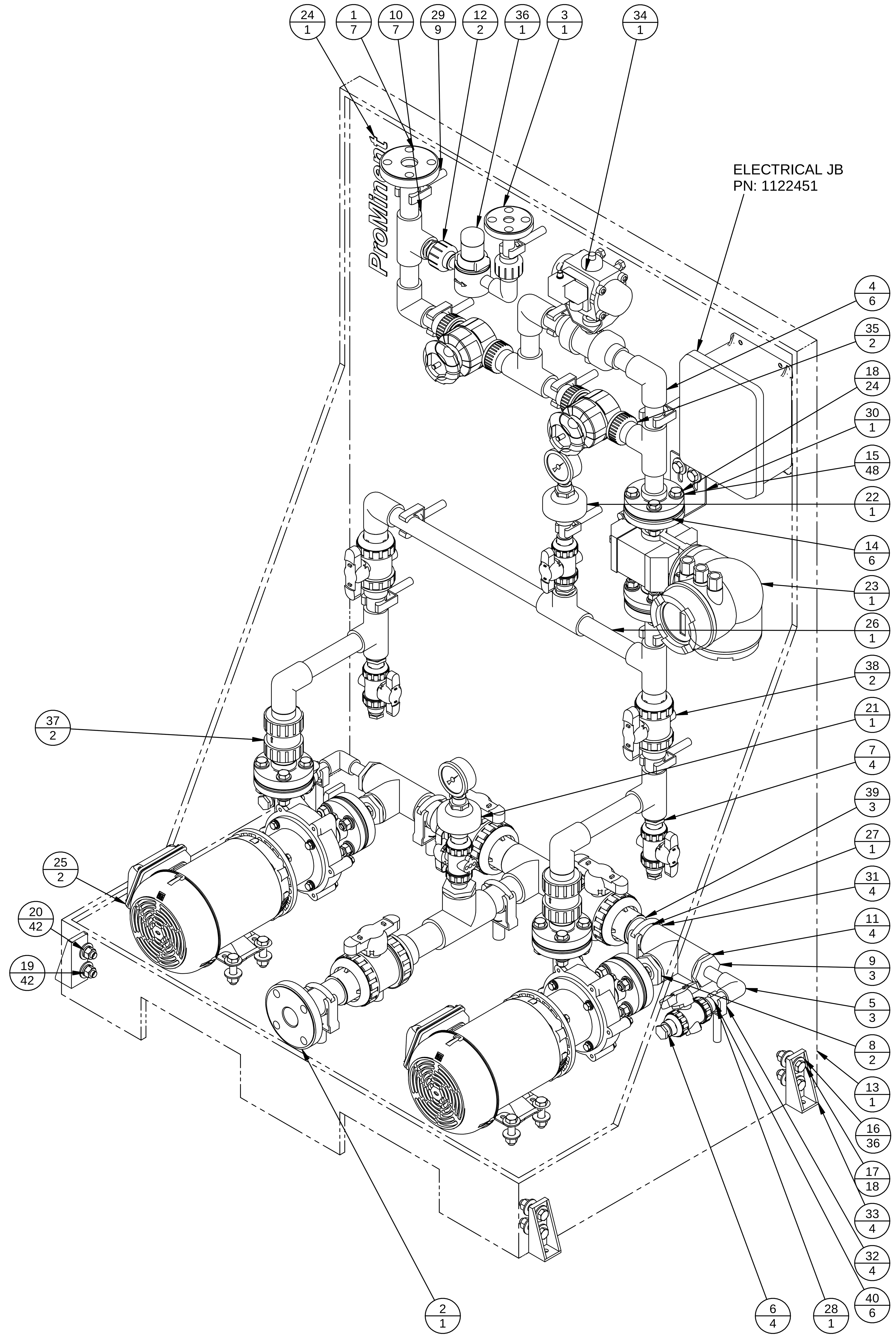
ITEM	PART #	DESCRIPTION	QTY
1	7740695	FITTING: 1" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	7
2	7900948	FITTING: 1-1/2" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	1
3	7741396	FITTING: 1/2" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	1
4	7741327	FITTING: ELBOW, 1" SWxSW, PVC, SCH 80	6
5	7260006	FITTING: ELBOW, 1/2" SWxSW, PVC, SCH 80	3
6	7000325	FITTING: PLUG 1/2" MNPT PVC SCH 80	4
7	7741358	FITTING: REDUCER BUSHING, 1" SPIG x 1/2" SW, PVC SCH80	4
8	7900952	FITTING: REDUCER BUSHING, 1-1/2" SPIG x 1" SW, PVC SCH80	2
9	7900950	FITTING: REDUCER BUSHING, 1-1/2" SPIG x 1/2" SW, PVC SCH80	3
10	7741333	FITTING: TEE, 1" SWxSWxSW, PVC, SCH80	7
11	7741442	FITTING: TEE, 1-1/2" SWxSWxSW, PVC, SCH 80	4
12	7260035	FITTING: UNION, 1/2" SWxSW, PVC, EPDM, SCH80	2
13	1122575	FRAME: MAG DRIVE 2 PUMP, 65" x 46" x 30", BLACK PE	1
14	7904559	GASKET: 1", FULL FACE, 150#, 1/8" THICK, EPDM	6
15	7902194	HARDWARE: FLAT WASHER, 1/2", 1.060" OD, 316 SS	48
16	7900011	HARDWARE: FLAT WASHER, 1/2", 316 SS	36
17	7902724	HARDWARE: HEX CAP SCREW, 1/2"-13, 2" LG, 18-8 SS, 1-1/4" THREAD LG	18
18	7900847	HARDWARE: HEX CAP SCREW, 1/2"-13, 2.5"LG, 18-8 SS, 1" THREAD LG	24
19	7900015	HARDWARE: HEX NUT, 1/2"-13, 18-8 SS	42
20	7900012	HARDWARE: LOCK WASHER, 1/2", 18-8 SS	42
21	1121677	INSTRUMENT: 2 -1/2" PRESSURE GAUGE, 0-15 PSIG, 304SS CASE, 316SS INTERNALS, REMOVEABLE BEZZEL 1/4" MNPT BOTTOM MOUNT, SILICONE OIL FILL WITH PVC ISOLATOR, 1/2" SOCKETWELD PROCESS CONNECTION, 1/4" FNPT GAUGE CONNECTION, GLYCERINE FILL, WIKA	1
22	1121678	INSTRUMENT: 2 -1/2" PRESSURE GAUGE, 0-60 PSIG, 304SS CASE, 316SS INTERNALS, 1/4" MNPT BOTTOM MOUNT, SILICONE OIL FILL WITH PVC ISOLATOR, 1/2" SOCKETWELD PROCESS CONNECTION, 1/4" FNPT GAUGE CONNECTION, GLYCERINE FILL, WIKA	1
23	1130776 + 1122667 + 1122667	INSTRUMENT: MAGNETIC FLOW METER, PROMAG P 300, 5P3B25, DN25, INTEGRAL UNIT, 1" FLANGE 150# CONNECTIONS-SS(NON WETTED, PTFE LINER ANSI B16.5, CONNECTIONS, INTEGRAL MOUNTED NEMA-4X ENCLOSURE WITH LCD DISPLAY, 4-20mA OUTPUT, HART PROTOCOL, WITH TWO ALLOY C22 GROUND DISKS. 24VDC - ENDRESS-HAUSER PN: 5P3B25-CSIBAEAFADEA1SHAA1+AAZ1 + DK5GD-25BEL	1
24	7900315	LABEL: PROMINENT LOGO, WHITE & ORANGE x 1-7/8"H, VINYL	1
25	1122485	MAG DRIVE CENTRIFUGAL PUMP, 1" 150# RFSO, PVDF IMPELLER, EPDM, 575V, 3 Ph, 60 Hz, FINISH THOMPSON INC.	2
26	7741324	PIPE: 1", PVC, SCH80	8FT
27	7741447	PIPE: 1-1/2", PVC, SCH80	4FT
28	7741400	PIPE: 1/2", PVC, SCH80	2FT
29	7741318	SUPPORT: 1" (32mm) PIPE CLIP WITH 1/4" x 2-1/4" PVC PIPE STANDOFF	9
30	1122577	SUPPORT: 1"FLANGE SUPPORT BRACKET, TYPE 1, 304 SS	1
31	7741590	SUPPORT: 1-1/2" (50mm) PIPE CLIP WITH 1/2" x 1-1/2" PVC PIPE STANDOFF	4
32	7260010	SUPPORT: 1/2" (20mm) PIPE CLIP WITH 1/4" x 2-1/2" PVC PIPE STANDOFF	4
33	7900388	SUPPORT: FRP INSIDE CORNER GUSSET 1-5/8" x4", 3 HOLE	4
34	1122519	VALVE: 1" ACTUATOR PNEUMATIC, PA SERIES, PAS00, ON 1" PVC/EPDM, TYPE 21 UNION BALL VALVE, WITH PAD MOUNTED SOLENOID VALVE. 24 VDC - CHEMLINE,	1
35	1116853	VALVE: 1" DIAPHRAGM VALVE, PVC/EPDM, TYPE 514 PVC-U, SOCKET WELD ASTM, TRUE UNION. - GEORG FISCHER	2
36	1019883	VALVE: BACK PRESSURE VALVE, 1/2" SW CONNECTION, BODY MATERIAL PVC, PRESSURE RANGE 0-150PSI, PROMINENT	1
37	7903817	VALVE: BALL CHECK VALVE, 1" SW, TRUE UNION, BODY MATERIAL PVC, SEALS EPDM, CHEMLINE	2
38	7152157	VALVE: BALL VALVE, 1" SW, BODY MATERIAL PVC, SEALS EPDM, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	2
39	7904867	VALVE: BALL VALVE, 1-1/2" SW, BODY MATERIAL PVC, SEALS EPDM, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	3
40	7901183	VALVE: BALL VALVE, 1/2" SW, BODY MATERIAL PVC, SEALS EPDM, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	6

SHIPPED LOOSE ITEMS

ITEM	PART #	DESCRIPTION	QTY
SL	1062205	DEVICE: 1-1/2" TRUE UNION Y SEDIMENT STRAINER, PVC/EPDM SW	1

MAG DRIVE CENTRIFUGAL PUMP
MODEL: DB9V-R-E-FF-M272
MAXIMUM FLOW: 46 USGPM @ HEAD 11FT
MINMUM FLOW: 0.5 USPGM @ HEAD 67FT
CONSTRUCTION MATERIALS: PVDF/EPDM O-RING
MOTOR: 3435 RPM,1 HP (0.75 kW), 575V,60 Hz, 3 Ph
TYP: x2 (DUTY / STANDBY)

1 TOP SIDE = CHART NUMBER
2 BOTTOM SIDE = QUANTITY NUMBER



NOTES:

1. SYSTEM IS DESIGNED, FABRICATED, TESTED AND INSPECTED AS PER PROMINENT STANDARD
2. PIPING MATERIAL IS PVC SCH 80 IN CONFORMANCE WITH ASTM D 1785 (FOR PHYSICAL DIMENSIONS, TEST REQUIREMENTS AND MAXIMUM OPERATING PRESSURE) IN SIZES1-1/2",1" & 1/2" PIPE.
   ALL CONNECTIONS ARE 1-1/2", 1" & 1/2" SCH 80 PVC SOCKET WELD UNLESS OTHERWISE REQUIRED BY PIPELINE DEVICES.UNIONS ARE TRUE UNION STYLE, SCH80 PVC WITH EPDM O-RING SEAL RATED FOR 150 PSIG. FLANGES ARE PVC, FULL FACE, CLASS 150, ASME/ANSI B16.5.
3. GASKETS ARE FULL FACE TYPE, CLASS 150, EPDM, 1/8" THK FOR FLANGE CONNECTION, ASME B16.20.
4. BOLTING ARE 18-8 SS HEX CAP SCREW WITH FLAT WASHER, LOCK WASHER AND 18-8 SS HEX NUT.
5. PUMP AND PIPING SUPPORT FRAME IS CONSTRUCTED OF BLACK POLYETHYLENE. MATERIAL THICKNESS: 1/2" [13MM].AND IS FABRICATED BY WELD CONSTRUCTION.
6. ALL INTERCONNECTING PIPE & FITTINGS AND WIRING BY OTHERS.
7. ALL SEAL MATERIAL IS PTFE/EPDM UNLESS SPECIFIED BY CUSTOMER.
8. TOLERANCE ON ALL TERMINATION POINTS: +/-10mm (+/-3/8").

   APPROX.SHIPPING WEIGHT: 285 LB (129 Kg).
   APPROX.OPERATING WEIGHT: 310LB (140 Kg).

DESIGN NOTES:

SYSTEM OPERATING CONDITIONS ARE DIFFERENT FROM PUMP PERFORMANCE CURVE
MAXIMUM SYSTEM OPERATING FLOW: 30 USGPM @ 14 PSIG
MINIMUM SYSTEM OPERATING FLOW: 0.5 USGPM @ 29 PSIG

UPSTREAM INJECTION PUMP-SUCTION:

- DESIGN TEMPERATURE: MIN. 15ºC TO MAX. 25ºC
- DESIGN PRESSURE: 14.7 PSIG
- MIN. TEST PRESSURE: 25 PSIG

DOWNSTREAM INJECTION PUMP-DISCHARGE:

- DESIGN TEMPERATURE: MIN. 15ºC TO MAX. 25ºC
- DESIGN PRESSURE: 45 PSIG
- MIN. TEST PRESSURE: 55 PSIG

TESTING CONDITION:

- TEST TYPE: HYDROSTATIC
- TEST MEDIUM: WATER
- TEST TEMPERATURE: AMBIENT 68ºF (20ºC)
- TEST DURATION: 10 MIN. (MINIMUM)

CORROSION ALLOWANCE: 0.0" (0.0mm).

REVISIONS

REV	DATE (YYYY-MM-DD)	DESCRIPTION	BY	APPD	REVD
2	2023-07-25	UPDATED MAGNETIC FLOW METER	GB	AG	
1	2022-08-19	REVISED NOTE 7	GB	RJ	
0	2022-03-15	INITIAL RELEASE	GB	RJ	

CUSTOMER: VEOLIA WATER TECHNOLOGIES & SOLUTIONS

SUBJECT: ---

PFC PROSIP No: 1122686
PURCHASE ORDER No: --
PURCHASER'S EQUIP. No

TITLE: VEOLIA MAGDRIVE-F PVC-EPDM, 2P 575V
- BILL OF MATERIALS -

ENGINEERS SEAL

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GUELPH - ONTARIO - CANADA

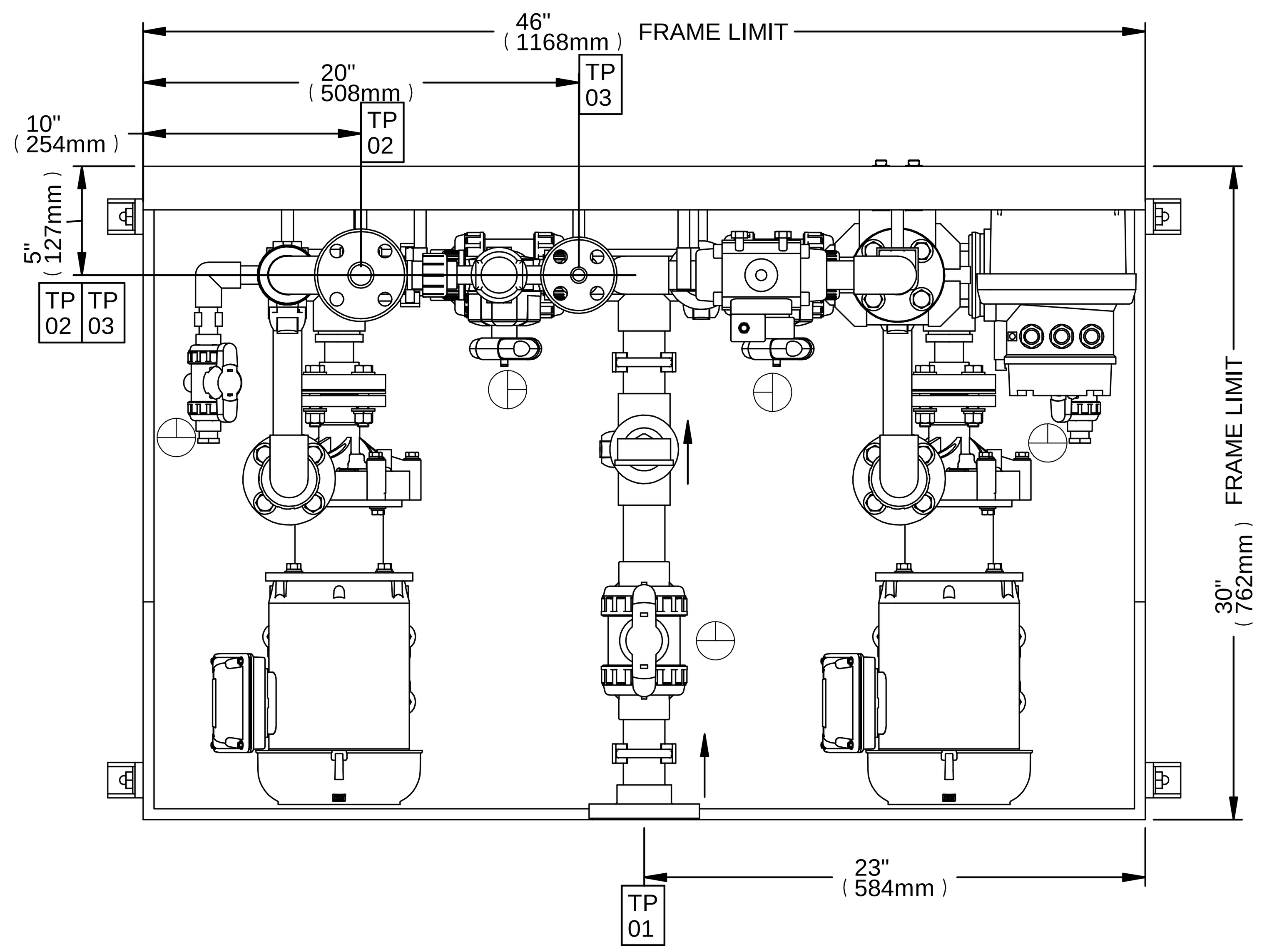
PROMINENT FLUID CONTROLS LTD.
490 SOUTHGATE DRIVE.
GUELPH, ONTARIO, CANADA
N1G 4P5
TEL. 519 836 5692 FAX. 519 836 5226

PROMINENT FLUID CONTROLS INC.
136 INDUSTRY DRIVE,
PITTSBURGH P.A., USA.
15275
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	GB	APPROVED	
DRAWN	GB	SCALE	NTS
SHEET No: 2/2	CHECKED RJ	DATE (YYYY-MM-DD)	2022-03-15

CUSTOMER DWG No: ---
PFC DWG No: 1122686-200- 2
REV: 2

PN: 1122684



TERMINATION POINT SCHEDULE		
NOZZLE(TP)	SERVICE	CONNECTION
01	SUCTION / INLET	1-1/2" FF FLANGE, 150#, PVC
02	DISCHARGE / OUTLET	1" FF FLANGE, 150#, PVC
03	PSV RELIEF OUTLET	1/2" FF FLANGE, 150#, PVC

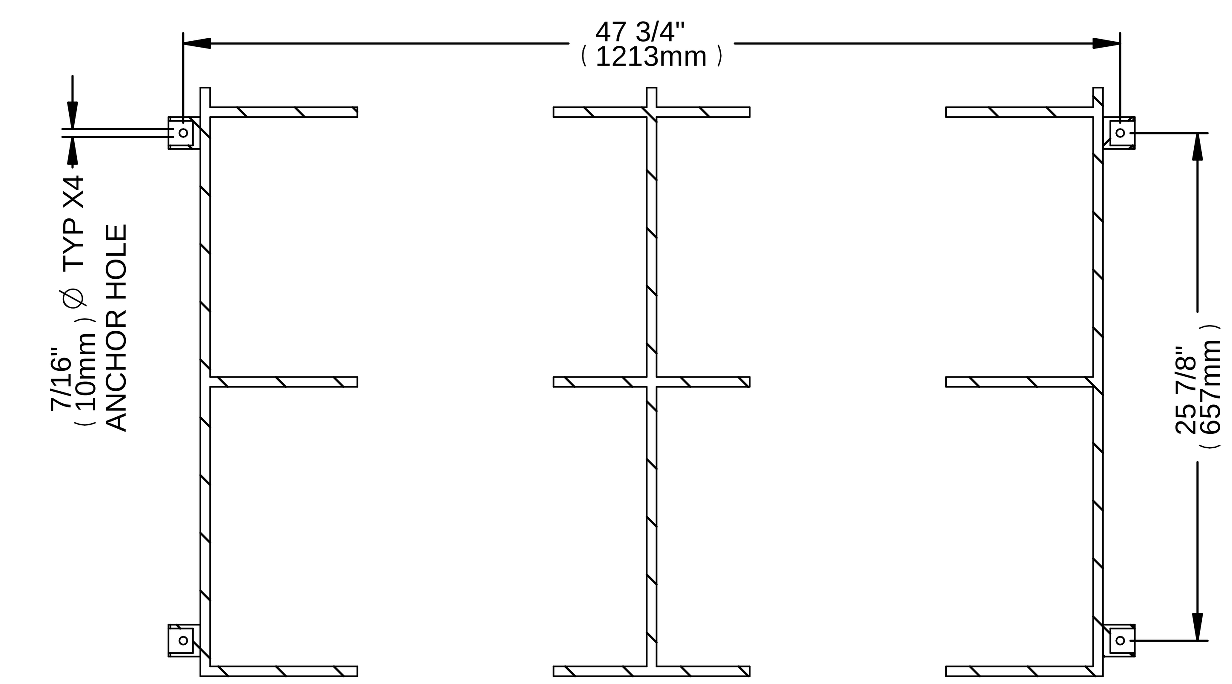
MAG DRIVE CENTRIFUGAL PUMP
MODEL: DB9V-R-FF-M272
MAXIMUM FLOW: 46 USGPM @ HEAD 11FT
MINMUM FLOW: 0.5 USGPM @ HEAD 67FT
CONSTRUCTION MATERIALS: PVDF/FKM O-RING
MOTOR: 3435 RPM,1 HP (0.75 kW), 575V,60 Hz, 3 Ph
TYP: x2 (DUTY / STANDBY)

NOTE:SYSTEM OPERATING CONDITIONS ARE DIFFERENT FROM PUMP PERFORMANCE CURVE.
PLEASE REFER TO DRAWING NOTES ON SECOND PAGE FOR SYSTEM OPERATING & DESIGN CONDITIONS

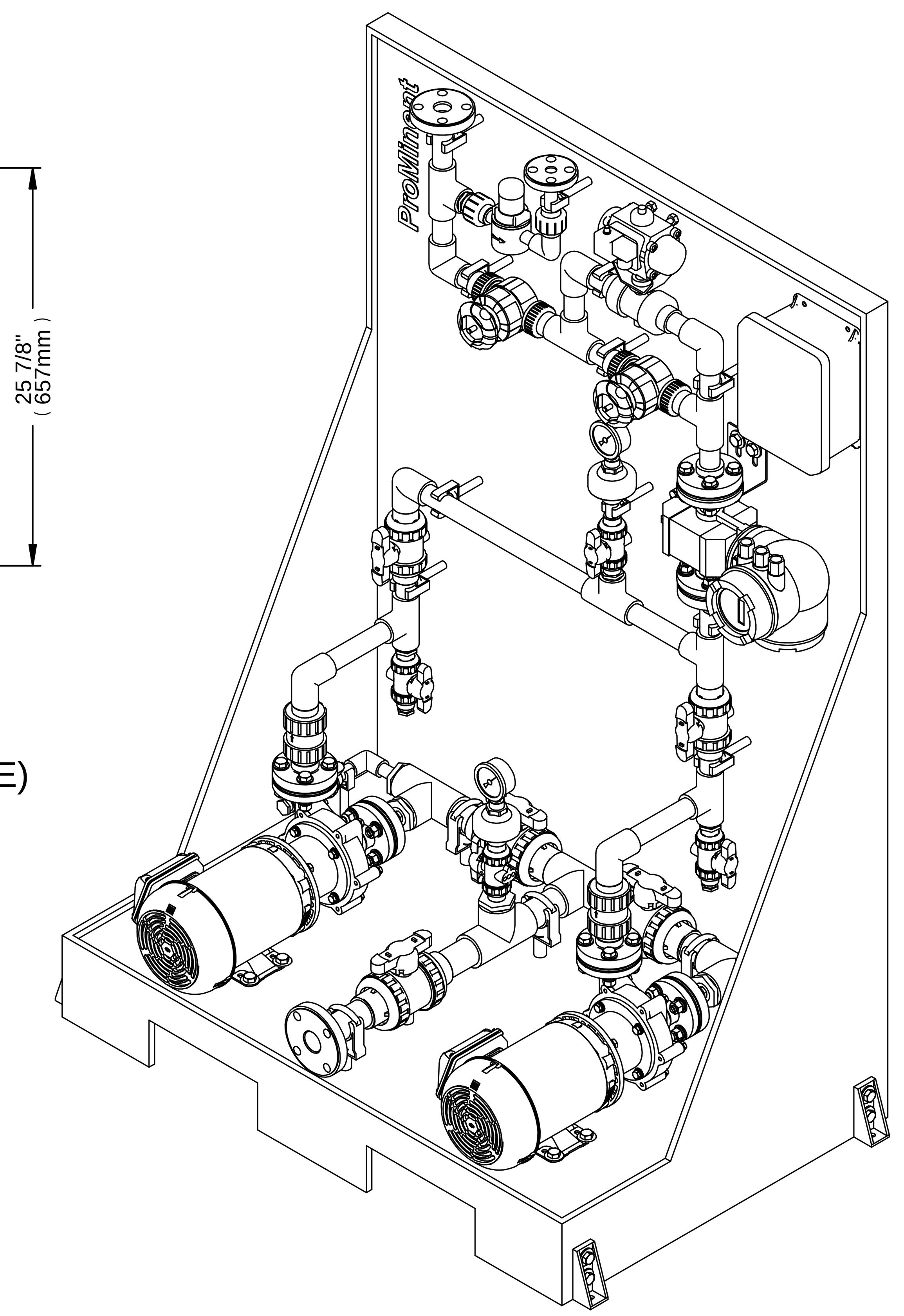
VENTED BALL VALVES REQUIRED

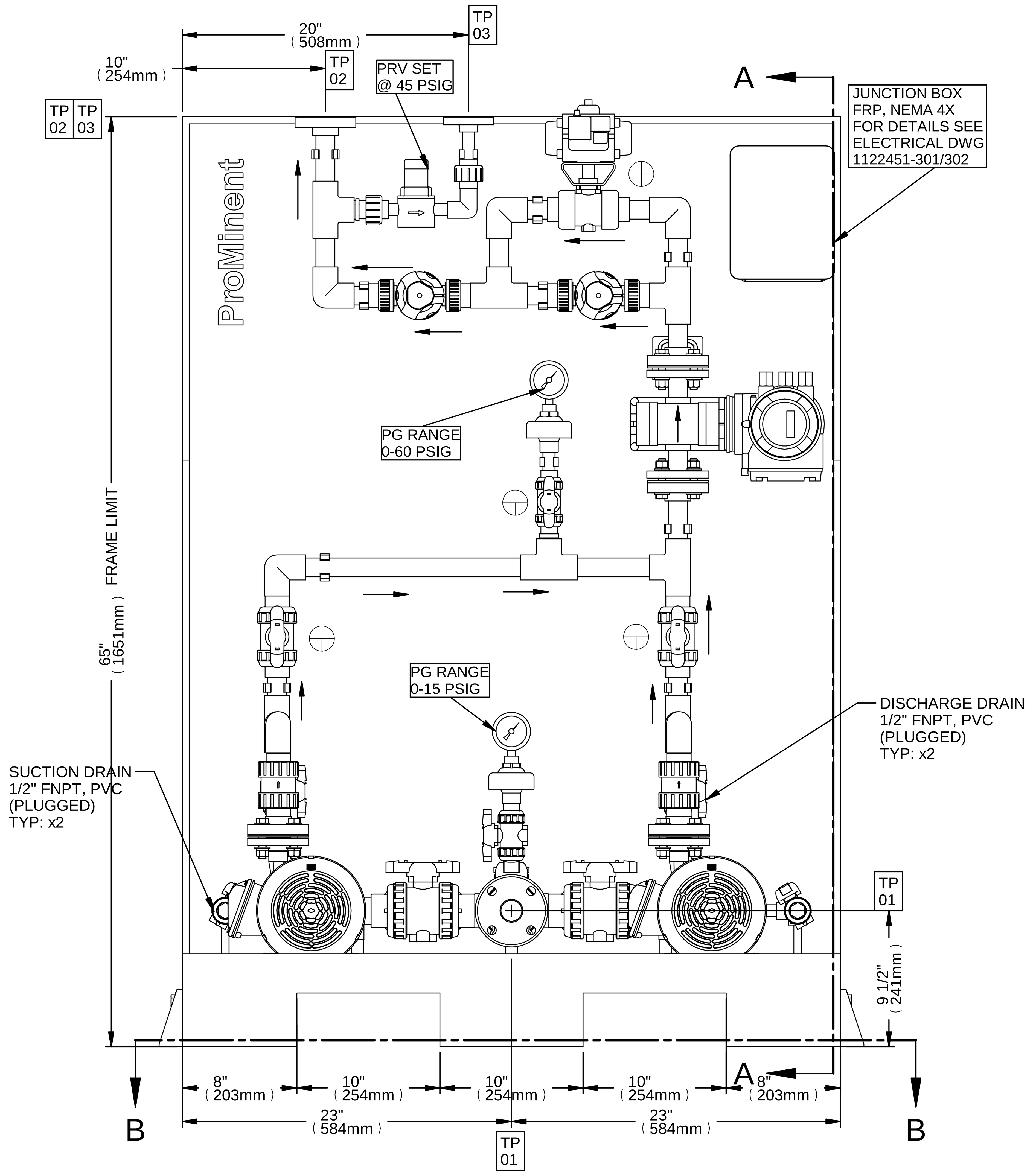
⊖-THIS SYMBOL INDICATES SIDE OF THE VALVE THAT THE BALL IS TO BE VENTED TO. DRILL Ø1/8" HOLE.

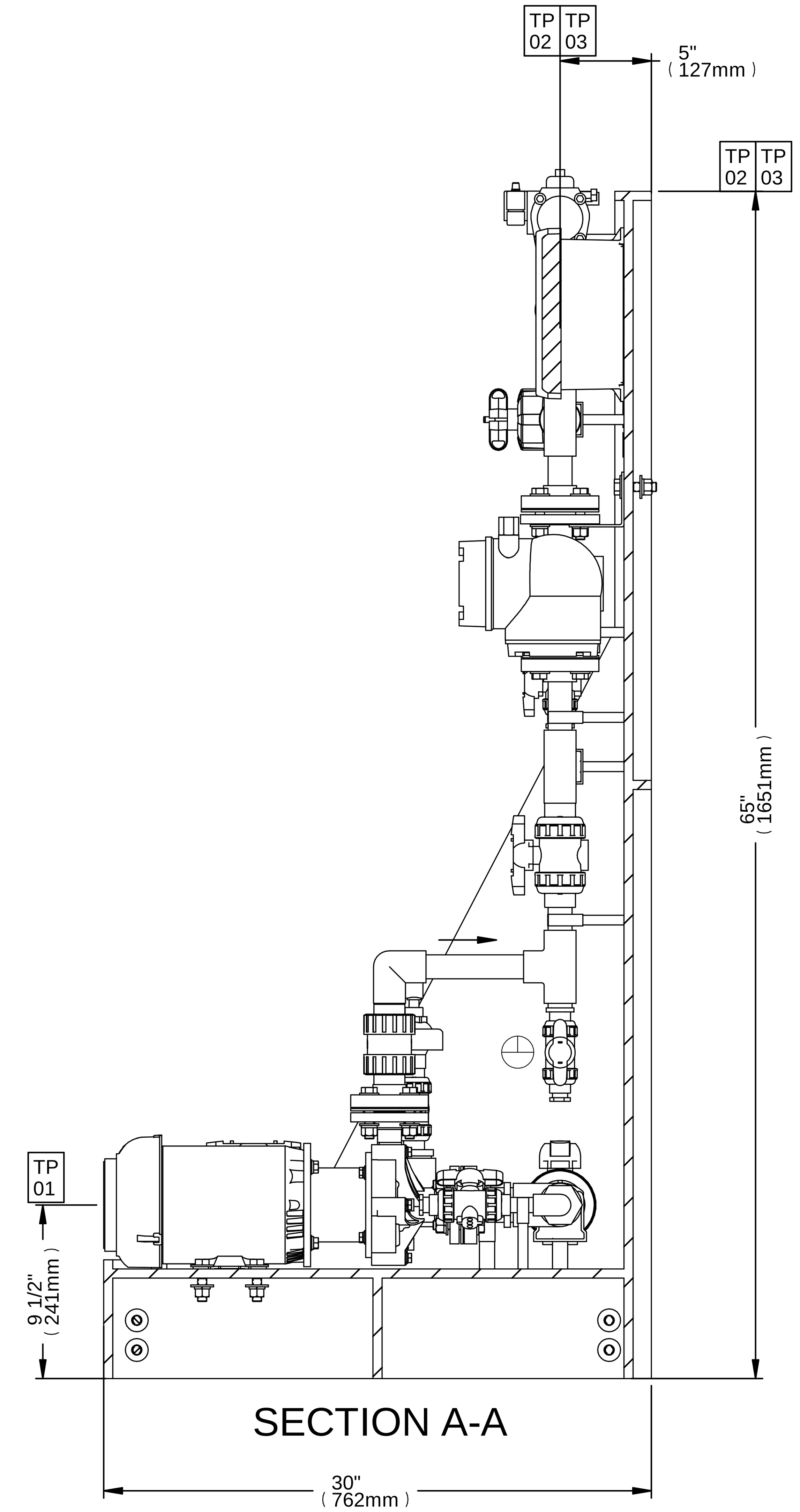
SODIUM HYPOCHLORITE SYSTEM



SECTION B-B
FOOTPRINT
USE QTY:4, 3/8" BOLTS
(ANCHOR BOLTS NOT IN PROMINENT SCOPE)







SECTION A-A

REV	DATE (YYYY-MM-DD)	DESCRIPTION	BY	APPD	REVD
1	2023-07-25	UPDATED MAGNETIC FLOW METER	GB	AG	
0	2022-03-15	INITIAL RELEASE	GB	RJ	

REVISIONS

CUSTOMER
VEOLIA WATER TECHNOLOGIES & SOLUTIONS

SUBJECT: ---
PFC PROSIP No: 1122684
PURCHASE ORDER No: --
PURCHASER'S EQUIP. No

TITLE
VEOLIA MAGDRIVE-F PVC-VITON, 2P 575V
- GENERAL ARRANGEMENT DRAWING -

ENGINEERS SEAL

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PROMINENT FLUID CONTROLS LTD.
490 SOUTHGATE DRIVE.
GUELPH, ONTARIO, CANADA
N1G 4P5
TEL. 519 836 5692 FAX. 519 836 5226

PROMINENT FLUID CONTROLS INC.
136 INDUSTRY DRIVE,
PITTSBURGH P.A., USA.
15275
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	GB	APPROVED	
DRAWN	GB	SCALE	NTS
CHECKED	RJ	DATE (YYYY-MM-DD)	2022-03-15

SHEET No: 1/2
CUSTOMER DWG No: ---
PFC DWG No: 1122684-200- 1
REV: 1

PN: 1122684

COMPONENT LIST

*PART IS HIDDEN FROM VIEW

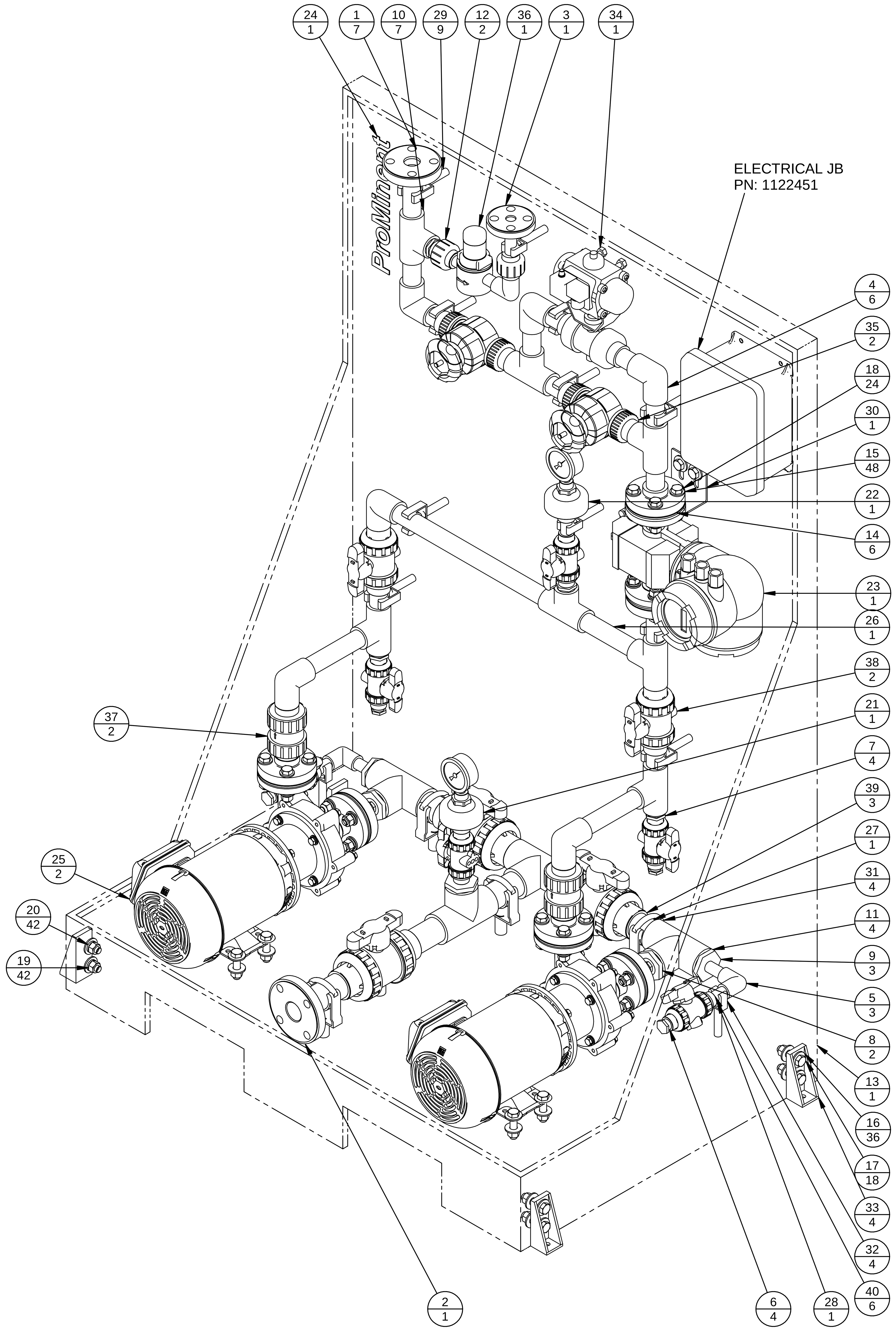
ITEM	PART #	DESCRIPTION	QTY
1	7740695	FITTING: 1" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	7
2	7900948	FITTING: 1-1/2" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	1
3	7741396	FITTING: 1/2" SW FLANGE, 1PC, 150#, SCH80, PVC, ASTM D 1784	1
4	7741327	FITTING: ELBOW, 1" SWxSW, PVC, SCH 80	6
5	7260006	FITTING: ELBOW, 1/2" SWxSW, PVC, SCH 80	3
6	7000325	FITTING: PLUG 1/2" MNPT PVC SCH 80	4
7	7741358	FITTING: REDUCER BUSHING, 1" SPIG x 1/2" SW, PVC SCH80	4
8	7900952	FITTING: REDUCER BUSHING, 1-1/2" SPIG x 1" SW, PVC SCH80	2
9	7900950	FITTING: REDUCER BUSHING, 1-1/2" SPIG x 1/2" SW, PVC SCH80	3
10	7741333	FITTING: TEE, 1" SWxSWxSW, PVC, SCH80	7
11	7741442	FITTING: TEE, 1-1/2" SWxSWxSW, PVC, SCH 80	4
12	7740551	FITTING: UNION, 1/2" SWxSW, PVC, VITON, SCH80	2
13	1122575	FRAME: MAG DRIVE 2 PUMP, 65" x 46" x 30", BLACK PE	1
14	7901609	GASKET: 1", FULL FACE, 150#, 1/8" THICK, FPM (VITON)	6
15	7902194	HARDWARE: FLAT WASHER, 1/2", 1.060" OD, 316 SS	48
16	7900011	HARDWARE: FLAT WASHER, 1/2", 316 SS	36
17	7902724	HARDWARE: HEX CAP SCREW, 1/2"-13, 2" LG, 18-8 SS, 1-1/4" THREAD LG	18
18	7900847	HARDWARE: HEX CAP SCREW, 1/2"-13, 2.5"LG, 18-8 SS, 1" THREAD LG	24
19	7900015	HARDWARE: HEX NUT, 1/2"-13, 18-8 SS	42
20	7900012	HARDWARE: LOCK WASHER, 1/2", 18-8 SS	42
21	1121677	INSTRUMENT: 2 -1/2" PRESSURE GAUGE, 0-15 PSIG, 304SS CASE, 316SS INTERNALS, REMOVEABLE BEZZEL 1/4" MNPT BOTTOM MOUNT, SILICONE OIL FILL WITH PVC ISOLATOR, 1/2" SOCKETWELD PROCESS CONNECTION, 1/4" FNPT GAUGE CONNECTION, GLYCERINE FILL, WIKA	1
22	1121678	INSTRUMENT: 2 -1/2" PRESSURE GAUGE, 0-60 PSIG, 304SS CASE, 316SS INTERNALS, 1/4" MNPT BOTTOM MOUNT, SILICONE OIL FILL WITH PVC ISOLATOR, 1/2" SOCKETWELD PROCESS CONNECTION, 1/4" FNPT GAUGE CONNECTION, GLYCERINE FILL, WIKA	1
23	1130776 + 1122667 + 1122667	INSTRUMENT: MAGNETIC FLOW METER, PROMAG P 300, 5P3B25, DN25, INTEGRAL UNIT, 1" FLANGE 150# CONNECTIONS-SS(NON WETTED, PTFE LINER ANSI B16.5, CONNECTIONS, INTEGRAL MOUNTED NEMA-4X ENCLOSURE WITH LCD DISPLAY, 4-20mA OUTPUT, HART PROTOCOL, WITH TWO ALLOY C22 GROUND DISKS. 24VDC - ENDRESS-HAUSER PN: 5P3B25-CSIBAEAFADEA1SHAA1+AAZ1 + DK5GD-25BEL	1
24	7900315	LABEL: PROMINENT LOGO, WHITE & ORANGE x 1-7/8"H, VINYL	1
25	1122484	MAG DRIVE CENTRIFUGAL PUMP, 1" 150# RFSO, PVDF IMPELLER, VITON, 575V, 3 Ph, 60 Hz, FINISH THOMPSON INC.	2
26	7741324	PIPE: 1", PVC, SCH80	8FT
27	7741447	PIPE: 1-1/2", PVC, SCH80	4FT
28	7741400	PIPE: 1/2", PVC, SCH80	2FT
29	7741318	SUPPORT: 1" (32mm) PIPE CLIP WITH 1/4" x 2-1/4" PVC PIPE STANDOFF	9
30	1122577	SUPPORT: 1"FLANGE SUPPORT BRACKET, TYPE 1, 304 SS	1
31	7741590	SUPPORT: 1-1/2" (50mm) PIPE CLIP WITH 1/2" x 1-1/2" PVC PIPE STANDOFF	4
32	7260010	SUPPORT: 1/2" (20mm) PIPE CLIP WITH 1/4" x 2-1/2" PVC PIPE STANDOFF	4
33	7900388	SUPPORT: FRP INSIDE CORNER GUSSET 1-5/8" x4", 3 HOLE	4
34	1122518	VALVE: 1" ACTUATOR PNEUMATIC, PA SERIES, PAS00, ON 1" PVC/VITON, TYPE 21 UNION BALL VALVE, VENTED BALL WITH PAD MOUNTED SOLENOID VALVE. 24 VDC - CHEMLINE	1
35	1116851	VALVE: 1" DIAPHRAGM VALVE, PVC/VITON, TYPE 514 PVC-U, SOCKET WELD ASTM, TRUE UNION. - GEORG FISCHER	2
36	1019883	VALVE: BACK PRESSURE VALVE, 1/2" SW CONNECTION, BODY MATERIAL PVC, PRESSURE RANGE 0-150PSI, PROMINENT	1
37	7901155	VALVE: BALL CHECK VALVE, 1" SW, TRUE UNION, BODY MATERIAL PVC, SEALS VITON, CHEMLINE	2
38	7745145	VALVE: BALL VALVE, 1" SW, BODY MATERIAL PVC, SEALS VITON (FKM), VENTED BALL, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	2
39	7745146	VALVE: BALL VALVE, 1-1/2" SW, BODY MATERIAL PVC, SEALS VITON (FKM), VENTED BALL, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	3
40	7745143	VALVE: BALL VALVE, 1/2" SW, BODY MATERIAL PVC, SEALS VITON (FKM), VENTED BALL, (COMES WITH SOCKET & FNPT ENDS), TYPE 21, CHEMLINE	6

SHIPPED LOOSE ITEMS

ITEM	PART #	DESCRIPTION	QTY
SL	1049960	DEVICE: 1-1/2" TRUE UNION Y SEDIMENT STRAINER, PVC/VITON SW	1

MAG DRIVE CENTRIFUGAL PUMP
MODEL: DB9V-R-FF-M272
MAXIMUM FLOW: 46 USGPM @ HEAD 11FT
MINMUM FLOW: 0.5 USPGM @ HEAD 67FT
CONSTRUCTION MATERIALS: PVDF/FKM O-RING
MOTOR: 3435 RPM,1 HP (0.75 kW), 575V,60 Hz, 3 Ph
TYP: x2 (DUTY / STANDBY)

1/2: TOP SIDE = CHART NUMBER
BOTTOM SIDE = QUANTITY NUMBER



NOTES:

1. SYSTEM IS DESIGNED, FABRICATED, TESTED AND INSPECTED AS PER PROMINENT STANDARD

2. PIPING MATERIAL IS PVC SCH 80 IN CONFORMANCE WITH ASTM D 1785 (FOR PHYSICAL DIMENSIONS, TEST REQUIREMENTS AND MAXIMUM OPERATING PRESSURE) IN SIZES1-1/2",1" & 1/2" PIPE.
ALL CONNECTIONS ARE 1-1/2", 1" & 1/2" SCH 80 PVC SOCKET WELD UNLESS OTHERWISE REQUIRED BY PIPELINE DEVICES.UNIONS ARE TRUE UNION STYLE, SCH80 PVC WITH VITON O-RING SEAL RATED FOR 150 PSIG. FLANGES ARE PVC, FULL FACE, CLASS 150, ASME/ANSI B16.5.

3.GASKETS ARE FULL FACE TYPE, CLASS 150, VITON, 1/8" THK FOR FLANGE CONNECTION, ASME B16.20.

4. BOLTING ARE 18-8 SS HEX CAP SCREW WITH FLAT WASHER, LOCK WASHER AND 18-8 SS HEX NUT.

5. PUMP AND PIPING SUPPORT FRAME IS CONSTRUCTED OF BLACK POLYETHYLENE. MATERIAL THICKNESS: 1/2" [13MM].AND IS FABRICATED BY WELD CONSTRUCTION.

6. ALL INTERCONNECTING PIPE & FITTINGS AND WIRING BY OTHERS.

7. ALL SEAL MATERIAL IS PTFE/VITON OTHERWISE SPECIFIED BY CUSTOMER.

8. TOLERANCE ON ALL TERMINATION POINTS: +/-10mm (+/-3/8").

APPROX.SHIPPING WEIGHT: 285 LB (129 Kg).
APPROX.OPERATING WEIGHT: 310LB (140 Kg).

DESIGN NOTES:

SYSTEM OPERATING CONDITIONS ARE DIFFERENT FROM PUMP PERFORMANCE CURVE
MAXIMUM SYSTEM OPERATING FLOW: 30 USGPM @ 14 PSIG
MINIMUM SYSTEM OPERATING FLOW: 0.5 USGPM @ 29 PSIG

UPSTREAM INJECTION PUMP-SUCTION:

- DESIGN TEMPERATURE: MIN. 15ºC TO MAX. 25ºC
- DESIGN PRESSURE: 14.7 PSIG
- MIN. TEST PRESSURE: 25 PSIG

DOWNSTREAM INJECTION PUMP-DISCHARGE:

- DESIGN TEMPERATURE: MIN. 15ºC TO MAX. 25ºC
- DESIGN PRESSURE: 45 PSIG
- MIN. TEST PRESSURE: 55 PSIG

TESTING CONDITION:

- TEST TYPE: HYDROSTATIC
- TEST MEDIUM: WATER
- TEST TEMPERATURE: AMBIENT 68ºF (20ºC)
- TEST DURATION: 10 MIN. (MINIMUM)

CORROSION ALLOWANCE: 0.0" (0.0mm).

REVISIONS

REV	DATE (YYYY-MM-DD)	DESCRIPTION	BY	APPD	REVD
1	2023-07-25	UPDATED MAGNETIC FLOW METER	GB	AG	
0	2022-03-15	INITIAL RELEASE	GB	RJ	

CUSTOMER: VEOLIA WATER TECHNOLOGIES & SOLUTIONS

SUBJECT: ---

PFC PROSIP No: 1122684

PURCHASE ORDER No: --

PURCHASER'S EQUIP. No

TITLE: VEOLIA MAGDRIVE-F PVC-VITON, 2P 575V - BILL OF MATERIALS -

ENGINEERS SEAL

ProMinent®
THE PROMINENT GROUP OF COMPANIES
GUELPH - ONTARIO - CANADA

PROMINENT FLUID CONTROLS LTD.
490 SOUTHGATE DRIVE.
GUELPH, ONTARIO, CANADA
N1G 4P5
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PROMINENT FLUID CONTROLS INC.
136 INDUSTRY DRIVE,
PITTSBURGH P.A., USA.
15275
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DESIGNED	GB	APPROVED	
DRAWN	GB	SCALE	NTS
CHECKED	RJ	DATE (YYYY-MM-DD)	2022-03-15

SHEET No: 2/2

CUSTOMER DWG No: ---

PFC DWG No: 1122684-200- 2

REV: 1

NOTE:
1. PFD DOES NOT REPRESENT SPECIFIC EQUIPMENT NOR INDICATE SCOPE OF SUPPLY. FOR MORE INFORMATION REFER TO P&IDS.

VEOLIA
REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

PROCESS FLOW DIAGRAM
MEMBRANE FILTRATION SYSTEM

DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN11-DI-001	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
495186		NONE	D	1 OF 1

LAST SAVED: Thursday, January 25, 2024 3:51:54 PM

FILE LOCATION: C:_ADSKVault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN11-DI-001.dwg

Water Technologies & Solutions

PRELIMINARY SAMPLE DRAWINGS FOR THE
DUNDAS WWTP EXPANSION PRJECT

USING ZEEWEED MBR
MEMBRANE FILTRATION TECHNOLOGY

PIPING & INSTRUMENTATION DIAGRAM

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X
.XX FRAC
.XXX

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
TITLE PAGE

DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN21-DS-001	A

REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
495186		NONE	D	1 OF 3

LAST SAVED: Thursday, January 25, 2024 10:26:31 AM

FILE LOCATION: C:_ADSKVault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-001.dwg

GENERAL TAGGING FORMAT

AAB - CCC - DDDE - F

- AA - PROCESS AREA
- B - PROCESS AREA GROUPING (OPTIONAL)
- CCC - ELEMENT IDENTIFIER
- DDD - SEQUENCE / LOOP IDENTIFIER
- E - SUB SEQUENCE / LOOP IDENTIFIER (OPTIONAL)
- F - MULTIPLE TRAIN IDENTIFIER (OPTIONAL)

EQUIPMENT: 32-P-101

INSTRUMENT/ AUTO VALVE: 32-TI 101 — NOTE: REFER TO ISA TABLE

PIPING SPECIALITY: 32-SP 101

MANUAL VALVE: ADDITIONAL INFORMATION — YYY; MANUAL VALVE CODE — 3"-GA-003A-C; MANUAL VALVE TAG — 32-HV-101

EQUIPMENT IDENTIFIER

ACF - ACTIVATED CARBON FILTER	OZ - OZONATOR
AD - ADSORBER	OZG - OZONE GENERATOR
AER - AERATOR	P - PUMP
B - BLOWER / FAN	PD - PULSATION DAMPER
BF - BAG FILTER	PK - GENERIC PACKAGE
BC - BRINE CONCENTRATOR	PRE - PRECIPITATOR
BT - BIOGAS TREATMENT UNIT	PX - PRESSURE EXCHANGER
BO - BOILER	QU - QUENCHER
CF - CARTRIDGE FILTER	R - REACTOR
CE - CENTRIFUGE	RB - BIOLOGICAL REACTOR
CS - CHEMICAL SYSTEM	REC - RECEIVER
CLR - CLARIFIER	RO - REVERSE OSMOSIS
CO - COMPRESSOR	RT - RESIN TRAP
CP - CONTROL PANEL	SC - SCRUBBER
CR - CRYSTALLIZER	SCR - SCREEN
CT - COOLING TOWER	SEP - SEPARATOR
DA - AIR DRYER	SFT - SOFT STARTER
DEG - DEGASSIFIER	SK - SKID
DMF - DUAL MEDIA FILTER	SKM - SKIMMER
DP - PROCESS DRYER	SL - NOISE REDUCTION
ED - ELECTRODIALYSIS	SM - STATIC MIXER
EDI - ELECTRO DEIONIZATION	SP - PIPING SPECIALTY
EDR - ELECTRODIALYSIS REVERSAL	SS - SAMPLE SINK
EV - EVAPORATOR	ST - STEAM TRAP
F - FILTER	STR - STRAINER
FDA - FORCED DRAFT AERATOR/DEGASIFIER	SU - SUMP
FP - FILTER PRESS	SV - SAMPLE VALVE
FS - FLARE STACK	T - TOWER
FSP - FLOTATION SEPARATOR	TK - TANK
GEN - POWER GENERATOR	TRB - TURBINE
GTM - GAS TURBINE MEMBRANE	UF - ULTRAFILTRATION
H - HEATER	UK - MISCELLANEOUS EQUIPMENT
HF - HEPA FILTER	UV - ULTRAVIOLET
HPB - HYDRAULIC PRESSURE BOOSTER	V - VESSEL
HV - MANUAL VALVE	VC - VAPOR COMPRESSOR
HX - HEAT EXCHANGER	VFD - VARIABLE FREQUENCY DRIVE
IX - ION EXCHANGER	VB - VACUUM BREAKER
IQ - INJECTION QUILL	VD - VACUUM DEGASIFIER
JB - JUNCTION BOX	VOD - VENT OZONE DESTRUCT
LA - LOADING ARM	WS - SOFTENER
LD - LIFTING DEVICE	X - EXTRUDER
LS - LIME SOFTENER	Z - ELECTRICAL EQUIPMENT - (GENERAL)
M - MOTOR	
MS - MOTOR STARTER	
MBR - MEMBRANE BIOREACTOR	
MCC - MOTOR CONTROL CENTER	
MF - MICROFILTRATION	
MH - MATERIAL HANDLING	
MMF - MULTIMEDIA FILTER	
MX - MIXER	
NF - NANOFILTER	
OC - OXYGEN CONCENTRATOR	

MANUAL VALVE CODE FORMAT

(OPTIONAL) X - AA - BBBC - D

- X - SIZE
- AA - TYPE
- BBB - SEQUENCE IDENTIFIER
- C - CONNECTION / END TYPE
- D - MODIFIER

TYPE	CONNECTION/END TYPE	MODIFIER
AN - ANGLE VALVE	A - FLANGED (RF)	A - VALVE BONNET EXTENSION
BA - BALL VALVE	B - FLANGED (FF)	B - 2" VALVE EXTENSION
BU - BUTTERFLY VALVE	C - THREADED - FEMALE	C - CHAIN OPERATOR WITH 15' CHAIN
CK - CHECK VALVE	D - THREADED - MALE	D - CHAIN OPERATOR WITH 30' CHAIN
DI - DIAPHRAGM VALVE	E - SOCKET WELD	E - OPEN AND CLOSE LIMIT SWITCHES
FW - 4-WAY VALVE	F - BUTTWELD	F - GEAR OPERATOR
GA - GATE VALVE	G - WAFER	G - LEVER OPERATOR
GL - GLOBE VALVE	H - LUGGED	H - 100% ADJUSTABLE TRAVEL STOPS
KN - KNIFE VALVE	J - MECHANICAL JOINT	J - VACUUM SERVICE PACKING
NV - NEEDLE VALVE	K - TUBING COMPRESSION FITTING	
PL - PLUG VALVE	L - OTHER	
PV - PINCH VALVE	X - UNASSIGNED	
TW - 3-WAY VALVE		
VS - SPECIAL VALVE		

VALVE SYMBOLS

NORMALLY OPEN / NORMALLY CLOSED

ANGLE VALVE; ANGLE SEAT VALVE; BACKFLOW PREVENTER; BALL; BUTTERFLY; CHECK; DIAPHRAGM; FOOT; FOUR WAY VALVE; GATE; GLOBE; KNIFE GATE; NEEDLE; PINCH; PLUG; SANITARY VALVE 3-WAY; SANITARY VALVE 4-WAY; SLIDING GATE DOWNWARD OPENING; SLIDING GATE UPWARD OPENING; THREE WAY VALVE; V-BALL

SPECIAL PIPING ITEMS

BASKET STRAINER	RESTRICTION ORIFICE
CALIBRATION COLUMN	SCREEN
CONE STRAINER	SIGHT GLASS IN-LINE
DESICCANT AIR DRYER	SILENCER
	SIPHON
DESUPERHEATER	SPECTACLE BLIND - CLOSED
DIFFUSER, COURSE BUBBLE	SPECTACLE BLIND - OPEN
DIFFUSER, FINE BUBBLE	SPRAY NOZZLE
EDUCTOR	TRAP, AIR
EXPANSION JOINT	TRAP, FLUID
FILTER	TRAP, GENERIC
FLAME ARRESTOR	TRAP, MEDIA
FLEXIBLE CONNECTION	TRAP, RESIN
FLOW STRAIGHTENER	TRAP, STEAM
HYDROMETER POT	VALVE MANIFOLD
INJECTION QUILL	VENT
INLINE STATIC MIXER	VENT HOOD
MUFFLER	Y-STRAINER
PULSATION DAMPENER	

CONNECTIONS

CAMLOCK; CAMLOCK PLUG; CAP; COMPRESSION FITTING; COMPRESSION FITTING PLUG; DRAIN HUB; FLANGE; FLANGE, BLIND; MECH. COUPLING, GROOVE END (VICTAULIC); MECH. COUPLING, GROOVE END (VICTAULIC) WITH PLUG; MECH. COUPLING, PLAIN END (STRAUB); PLUG; REDUCER; SANITARY CONNECTION; SCREWED CAP; SOCKET CONNECTION; THREADED CONNECTION; THREADED CONNECTION W / PLUG; THREADED OLET W/PLUG; UNION

PIPE TAGGING FORMAT

(OPTIONAL) PIPE SPECIFICATION — AA - DDDEEEF - BBC - GGGG - HHHI - J - K - L

- AA - LINE SIZE
- DDD - PIPE MATERIAL CODE
- EEE - PIPE PRESSURE RATING CODE
- F - PIPE SERVICE MODIFIER
- BB - PROCESS AREA
- C - SUB PROCESS AREA
- GGGG - FLUID CODE
- HHH - SEQUENCE IDENTIFIER
- I - SUB SEQUENCE IDENTIFIER
- J - MULTIPLE TRAIN IDENTIFIER
- K - INSULATION THICKNESS (N FOR NONE)
- L - HEAT TRACING

PIPE SPECIFICATIONS

PIPE MATERIAL CODES

6MO	6% MOLY (AL6XN, 254SMO)
A20	ALLOY 20
CC	CONCRETE
CI	CAST IRON
CPVC	CPVC
CS	CARBON STEEL
DI	DUCTILE IRON
FRP	FRP
GS	GALVANIZED STEEL
HC	HASTELLOY C276
HDPE	HDPE
NY	NYLON
PE	POLYETHYLENE
PLDI	POLYETHYLENE LINED DUCTILE IRON
PP	POLYPROPYLENE
PPL	POLYPROPYLENE LINED
PT	POLY TUBE
PTFE	PTFE
PVC	PVC
PVD	PVDF
RH	RUBBER HOSE
SA	304 / 304L STAINLESS
SAT	304 / 304L STAINLESS TUBING
SD	2205 STAINLESS
SE	SUPER DUPLEX (2507, ZERON 100)
SS	316 / 316L STAINLESS
SST	316 / 316L STAINLESS TUBING
TL	TEFLON LINED
XXX	CUSTOM

PIPE PRESSURE RATING CODES

P00	< 150#
125	125#
150	150#
300	300#
600	600#
900	900#
15X	1500#
P06	PN6
P10	PN10
P16	PN16
P20	PN20
P50	PN50
P68	PN68
P1X	PN100
D11	SDR11
D13	SDR13
D17	SDR17
D21	SDR21
D26	SDR26
D32	SDR32
D41	SDR41
D64	SDR64
S12	SCHEDULE 120
S40	SCHEDULE 40
S80	SCHEDULE 80
A00	ATMOSPHERIC
D00	DUCTING
V00	VACUUM

FLUID CODES

AF - ANTIFOAM	HCL - HYDROCHLORIC ACID
AS - ACTIVATED SLUDGE	HS - SULFURIC ACID
AST - AUXILIARY STEAM	IA - INSTRUMENT AIR
BA - BLOWER AIR	KMN - POTASSIUM PERMANGANATE
BCD - BIOCIDE	KS - CAUSTIC (SODIUM HYDROXIDE)
BWI - BACKWASH IN	LO - LUBE OIL
BWW - BACKWASH WASTE	MUW - MAKEUP WATER
C - CONCENTRATE	NUT - NUTRIENT
CBD - CONCENTRATE BLOWDOWN	OGS - ORGANO SULFIDE
CE - CENTRATE	OS - O2 SCAVENGER
CF - CONCENTRATE FEED	OSP - OFF SPEC PRODUCT
CIPI - CIP IN	P - PRODUCT
CIPR - CIP OUT	PAC - POWDER ACTIVATED CARBON
CIT - CITRIC ACID	PER - PERMEATE
CMU - CONCENTRATE MAKEUP	POL - POLYMER
CO - CONCENTRATE OUT	PW - POTABLE WATER
COAG - COAGULANT	R - REJECT
CR - CONCENTRATE RETURN	RAS - RETURN ACTIVATED SLUDGE
CWR - COOLING WATER RETURN	ROR - REVERSE OSMOSIS REJECT
CWS - COOLING WATER SUPPLY	RW - RAW WATER
D - DILUTE	SA - SERVICE AIR
DEC - DECANT	SAS - SODA ASH SLURRY
DF - DILUTE FEED	SBF - SATURATED BRINE FEED
DI - DILUTE IN	SBS - SODIUM BISULFITE
DO - DILUTE OUT	SC - STEAM CONDENSATE
DR - OVERFLOW / DRAIN	SEW - SEAL WATER
DW - DEAERATOR WATER	SI - ANTISCALANT
E - ELECTRODE	SL - SLUDGE
EC - EVAPORATOR CONCENTRATE	SML - SOLID MATERIAL HYDRATED LIME
ECIP - ELECTRODE CIP	SMSA - SOLID MATERIAL SODA ASH
EF - ELECTRODE FEED	ST - STEAM
EFF - EFFLUENT	SW - SERVICE WATER
EP - EVAPORATOR PRODUCT / DISTILLATE	SY - SLURRY
ER - EVAPORATOR RECIRCULATION	UFC - ULTRAFILTRATION CONCENTRATE
ERR - ELECTRODE RETURN / RECYCLE	UFP - ULTRAFILTRATION PERMEATE
EV - EVAPORATOR VAPOR	UPW - ULTRAPURE WATER
EW - ELECTRODE WASTE	V - VENT
FC - FERRIC CHLORIDE	WAS - WASTE ACTIVATED SLUDGE
FE - EVAPORATOR FEED	WW - WASTEWATER
FIL - FILTRATE	X - REVERSAL STREAM X
FO - FLUSH OUT	XC - CRYSTALLIZER CONCENTRATE
FW - FEED WATER	XR - CRYSTALLIZER RECIRCULATION
HC - SODIUM HYPOCHLORITE	XV - CRYSTALLIZER VAPOR
	Y - REVERSAL STREAM Y

PIPE & ELECTRICAL LINES

CAPILLARY TUBING; COMMUNICATION / SOFTWARE; ELECTRICAL LINE; EQUIPMENT LIMIT OR BOUNDARY LINE; HYDRAULIC SIGNAL; PRIMARY PROCESS LINE; PRIMARY PROCESS LINE (BY OTHERS); PNEUMATIC; SECONDARY PROCESS LINE; SECONDARY PROCESS LINE (BY OTHERS); WIRED ELECTROMAGNETIC; WIRELESS ELECTROMAGNETIC

PIPELINE SYMBOLS

- FLUID TYPE / BY OTHERS / CONNECTED DRAWING TITLE / FREE TEXT — OSBL OFF-PAGE CONNECTOR
- FLUID TYPE / 000 PID NUMBER / CONNECTED DRAWING TITLE / FREE TEXT — STANDARD OFF-PAGE CONNECTOR
- FLUID TYPE / 000 PID NUMBER / CONNECTED DRAWING TITLE / FREE TEXT — STANDARD BIDIRECTIONAL OFF-PAGE CONNECTOR
- SIGNAL TYPE / BY OTHERS / CONNECTING INSTRUMENT / FREE TEXT — OSBL OFF-PAGE I/O CONNECTOR
- SIGNAL TYPE / 000 PID NUMBER / CONNECTING INSTRUMENT / FREE TEXT — STANDARD OFF-PAGE I/O CONNECTOR
- TIE POINT / SEQUENCE NUMBER — TP 01 — OTHERS | VEOLIA — PROCESS DESIGN TIE POINTS W/ CUSTOMER
- CONTINUATION SYMBOL
- FLOW INDICATOR
- 01 KEYED NOTE
- XX ON-PAGE I/O CONNECTOR
- SLOPE
- SS150A | PVCS80A — SCOPE / SPEC / MATERIAL CHANGE

INSULATION

INSULATION THICKNESS; INSULATION TRACE; INSULATION PURPOSE (2" / ET / PP)

HEAT TRACING

- ET - ELECTRICAL TRACE
- HT - HEAT TRACE
- N - NONE
- ST - STEAM TRACE

INSULATION PURPOSE

- CC - COLD CONSERVATION
- HC - HEAT CONSERVATION
- N - NONE
- PP - PERSONNEL PROTECTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED: DECIMALS .X .XX .XXX; ANGLES; FRAC

VEOLIA

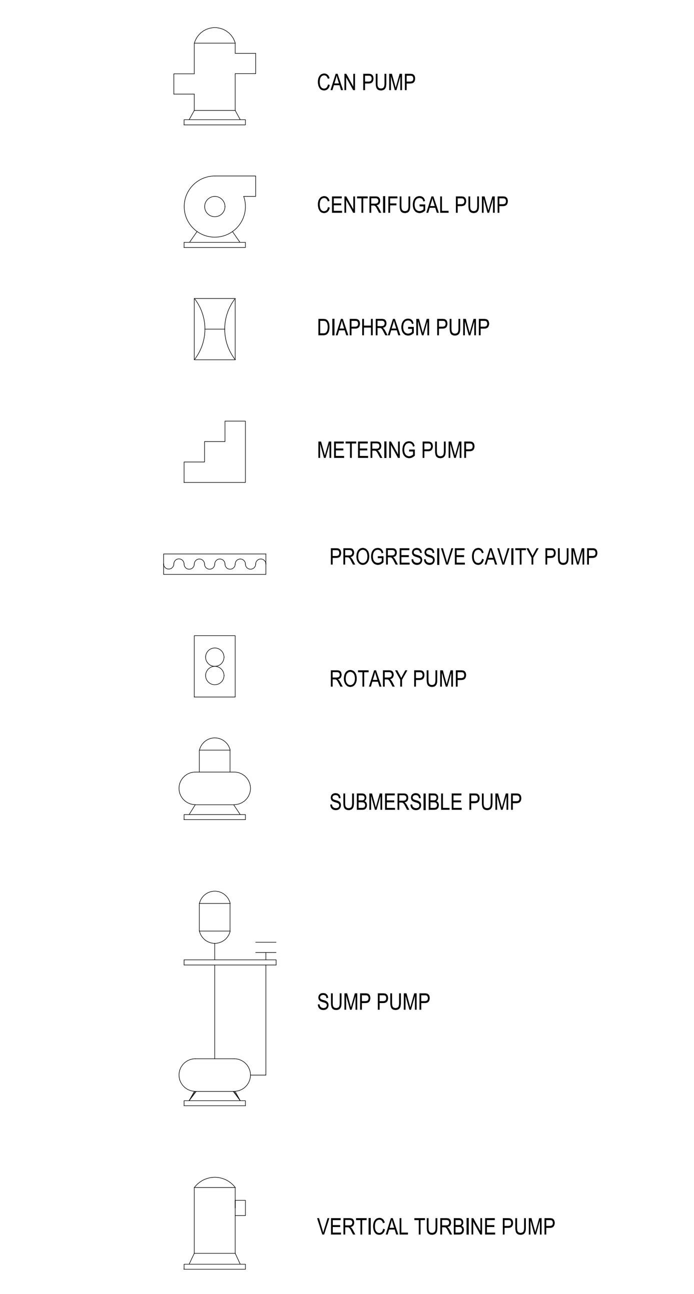
CUSTOMER INFORMATION: SAMPLE FOR DUNDAS WWTP

P&ID
LEGENDS & SYMBOLS

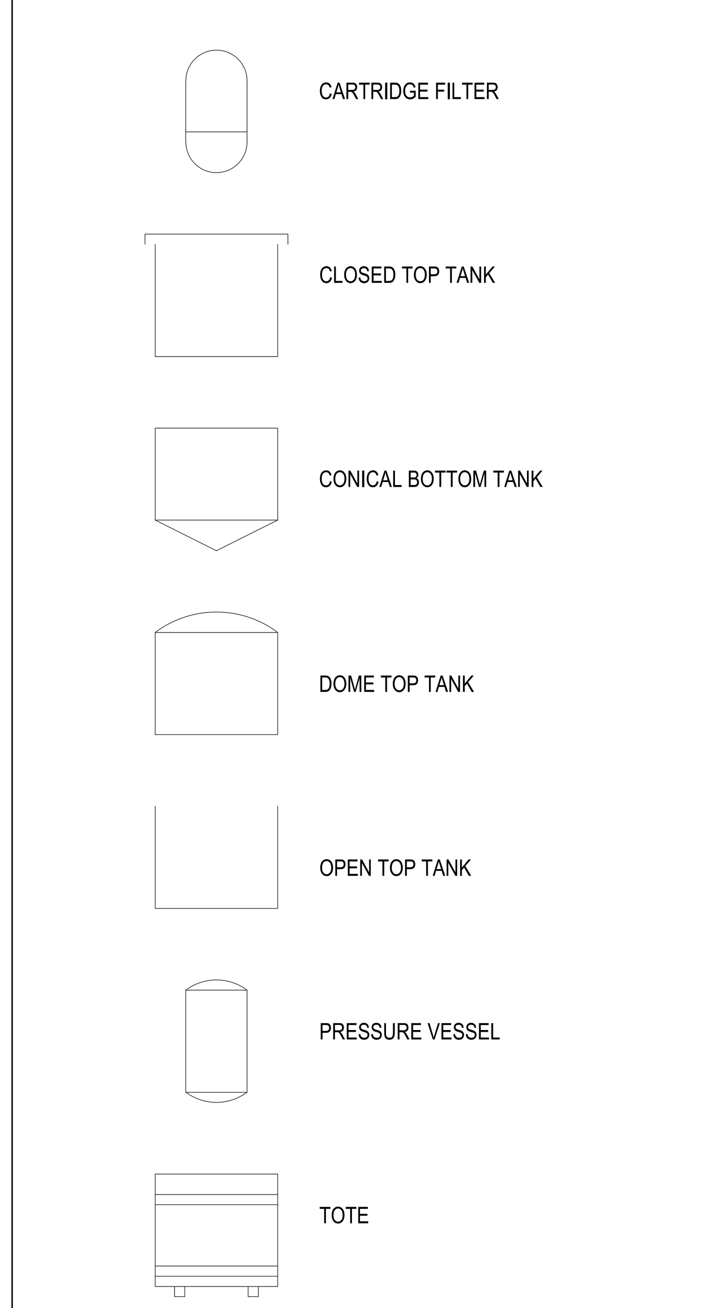
DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-001 — REVISION: A
REF.: - DOC. OWNER: -
PROJECT NO.: 495186 | PART/MATERIAL NO. | SCALE: NONE | SIZE: D | SHEET: 2 OF 3

LAST SAVED: Thursday, January 25, 2024 10:26:31 AM
FILE LOCATION: C:_ADSK\Vault\VNAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-001.dwg

PUMP SYMBOLS



VESSEL / TANK SYMBOLS



ISA FORMAT INSTRUMENT IDENTIFICATION CODES

FUNCTION		ALARMS					CONTROLLERS		READOUT DEVICES		SWITCHES & SWITCH DEVICES						TRANSMITTERS									
MEASURED VARIABLE	FIRST LETTER	GENERAL	HIGH	HIGH - HIGH	LOW	LOW - LOW	INDICATING	BLIND	RECORDING	INDICATING	GENERAL	HIGH	HIGH - HIGH	LOW	LOW - LOW	COMBINATION	RECORDING	INDICATING	BLIND	SOLENOIDS, RELAYS, COMMANDS, COMPUTING DEVICES	VALVES (ON/OFF)	VALVES CONTROL (MODULATING)	PRIMARY ELEMENT	WELL OR PROBE HOLDER	VIEWING DEVICE (GLASS)	SAFETY DEVICE
ANALYSIS	A	AA	AAH	AAHH	AAL	AALL	AIC	AC	AR	AI	AS	ASH	ASHH	ASL	ASLL	ASHL	ART	AIT	AT	AY	AV	ACV	AE	AW	.	.
BURNER/COMBUSTION	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NOT ASSIGNED	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NOT ASSIGNED	D	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VOLTAGE	E	EA	EAH	EAHH	EAL	EALL	EIC	EC	ER	EI	ES	ESH	ESHH	ESL	ESLL	ESHL	ERT	EIT	ET	EY	.	.	EE	.	.	.
FLOW	F	FA	FAH	FAHH	FAL	FALL	FIC	FC	FR	FI	FS	FSH	FSHH	FSL	FSLL	FSHL	FRT	FIT	FT	FY	FV	FCV	FE	.	.	.
FLOW QUANTITY	FQ	FQA	FQAH	FQAHH	FQAL	FQALL	FQIC	FQC	FQR	FQI	FQS	FQSH	FQSHH	FQSL	FQSLL	FQSHL	FQRT	FQIT	FQT	FQY	FQV	FQCV	FE	.	.	.
FLOW RATIO	FF	FFA	FFAH	FFAHH	FFAL	FFALL	FFIC	FFC	FFR	FFI	FFS	FFSH	FFSHH	FFSL	FFSLL	FFSHL	.	.	.	FFY	FFV	FFCV	FE	.	.	.
NOT ASSIGNED	G	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
HAND	H	HA	.	.	.	.	HIC	HC	.	.	HS	.	.	.	.	.	.	.	.	.	HV	HCV	.	.	.	.
CURRENT	I	IA	IAH	IAHH	IAL	IALL	IIC	IC	IR	II	IS	ISH	ISHH	ISL	ISLL	ISHL	IRT	IIT	IT	IY	.	.	IE	.	.	.
POWER	J	JA	JAH	JAHH	JAL	JALL	JIC	JC	JR	JI	JS	JSH	JSHH	JSL	JSLL	JSHL	JRT	JIT	JT	JY	.	.	JE	.	.	.
TIME	K	KA	KAH	KAHH	KAL	KALL	.	.	.	KI	.	KSH	KSHH	KSL	KSLL	.	.	.	.	.	.	.	.	.	.	.
TIME QUANTITY	KQ	KQA	KQAH	KQAHH	KQAL	KQALL	.	.	.	KQI	.	KQSH	KQSHH	KQSL	KQSLL	.	.	.	.	.	.	.	.	.	.	.
LEVEL	L	LA	LAH	LAHH	LAL	LALL	LIC	LC	LR	LI	LS	LSH	LSHH	LSL	LSLL	LSHL	LRT	LIT	LT	LY	LV	LCV	LE	LW	LG	.
NOT ASSIGNED	M	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NOT ASSIGNED	N	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NOT ASSIGNED	O	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PRESSURE/VACUUM	P	PA	PAH	PAHH	PAL	PALL	PIC	PC	PR	PI	PS	PSH	PSHH	PSL	PSLL	PSHL	PRT	PIT	PT	PY	*PV	PCV	PE	.	PG	PSV , PSE
PRESSURE DIFF.	PD	PDA	PDAH	PDAHH	PDAL	PDALL	PDIC	PDC	PDR	PDI	PDS	PDSH	PDSHH	PDSL	PDSLL	PDSHL	PDRT	PDIT	PDT	PDY	PDV	PDCV	PE	.	PDG	.
QUANTITY	Q	QA	QAH	QAHH	QAL	QALL	QIC	QC	QR	QI	QS	QSH	QSHH	QSL	QSLL	QSHL	QRT	QIT	QT	QY	.	.	QE	.	.	.
RADIATION	R	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SPEED/FREQUENCY	S	SA	SAH	SAHH	SAL	SALL	SIC	SC	SR	SI	SS	SSH	SSHH	SSL	SSLL	SSHL	SRT	SIT	ST	SY	.	.	SE	.	.	.
TEMPERATURE	T	TA	TAH	TAHH	TAL	TALL	TIC	TC	TR	TI	TS	TSH	TSHH	TSL	TSLL	TSHL	TRT	TIT	TT	TY	TV	TCV	TE	TW	TG	TSE
TEMPERATURE DIFF.	TD	TDA	TDAH	TDAHH	TDAL	TDALL	TDIC	TDC	TDR	TDI	TDS	TDSH	TDSHH	TDSL	TDSLL	TDSHL	TDRT	TDIT	TDT	TDY	.	.	TE	TW	TG	.
MULTIVARIABLE	U	UA	.	.	.	.	.	.	UR	UI	US	.	.	.	.	.	URT	UIT	UT	UY	.	.	.	.	.	.
VIBRATION / MACH. ANALYSIS	V	VA	VAH	VAHH	VAL	VALL	VIC	VC	VR	VI	VS	VSH	VSHH	VSL	VSLL	VSHL	VRT	VIT	VT	VY	.	.	VE	.	.	.
WEIGHT	W	WA	WAH	WAHH	WAL	WALL	WIC	WC	WR	WI	WS	WSH	WSHH	WSL	WSLL	WSHL	WRT	WIT	WT	WY	WV	WCV	WE	.	.	.
MISC.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
EVENT/STATE/PRESENCE	Y	YA	.	.	.	.	.	.	.	.	YS	.	.	.	.	.	.	.	.	YY	.	.	.	.	.	.
POSITION/DIMENSION	Z	*ZA	ZAH	ZAHH	ZAL	ZALL	ZIC	ZC	ZR	ZI	*ZS	ZSH	ZSHH	ZSL	ZSLL	ZSHL	ZRT	ZIT	ZT	ZY	.	.	ZE	.	.	.

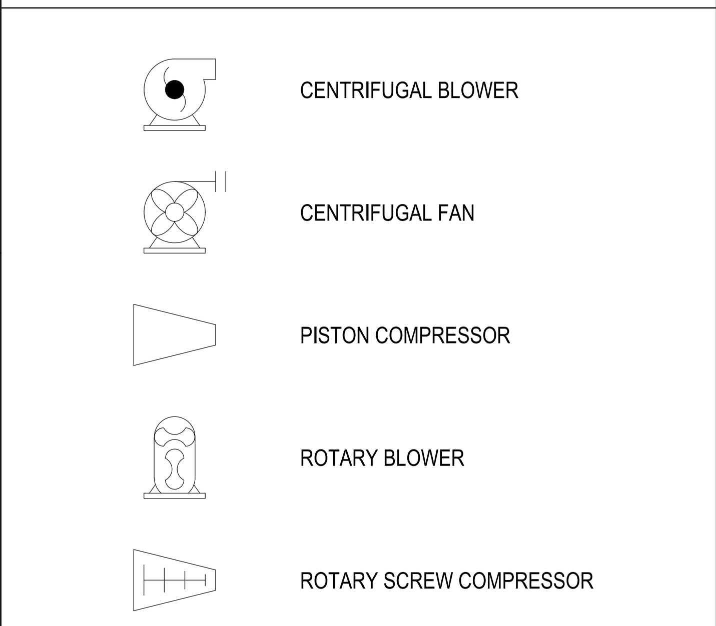
NOTE:
1. THIS TABLE IS NOT ALL-INCLUSIVE.
2. "A" IS USED FOR ANALYTICAL VARIABLES NOT LISTED IN THE TABLE. EXAMPLE: O, H, CO, NO, CO, SO, pH, SMOKE, SP COND, CAT COND.
3. THIS TABLE IS DERIVED WITH CONTENT FROM ISA S5.1

* ZAC = CLOSE FAIL, ZAO = OPEN FAIL, ZSC = CLOSE STATUS, ZSO = OPEN STATUS.
* PVO = PNEUMATIC ACTUATOR RATE SET VALVE - OPENING, PVC = PNEUMATIC ACTUATOR RATE SET VALVE - CLOSING.

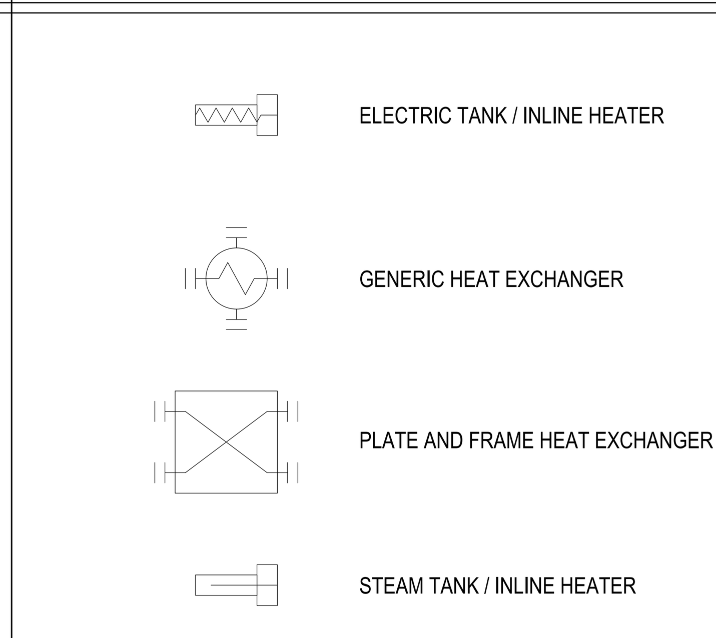
GENERAL ABBREVIATIONS

(A) - ABANDON IN PLACE
AG - ABOVE GROUND
ALK - ALKALINITY
AMB - AMBIENT
BF - BLIND FLANGE
BL - BATTERY LIMIT
BLDG - BUILDING
BTL - BOTTOM TANGENT LINE
C/W - COMPLETE WITH
CA - COMPRESSED AIR
CCO - CHEMICAL CLEAN OUT
CCW - COUNTER CLOCKWISE
CIP - CLEAN IN PLACE
CO - CLEAN OUT
COND - CONDUCTIVITY
CSC - CAR SEAL CLOSED
CSO - CAR SEAL OPEN
CW - CLOCKWISE
DIA - DIAMETER
DO - DISSOLVED OXYGEN
DWG - DRAWING
(E) - EXISTING
EA - EACH
EL - ELEVATION
ES - ELECTRIC SUPPLY
EXT - EXTERNAL
(F) - FUTURE
FC - FAIL CLOSED
FF - FLAT FACE
FI - FAIL INDETERMINATE
FL - FAIL LAST
FOF - FACE OF FLANGE
FO - FAIL OPEN
FP - FULL PORT
FV - FULL VACUUM
(G) - GREEN
HARD - HARDNESS
HH - HAND HOLE
HMI - HUMAN-MACHINE INTERFACE
HOA - HAND / OFF / AUTO
HP - HORSEPOWER
HVAC - HEAT,VENT,AIR CONDITIONING
HWL - HIGH WATER LEVEL
I/F - INTERFACE
IA - INSTRUMENT AIR
ID - INTERNAL DIAMETER
INT - INTERNAL
ISBL - INSIDE BATTERY LIMIT
LP - LOW PRESSURE
MAG - MAGNETIC
MAX - MAXIMUM
MIN - MINIMUM
MOC - MATERIAL OF CONSTRUCTION
MP - MEDIUM PRESSURE
MW - MANWAY
(N) - NEW
N - NOZZLE
NC - NORMALLY CLOSED
NNF - NORMALLY NO FLOW
NO - NORMALLY OPEN
NPT - NATIONAL PIPE THREAD
OAH - OVERALL HEIGHT
OD - OUTSIDE DIAMETER
ORP - OXYGEN REDUCTION POTENTIAL
OSBL - OUTSIDE BATTERY LIMIT
OHD - OVERHEAD
P&ID - PIPING & INSTRUMENT DIAGRAM
PH - PHASE
PLC - PROGRAMMABLE LOGIC CONTROLLER
POS - POSITIONED
PWHT - POST WELD HEAT-TREAT
QC - QUICK CONNECT
(R) - RELOCATE/REUSE
REQD - REQUIRED
RES - RESISTIVITY
RF - RAISED FACE
RP - REDUCED PORT
RTD - RESISTANCE TEMP DETECTOR
SAS - START/AUTO/STOP
SCADA - SUPERVISORY CONTROL & DATA ACQUISTION
SCH - SCHEDULE
SLD - SIDE LIQUID DEPTH
SOP - SHUT OFF PRESSURE
SP - SET POINT
SPEC - SPECIFICATION
SS - STRAIGHT SIDE
STD - STANDARD
SWL - STATIC WATER LEVEL
SYM - SYMMETRICALLY PIPED
T/T - TANGENT TO TANGENT
TBA - TO BE ANNOUNCED
TCx - THERMOCOUPLE (TYPE x)
TDH - TOTAL DISCHARGE HEAD
THK - THICK
TOC - TOTAL ORGANIC CARBON
TOS - TOP OF SLUDGE
TR - TRIM
TSO - TIGHT SHUT OFF
TURB - TURBIDITY
TYP - TYPICAL
UC - UTILITY CONNECTION
UG - UNDERGROUND
UPS - UNINTERRUPTED POWER SUPPLY
(V) - VENDOR FURNISHED
V - VOLTS
W - WATTS
(Y) - YELLOW

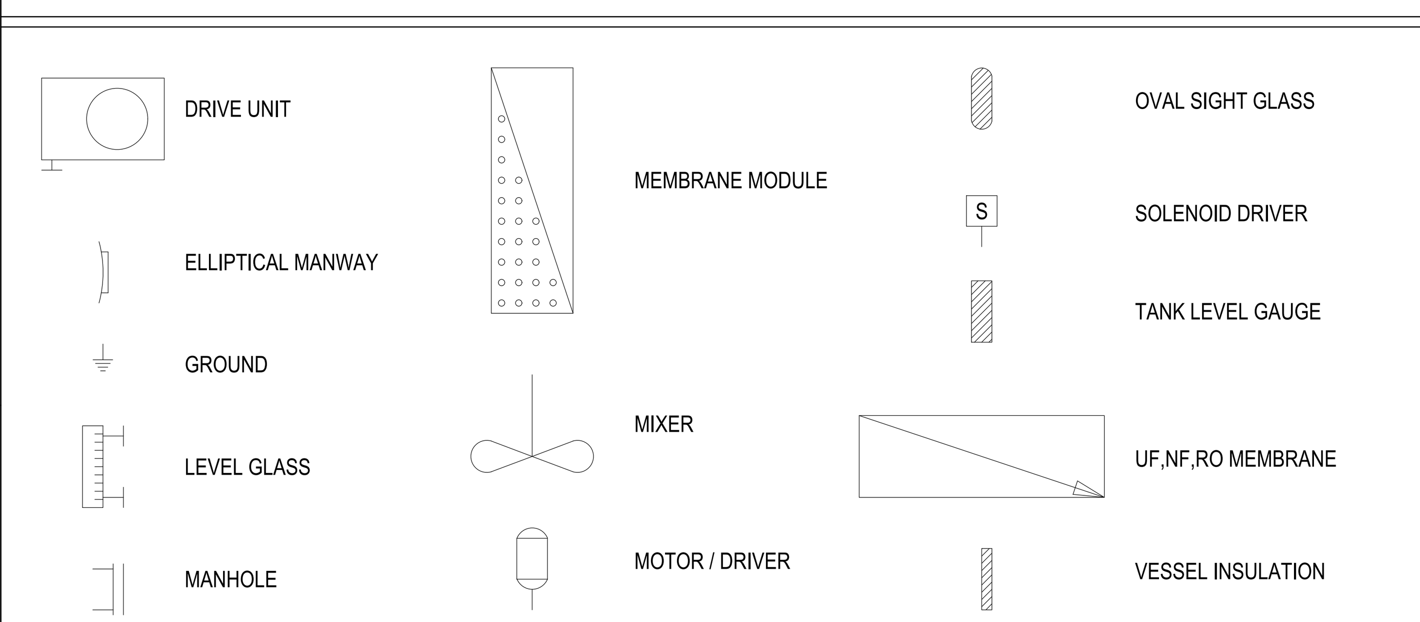
COMPRESSOR / BLOWER SYMBOLS



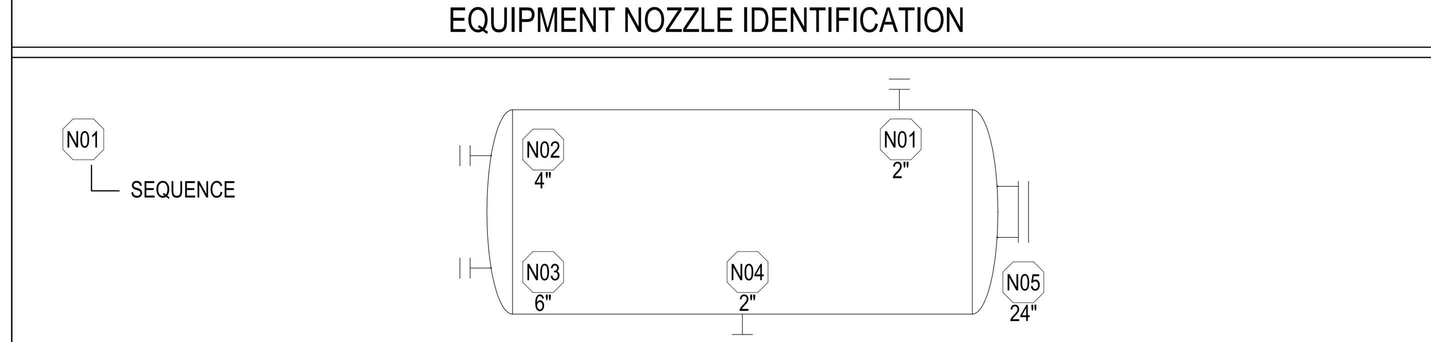
HEAT EXCHANGER SYMBOLS



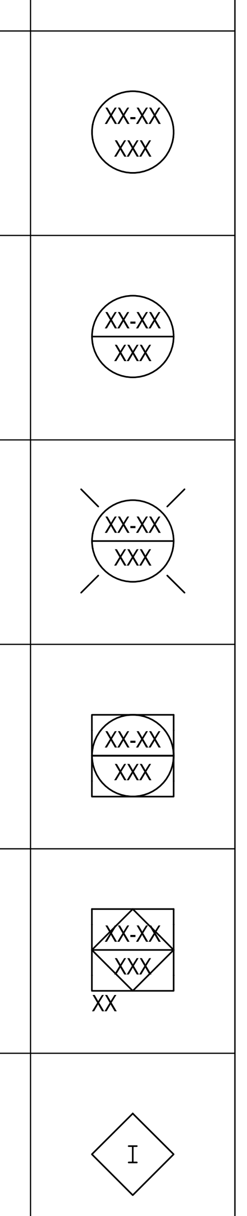
MISCELLANEOUS EQUIPMENT SYMBOLS



EQUIPMENT NOZZLE IDENTIFICATION

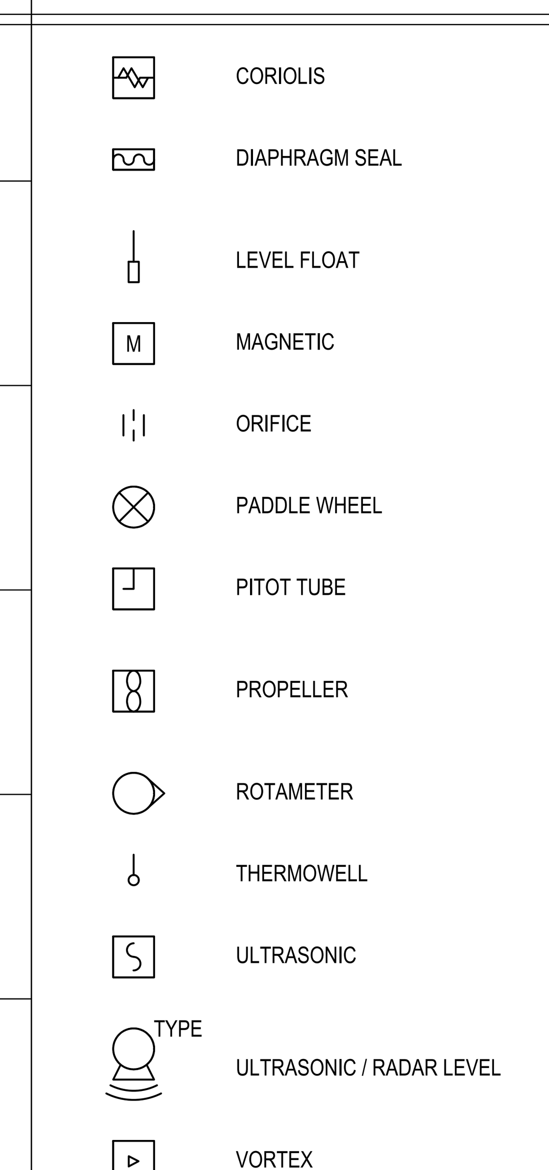


INSTRUMENT LOGIC SYMBOLS

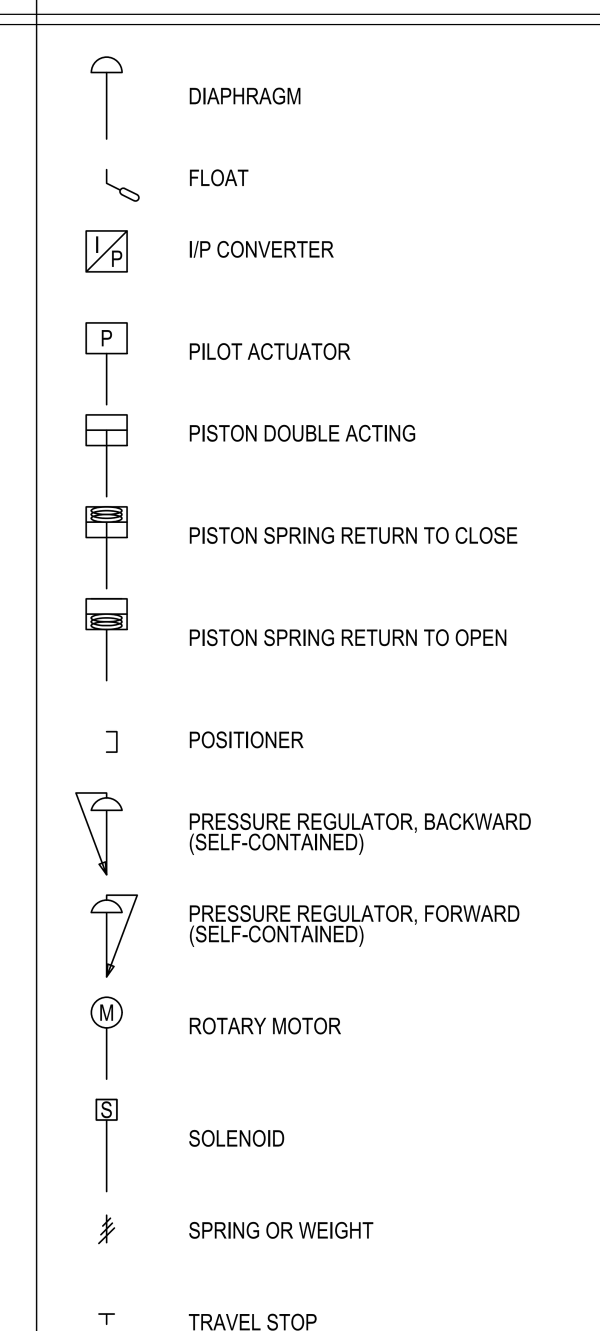


LOCATION / ACCESSIBILITY	SYMBOLS
FIELD OR LOCALLY MOUNTED	
PANEL MOUNTED	
INDICATOR LIGHT OR BEACON, ON PANEL	
HMI/SCADA FUNCTION WITH DISPLAY	
HARDWIRED I/O (XX = DI/DO/AI/AO) DI - DISCRETE INPUT DO - DISCRETE OUTPUT AI - ANALOG INPUT AO - ANALOG OUTPUT __ - SOFTWIRED I/O	
HARDWIRED INTERLOCK	

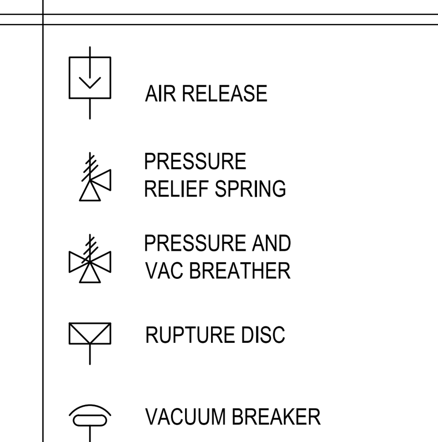
PRIMARY ELEMENT SYMBOLS



CONTROL VALVE ACTUATORS



RELIEF



NOTES/OTHER SYMBOLS

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION: SAMPLE FOR DUNDAS WWTP

P&ID
LEGENDS & SYMBOLS

DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN21-DS-001	A

REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
495186		NONE	D	3 OF 3

LAST SAVED: Thursday, January 25, 2024 10:26:31 AM

FILE LOCATION: C:_ADSKVault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-001.dwg

20-B-201A

MEMBRANE BLOWER

TYPE: POSITIVE DISPLACEMENT
MIN. RATED CAPACITY: 449 ICFM @ 6.0 PSIG
MAX. RATED CAPACITY: 1,763 ICFM @ 6.0 PSIG
BLOWER VENDOR & MODEL: AERZEN GM 80L

20-M-201A

MEMBRANE BLOWER MOTOR

POWER : 75 HP @ 575 V / 3 ph / 60 Hz
TEFC / 1800 RPM

MEMBRANE AERATION, AS INSTALLED

NUMBER OF TRAINS OPERATING		1	2	3	4
LEAP-LO	NUMBERS OF BLOWERS OPERATING	1	1	2	2
	FLOW PER BLOWER (ICFM)	700	1,400	700	1,400
LEAP-HI	NUMBERS OF BLOWERS OPERATING	1	2	3	4
	FLOW PER BLOWER (ICFM)	1,400	1,400	1,400	1,400

BLOWER DESIGN CONDITIONS	INSTALLED			MAXIMUM (TRAINS FULLY POPULATED)		
NO OF INSTALLED BLOWERS	4			4		
LEAP LO, PER TRAIN	700 ICFM	at	5.0-5.5 PSIG (34.5-38 kPa)	788 ICFM	at	5.0-5.5 PSIG (34.5-38 kPa)
LEAP HI, PER TRAIN	1,400 ICFM	at	5.2-5.5 PSIG (35.9-38kPa)	1,575 ICFM	at	5.2-5.5 PSIG (35.9-38 kPa)
MAX DISCHARGE TEMPERATURE	80°C			80°C		

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
BLOWER PACKAGE	VEOLIA	OTHERS	
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
VFD	OTHERS	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION SCOPE.
3. CLIENT IS RESPONSIBLE FOR HOT AIR PIPE INSULATION FOR PERSONNEL PROTECTION, AS APPLICABLE.
4. BLOWER DISCHARGE FLEXIBLE SLEEVE COMES WITH GEAR CLAMPS.
5. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
6. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.

VEOLIA

REFERENCE ONLY
DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
MEMBRANE BLOWERS
POSITIVE DISPLACEMENT TYPE

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-102
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 1

LAST SAVED: Thursday, January 25, 2024 10:29:57 AM

FILE LOCATION: C:_ADSKVault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-102.dwg

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
MEMBRANE CASSETTES AND MODULES	VEOLIA	OTHERS	INCLUDING SUPPORT HARDWARE
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
VEOLIA TRAIN PERMEATE PIPING	VEOLIA	OTHERS	DELINEATED BY SOLID LINES
VEOLIA TRAIN AIR PIPING	VEOLIA	OTHERS	DELINEATED BY SOLID LINES
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES
MEMBRANE TANKS	OTHERS	OTHERS	
TANK INFLUENT GATE	OTHERS	OTHERS	VEOLIA TO SIZE THE GATE
DEFLECTOR PLATE	OTHERS	OTHERS	VEOLIA TO SIZE THE PLATE
TANK COVERS	OTHERS	OTHERS	
CHANNEL/ INFLUENT GATES	OTHERS	OTHERS	
FALL PROTECTION SYSTEM	OTHERS	OTHERS	

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION SCOPE.
3. DRAWING TYPICAL FOR EVERY MEMBRANE TANK, WHERE -1 REPRESENTS TANK NUMBER; WITH EXCEPTION OF COMMON CHANNEL.
4. A PORTION OF THE AIR LINE NEEDS TO BE ROUTED A MINIMUM OF 2 FT (610 MM) ABOVE MAXIMUM LIQUID LEVEL IN TANK BEING AERATED TO PREVENT WATER BACK FLOW.
5. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
6. LEVEL TRANSMITTER TO BE INSTALLED AS FAR AS POSSIBLE FROM PUMP SUCTION BUT STILL WITHIN DRAIN TRENCH AREA.
7. CONNECTION TO BE PROVIDED AT HIGHEST POINT ON PIPING BETWEEN PERMEATE HEADER AND PUMP.
8. ALL EQUIPMENT INSTALLED OUTDOORS NEEDS TO BE TEMPERATURE AND UV PROTECTED AS REQUIRED, BY OTHERS.
9. LSHH IS PLACED 1 FT(300mm) BELOW THE TOP OF THE TANK. LSLL IS PLACED AT THE SAME ELEVATION AS THE TOP OF THE MEMBRANE FIBERS.
10. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.
11. RAS SUCTION/DISCHARGE PIPING IN ACCORDANCE WITH THE RFP SECTION 11300, 2.5, H.6 FOR FLOWS UP TO MMF N-2 CONDITION. ADHERING TO THIS REQUIREMENT FOR MDF N-1 AND PHF N-1 CONDITONS SIGNIFICANTLY INCREASES THE PIPE SIZE. AS THESE FLOWS WILL BE SUSTAINED FOR SHORT PERIODS OF TIME, VEOLIA HAS OPTED TO SIZE THE RAS LINE BASED ON THE RECOMMENDATIONS OF THE HYDRAULIC INSTITUTE WHICH STATES SUCTION FLOWS SHALL NOT EXCEED 8 FT/S (ANSI/HI 9.8-1998, PUMP INTAKE DESIGN, P. 20, PARA 9.8.4.3) AND DISCHARGE FLOWS SHALL NOT EXCEED 10 FT/S.

MEMBRANE TANK DATA	
TAG NUMBERS	20-TK-201-1
TANK MATERIAL	CONCRETE
INTERNAL LENGTH	510 INCH (12,954 mm)
INTERNAL WIDTH	108 INCH (2,743 mm)
TOTAL DEPTH (AT SHALLOW END)	156 INCH (3,962 mm)
MAX OPERATING LIQUID LEVEL	118 INCH (2,997 mm)
MIN OPERATING LIQUID LEVEL	110 INCH (2,794 mm)
CLEANING LEVEL	100 INCH (2,540 mm)
TOP OF FIBERS (LSLL) LEVEL	97 INCH (2,464 mm)

MEMBRANE DATA	INSTALLED	BUILDOUT
INSTALLED NUMBER OF TRAINS	4	
CASSETTE & MODULE SERIES	ZW500EV - LEAP	
MODULE SURFACE AREA	530 FT2 (49.2 m2)	
MAX # OF MEMBRANE MODULES PER CASSETTE	64	
# OF CASSETTE SPACES PER TANK	6	
# OF FULL CASSETTES	4	6
# OF FLEX CASSETTES	2	0
# OF MODULES PER FLEX CASSETTE	44	0
# OF MODULES PER TRAIN	344	384

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

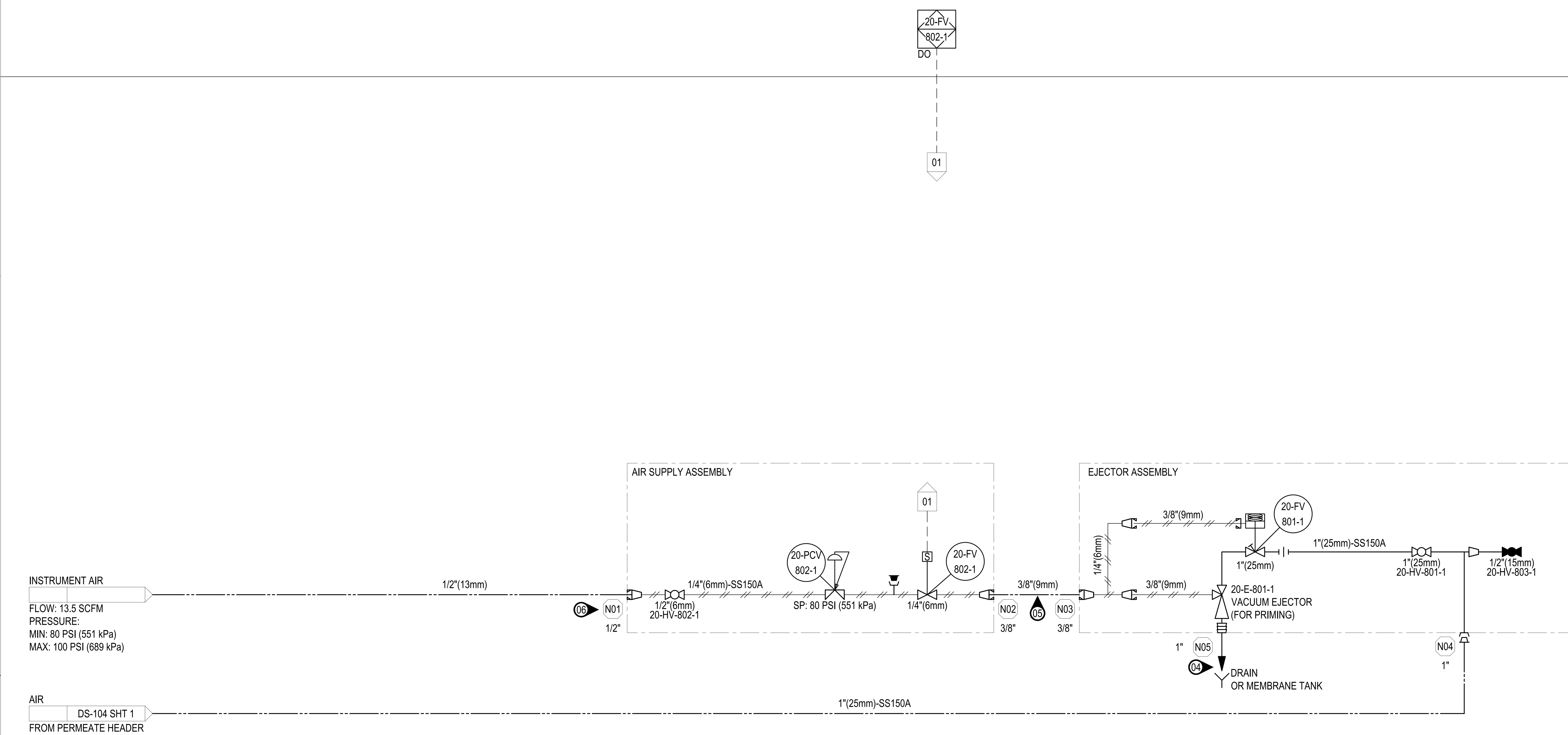
P&ID
MEMBRANE TANK

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-104
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 2

LAST SAVED: Thursday, January 25, 2024 3:51:03 PM

FILE LOCATION: C:_ADSK\Vault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-104.dwg

PLC / HMI



NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
EJECTOR ASSEMBLY (2 PIECES)	VEOLIA	OTHERS	ASSEMBLED BY VEOLIA
VALVES AND INSTRUMENTS	VEOLIA	VEOLIA	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES ———·-·———

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION.
3. DRAWING TYPICAL FOR EVERY TRAIN, WHERE "-1" REPRESENTS TRAIN NUMBER.
4. AIR GAP IS REQUIRED ON EJECTOR DISCHARGE LINE EXHAUST TO MEMBRANE TANK OR DRAIN.
5. THE 3/8" TUBING THAT CONNECTS THE TWO SPOOLS TOGETHER IS TO BE PROVIDED AND INSTALLED ONSITE BY OTHERS. PE OR NYLON TUBING IF USED SHOULD BE DARK COLOR FOR UV RESISTANCE IF LOCATED OUTDOORS.
6. REFER TO TIE POINTS ON EQUIPMENT ARRANGEMENT DRAWINGS.
7. ALL EQUIPMENT ON THIS SHEET ARE DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X
.XX FRAC
.XXX

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
AIR EJECTOR

DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN21-DS-104	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
495186		NONE	D	2 OF 2

LAST SAVED: Thursday, January 25, 2024 3:51:03 PM

FILE LOCATION: C:_ADSK\Vault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-104.dwg

20-P-301-1
PROCESS PUMP
TYPE: ROTARY-LOBE, REVERSIBLE
MIN. RATED CAPACITY: 24 L/s (380 GPM) @ 0 PSI FT TDH
MAX. RATED CAPACITY: 208 L/s (3,300 GPM) @ 15.2 PSI FT TDH
NUMBER OF DUTY PUMPS: ONE PER TRAIN
PUMP VENDOR AND MODEL : BORGER EL 3050

20-M-301-1
PROCESS PUMP MOTOR
POWER : 75 HP @ 575 V / 3 ph / 60 Hz
TEFC / 1800 RPM

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
PROCESS PUMP	VEOLIA	OTHERS	
VFD	OTHERS	OTHERS	
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION.
3. DRAWING TYPICAL FOR EVERY MEMBRANE TRAIN, WHERE -1 REPRESENTS TRAIN NUMBER.
4. VALVE FOR DRAIN, SERVICE, OR SAMPLE. VALVE TO BE POSITIONED TO ALLOW FULL DRAINING TO FLOOR DRAIN OR BUCKET, BY GRAVITY.
5. FLOOR DRAINS TO BE PROVIDED AND PIPED INTO BY GENERAL CONTRACTOR, AS REQUIRED.
6. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
7. FOR MAGMETER INSTALLATION INSTRUCTION, REFER TO VENDOR LITERATURE. NOTE THE FLOW IS BIDIRECTIONAL, SO IDENTICAL STRAIGHT PIPE RUNS MUST BE PROVIDED ON BOTH SIDES OF THE INSTRUMENT.
8. DESIGN ENGINEER TO ENSURE MAGMETER AND PERMEATE COLLECTOR REMAIN FLOODED AT ALL TIMES.
9. PRESSURE SWITCHES 20-PSH-301-1 AND 20-PSH-302-1 ARE WIRED DIRECTLY TO THE VFD.
10. BLEED VALVES TO BE INSTALLED TO ALLOW OPERATOR ACCESSIBILITY. BLEED VALVE TO BE POSITIONED TO ALLOW FULL DRAINING BETWEEN THE ISOLATION VALVES. DRAIN TO SAFE LOCATION. DRAINS FROM SODIUM HYPOCHLORITE SOLUTION AND ANY ACID SOLUTION SHOULD NOT BE COMBINED SINCE POISONOUS GASES MAY BE CREATED.
11. PROVIDE BACK PRESSURE IF REQUIRED TO FILL BACKPULSE TANKS AND ANALYZERS.
12. POINT OF CHEMICAL INJECTION SHOULD BE BOTTOM OF PIPE FOR HORIZONTAL PROCESS PIPE.
13. ALL CHEMICAL LINE VALVES SHOULD BE INSTALLED AS CLOSE AS POSSIBLE TO POINT OF INJECTION.
14. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.

DESIGN DUTY POINTS	INSTALLED		MAXIMUM TRAINS FULLY POPULATED	
INSTALLED # OF PUMPS	4		4	
FLOW CONDITION	FLOW PER TRAIN	MAX TDH, FT	FLOW PER TRAIN	MAX TDH, FT
AADF	32 L/s (512 GPM)	35	32 L/s (512 GPM)	35
MAXIMUM FLOW (PHF N-1)	197 L/s (3,120 GPM)	35	197 L/s (3,120 GPM)	35
BACKPULSE FLOW	160 L/s (2,532 GPM)	35	178 L/s (2,827 GPM)	35
CLEANING	96 L/s (1,519 GPM)	35	107 L/s (1,696 GPM)	35

VEOLIA
REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX — ANGLES FRAC

VEOLIA

CUSTOMER INFORMATION: SAMPLE FOR DUNDAS WWTP

P&ID
PERMEATE PUMP

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-105
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 2

LAST SAVED: Thursday, January 25, 2024 11:04:57 AM

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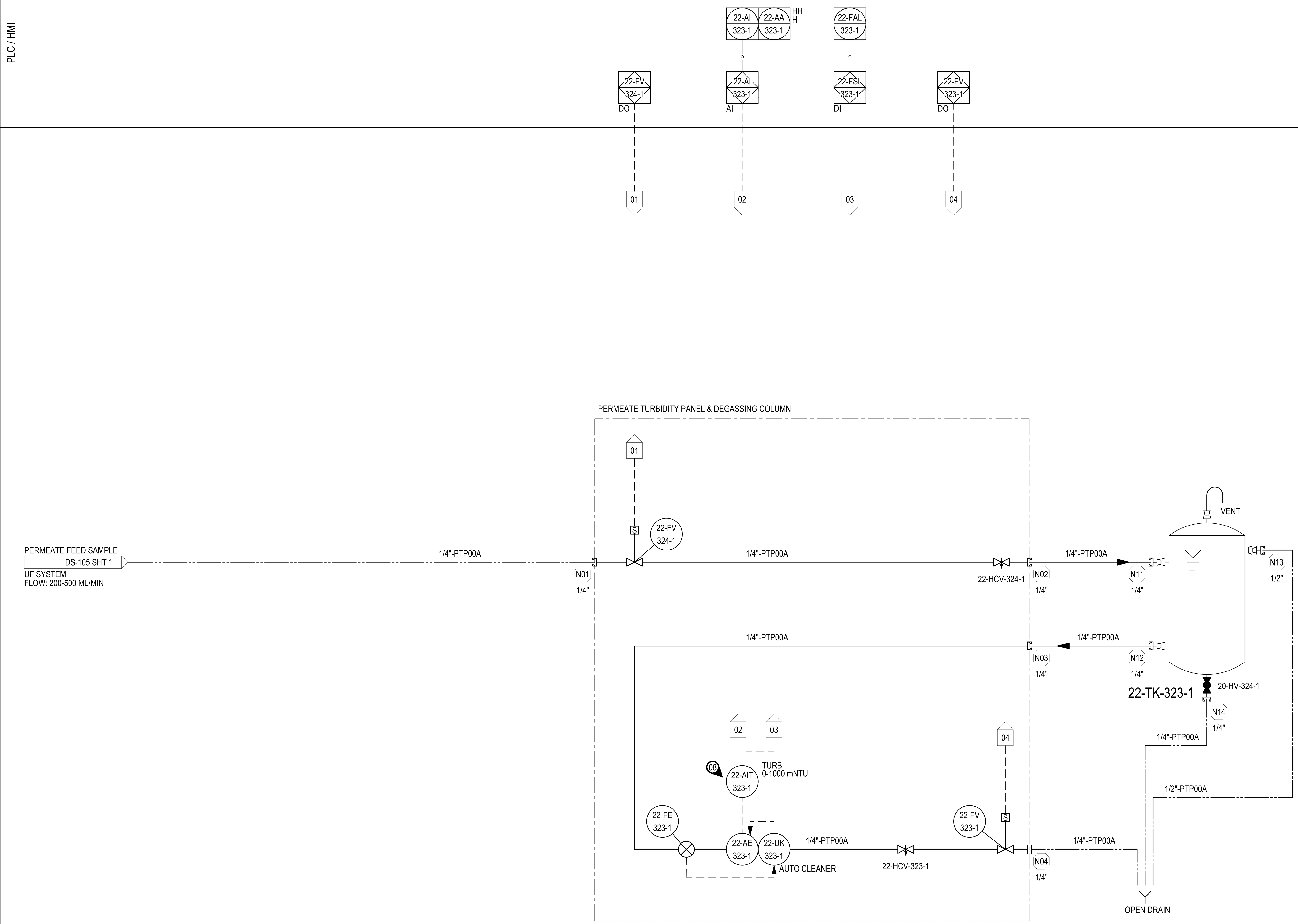

22-TK-323-1
DEGASSING COLUMN
VOLUME: 0.66 USgal (2490 mL)
MOC : PVC(CLEAR), SCH. 80
SEE EQUIPMENT ARRANGEMENT DRAWING
DIAMETER : 3" DIA X 24" SIDESHELL

NOTES:
1. ALL DOTTED LINES\EQUIPMENTS BY OTHERS. "——— - - ———"
2. ALL DRAIN POINTS TO BE PLUMBED TO ATMOSPHERIC DRAIN (BY OTHERS).
3. REFER TO TIE POINTS ON EQUIMENT ARRANGEMENT DRAWINGS.
4. DRAWING TYPICAL FOR EVERY TRAIN, WHERE "-1" REPRESENTS TRAIN NUMBER.
5. TURBIDIMETER TRANSMITTER MUST BE CONFIGURED TO FAIL HIGH.
6. ALL EQUIPMENT ON THIS SHEET IS SUPPLIED BY VEOLIA UNLESS OTHERWISE NOTED.
7. FLOW SET TO 3.3 GPH [210 ml/min].
8. TURBIDITY TRANSMITTER SHALL BE FIELD PROGRAMMED TO ALARM ON LOW SENSOR FLOW DURING COMMISSIONING. SETTINGS TO BE ADJUSTED FOR SPECIFIC PROJECT NEEDS.

08

INITIAL TURBIDITY SETTINGS	
SOURCE	XXXXXXX
PARAMETER	FLOW [L/min]
DATA VIEW	RELAY CONTACT STATUS
FUNCTION	ALARM
TRANSFER	RELAYS ARE DE-ENERGIZED
PHASE	DIRECT CONTROL
HIGH ALARM	9999 L/min (SET ABOVE USABLE VALUE)
LOW ALARM	0.150 L/min
HIGH DEADBAND	0.01 L/min
LOW DEADBAND	0.01 L/min

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
TURBIDIMETER

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-105
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 2 OF 2

LAST SAVED: Thursday, January 25, 2024 11:04:57 AM
FILE LOCATION: C:_ADSK\Vault\NAM-ITO\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-105.dwg

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. ALL EQUIPMENT ON THIS SHEET ARE DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
3. PLANT START-UP WATER TO BE ADDED TO TANK WITH HOSE.
4. CAPPED CONNECTION FOR RECIRCULATION BACK TO THE BIOREACTOR DURING START-UP. TEMPORARY PIPING IS PROVIDED BY OTHERS.
5. VALVE NEEDS TO BE LOCKED OPEN.
6. PERMEATE COLLECTOR AND BP TANK SIZED FOR BUILDOUT.
7. VENT OPTIONAL, AS REQUIRED.
8. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.

BACKPULSE TANK DATA		
# OF TANK	1	
TAG NUMBERS	20-TK-601	
TANK MATERIAL	CONCRETE, USING THE 3-4 FT WIDE GAP BETWEEN MEMBRANE TANKS #2 AND #3	
INTERNAL LENGTH	THE ENTIRE LENGTH OF MEMBRANE TANK	
TOTAL DEPTH	13	FT

VEOLIA

REFERENCE ONLY
DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX ANGLES FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
BACKPULSE TANK

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-106
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 1

LAST SAVED: Thursday, January 25, 2024 10:51:47 AM

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
RAS PUMP	VEOLIA	OTHERS	
WAS EQUIPMENT	OTHERS	OTHERS	
VFD	OTHERS	OTHERS	
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION.
3. VALVE FOR DRAIN, SERVICE, OR SAMPLE. VALVE TO BE POSITIONED TO ALLOW FULL DRAINING TO FLOOR DRAIN OR BUCKET, BY GRAVITY
4. FLOOR DRAINS TO BE PROVIDED AND PIPED INTO BY GENERAL CONTRACTOR, AS REQUIRED.
5. WHERE POSSIBLE, IT IS BENEFICIAL TO USE LONG RADIUS ELBOWS IN LIEW OF SHORT RADIUS ELBOWS.
6. SUFFICIENT BACK-PRESSURE MUST BE AVAILABLE ON THE COMMON RAS LINE TO ALLOW FOR PREFERENTIAL FLOW TO WAS DESTINATION. IF REQUIRED, AN AUTOMATICALLY ACTUATED VALVE CAN BE ADDED TO THE COMMON RAS LINE TO CREATE ADDITIONAL BACKPRESSURE.
7. FOLLOW MANUFACTURER'S RECOMMENDATION REGARDING INSTALLATION REQUIREMENTS, INCLUDING NUMBER OF STRAIGHT PIPE RUNS. IT IS CRITICAL THAT THE FLOWMETER IS ALWAYS FULL OF WATER BECAUSE IT WILL NOT PROVIDE READINGS IF THERE ARE ANY AIR POCKETS, HENCE, INSTALL IT ACCORDINGLY.
8. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
9. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.
10. RAS SUCTION/DISCHARGE PIPING IN ACCORDANCE WITH THE RFP SECTION 11300, 2.5, H.6 FOR FLOWS UP TO MMF N-2 CONDITION. ADHERING TO THIS REQUIREMENT FOR MDF N-1 AND PHF N-1 CONDITONS SIGNIFICANTLY INCREASES THE PIPE SIZE. AS THESE FLOWS WILL BE SUSTAINED FOR SHORT PERIODS OF TIME, VEOLIA HAS OPTED TO SIZE THE RAS LINE BASED ON THE RECOMMENDATIONS OF THE HYDRAULIC INSTITUTE WHICH STATES SUCTION FLOWS SHALL NOT EXCEED 8 FT/S (ANSI/HI 9.8-1998, PUMP INTAKE DESIGN, P. 20, PARA 9.8.4.3) AND DISCHARGE FLOWS SHALL NOT EXCEED 10 FT/S.

DESIGN DUTY POINTS		
INSTALLED NUMBER OF PUMPS	4	
FLOW CONDITION	FLOW PER TRAIN	TDH, FT
AVERAGE DAILY FLOW	123 L/s (1,950 GPM)	9 FT
MAXIMUM FLOW	416 L/s (6,600 GPM)	18 FT

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
RAS PUMP

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-110
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 1

LAST SAVED: Thursday, January 25, 2024 9:29:17 PM

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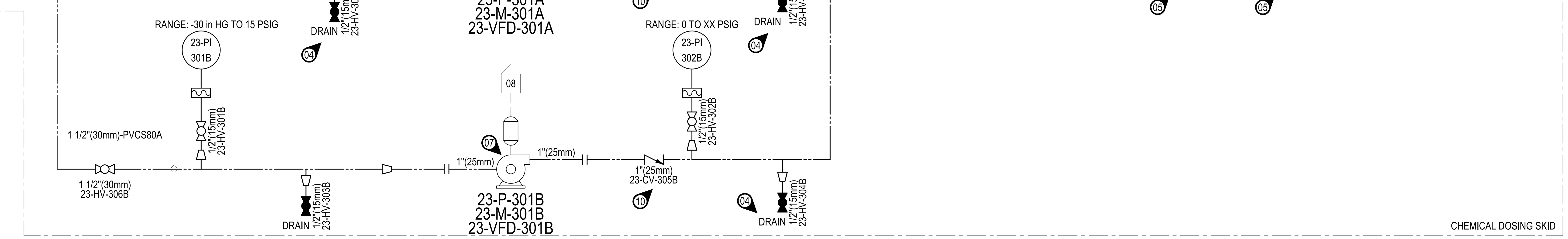


NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
CHEMICAL PUMPS	VEOLIA	OTHERS	
VFD	OTHERS	OTHERS	
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION.
3. INDIVIDUAL CHEMICALS OF DIFFERENT TYPES SHOULD NOT BE MIXED. CONTAINMENT SHOULD BE PUMPED, NOT DRAINED. DRAINS FROM SODIUM HYPOCHLORITE SOLUTION AND ANY ACID SOLUTION SHOULD NOT BE COMBINED SINCE POISONOUS GASES MAY BE CREATED.
4. FLOOR DRAINS TO BE PROVIDED AND PIPED INTO BY GENERAL CONTRACTOR, AS REQUIRED.
5. 23-HCV-105/305 TO BE ADJUSTED FOR MAINTENANCE CLEAN FLOW. 23-HCV-106/306 TO BE ADJUSTED FOR RECOVERY CLEAN FLOW. IF THERE IS ONLY RECOVERY CLEAN FLOW THEN 23-HCV-105/305 AND 23-FV-105/305 CAN BE REMOVED.
6. BOTTOM CONNECTION FROM THE TANK IS MANDATORY.
7. FLOODED SUCTION SET-UP REQUIRED FOR PUMP OPERATION.
8. VALVE TO OPEN ONLY FOR RECOVERY CLEANS.
9. TANK DESIGN, INCLUDING SECONDARY CONTAINMENT AND VENTING IF REQUIRED, IS BY OTHERS.
10. FOLLOW MANUFACTURER'S RECOMMENDATION REGARDING INSTALLATION REQUIREMENTS, INCLUDING NUMBER OF STRAIGHT PIPE RUNS. PIPING MUST BE ARRANGED SO FLOWMETER IS ALWAYS FLOODED.
11. WHERE AMBIENT TEMPERATURES ARE LOWER THAN THE CHEMICAL FREEZING TEMPERATURES, HEAT TRACING AND INSULATION IS REQUIRED, AND NOT SUPPLIED BY VEOLIA.
12. GASKETS AND HARDWARE SHOULD BE COMPATIBLE WITH SELECTED CHEMICAL, (NOT PROVIDED BY VEOLIA).
13. PSV IS SIZED FOR RELIEVING GAS BUILDUP IN THE LINE. IT IS NOT DESIGNED TO RELIEF FULL FLOW WHEN PUMP IS IN OPERATION.
14. LINE SIZE FROM PUMP DOWNSTREAM NEEDLE VALVE TO INJECTION POINT TO BE VERIFIED DURING DETAIL PROJECT ENGINEERING.
15. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
16. ALL PIPING OUTSIDE CONTAINMENT AREA TO BE INSTALLED WITH APPROPRIATE DOUBLE CONTAINMENT, AS REQUIRED.
17. ALL CHEMICAL TANKS/CONTAINMENT TO BE INSTALLED WITH A MINIMUM 24" CLEARANCE ON ALL SIDES FOR INSPECTION/36" CLEARANCE FOR OPERATION.
18. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.
    SITE REQUIREMENT NOTES:
    S1. DO NOT PERMIT INCOMPATIBLE CHEMICALS TO ENTER A COMMON FLOOR DRAIN.
    S2. FRESH WATER TO BE AVAILABLE IN CHEMICAL HANDLING AREAS.
    S3. EYEWASH AND SHOWER STATIONS IN ACCORDANCE WITH LOCAL REGULATIONS

23-P-101A/B
SODIUM HYPOCHLORITE DOSING PUMP
TYPE: END SUCTIONAL-CENTRIFUGAL
MIN. RATED CAPACITY: 0.5 GPM @ 29 PSIG
MAX. RATED CAPACITY: 20 GPM @ 14 PSIG
NUMBER OF DUTY PUMPS: ONE
PUMP VENDOR AND MODEL: DB9V-R-FF-M219

23-M-101A/B
SODIUM HYPOCHLORITE DOSING PUMP MOTOR
POWER : 1.0HP @ 575 VAC/3 ph/60 Hz
TEFC / 3450 RPM

GENERAL PUMP INFO	
SODIUM HYPOCHLORITE	12.5% w/w
NO. OF DUTY PUMPS	1
NO. OF STANDBY PUMPS	1
TYPE OF PUMP	MAG DRIVE CENTRIFUGAL
TAG NUMBERS (INSTALLED)	23-P-201
SPEED CONTROL	VFD
ELECTRIC MOTOR	1.0HP @ 3450RPM
VOLTAGE	480 V / 3 ph / 60 Hz
PUMP MODEL	DB9V-R-FF-M219

	DESIGN FLOW	BUILDOUT
MC	7.87 L/min (2.08 GPM)	8.78 L/min (2.32 GPM)
RC	43.15 L/min (11.4 GPM)	48.45 L/min (12.8 GPM)

GENERAL PUMP INFO	
CITRIC ACID	50% w/w
NO OF DUTY PUMPS	1
NO. OF STANDBY PUMPS	1
TYPE OF PUMP	MAG DRIVE CENTRIFUGAL
TAG NUMBERS (INSTALLED)	23-P-401
SPEED CONTROL	VFD
ELECTRIC MOTOR	1.0HP @ 3450RPM
VOLTAGE	480 VAC/3 ph/60 Hz
PUMP MODEL	DB9V-R-FF-M219

	DESIGN FLOW	BUILDOUT
MC	18.55 L/min (4.9 GPM)	20.82 L/min (5.5 GPM)
RC	20.44 L/min (5.4 GPM)	22.71 L/min (6.0 GPM)

23-P-301A/B
CITRIC ACID DOSING PUMP
TYPE: END SUCTIONAL-CENTRIFUGAL
MIN. RATED CAPACITY: 0.5 GPM @ 29 PSIG
MAX. RATED CAPACITY: 20 GPM @ 14 PSIG
NUMBER OF DUTY PUMPS: ONE
PUMP VENDOR AND MODEL: DB9V-R-FF-M219

23-M-301/B
CITRIC ACID DOSING MOTOR
POWER : 1.0HP @ 575 VAC/3 ph/60 Hz
TEFC / 3450 RPM

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX — ANGLES — FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
MEMBRANE CLEANING CHEMICAL SYSTEMS
CENTRIFUGAL MAG DRIVE PUMP

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-111
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 1

LAST SAVED: Thursday, January 25, 2024 3:52:21 PM

NOTES:

1. SCOPE OF SUPPLY ON THIS SHEET AS PER TABLE BELOW.

ITEMS	SUPPLIED BY	INSTALLATION BY	NOTES
AIR COMPRESSOR AND DRYER	VEOLIA	OTHERS	
MAIN AIR COMPONENT KIT	VEOLIA	OTHERS	
VALVES AND INSTRUMENTS	VEOLIA	OTHERS	
MOTOR STARTERS	OTHERS	OTHERS	
INTERCONNECTING PIPING	OTHERS	OTHERS	DELINEATED BY DOTTED LINES

2. SEE ELECTRICAL DRAWINGS DURING DETAILED ENGINEERING FOR ELECTRICAL WIRING AND INSTALLATION SCOPE.
3. INSTRUMENT AIR DISTRIBUTION NETWORK INCLUDING ISOLATION VALVES SUPPLIED BY OTHERS AS NEEDED. FIELD PIPING BY OTHERS. ENSURE SIZING AND ROUTING DESIGN ALLOWS FOR MINIMAL PRESSURE/VOLUME DROP SUCH THAT A MINIMUM OF 80PSI IS DELIVERED TO THE EQUIPMENT FOR OPERATION.
4. HANDLE FOR BYPASS VALVE TO BE REMOVED OR VALVE LOCKED IN CLOSED POSITION.
5. TIMED DRAIN VALVE SOLENOIDS CONNECT TO LOCAL 120VAC. ADJUST INTERVAL AND DURATION SETTINGS ON SOLENOID TO AMBIENT CONDITIONS.
6. LOW POINT DRAIN VALVE (SUPPLIED AND POWERED BY OTHERS) TO BE LOCATED AT LOW POINT IN PIPING WHERE MOISTURE MAY ACCUMULATE. ADDITIONAL VALVES MAY BE REQUIRED BASED ON PIPE ROUTING.
7. REGULATING VALVES TO BE SET IN THE FIELD BY VEOLIA FSR.
8. CONNECT AIR DRYER TO LOCAL 120 VAC. ONLY ONE DRYER TO OPERATE AT A TIME AND TO BE ROTATED MANUALLY ON A WEEKLY BASIS. IF ONLY ONE DRYER IS SUPPLIED A BYPASS LINE WITH MANUAL VALVE SHALL BE SUPPLIED.
9. CONTRACTOR TO WIRE AIR COMPRESSOR PRESSURE SWITCH TO MCC. VEOLIA FSR TO CONFIRM AND ADJUST PRESSURE SETPOINT DURING COMMISSIONING..
10. MOTOR STARTERS BY CUSTOMER IN CUSTOMER MCC. MOTOR HAND SWITCH BY CUSTOMER ON STARTER BUCKET.
11. PSV ARE NOT FIELD ADJUSTABLE AND SET POINT SHALL BE SET BELOW MAXIMUM OPERATING PRESSURE OF ALL SYSTEM COMPONENTS AND NOT HIGHER THAN 200 PSIG (1379kPa).
12. ALL EQUIPMENT ON THIS SHEET IS DESIGNED TO BE INSTALLED IN A NON-CLASSIFIED AREA (PER NFPA 820).
13. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.

90-CO-001A/B
AIR COMPRESSOR
QUANTITY: 1 DUTY + 1 STANDBY
RATED FLOW: 28.7 ICFM @ 175 PSIG
TYPE: PISTON
INCLUDES ACCESSORIES NOT SHOWN (AIR AFTERCOOLER, CHECK VALVE, RELIEF VALVE)

90-M-001A/B
AIR COMPRESSOR MOTOR
POWER: 7.5 HP @ 575V / 3PH / 60Hz

90-REC-001A/B
RECEIVER
VOLUME: 120 GAL (16 CU FT)
MOC: CARBON STEEL

90-F-002
COALESCING FILTER
DESIGN FLOW: 44 CFM
MICRON RATING: 1um

90-DA-001A/B
AIR DRYER
DESIGN FLOW: 24 CFM
TYPE: REFRIGERANT
POWER: 0.5 HP @ 120V / 1PH / 60hZ

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		SK	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES
FRAC

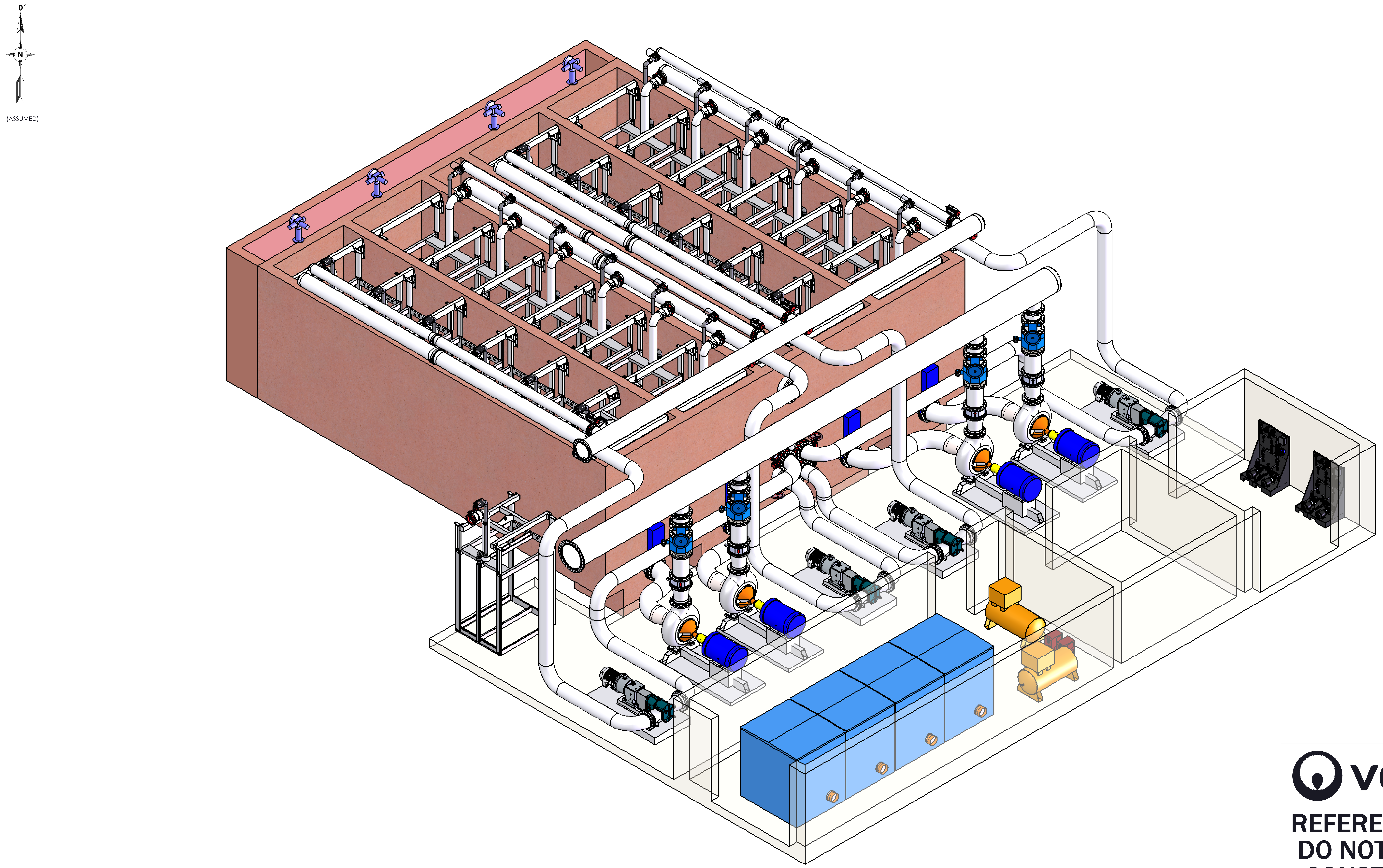
CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

P&ID
AIR COMPRESSORS

DRAWING NUMBER: 495186-WTS-PR-SYS-EN21-DS-112
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: NONE
SIZE: D
SHEET: 1 OF 1

LAST SAVED: Thursday, January 25, 2024 11:02:49 AM

FILE LOCATION: C:_ADSK\Vault\NAM-IT\O\495186-Carleton Place\1. PFD and P&ID\495186-WTS-PR-SYS-EN21-DS-112.dwg



ISO VIEW

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		VM	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX — ANGLES ° — FRAC

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

PRELIMINARY SYSTEM LAYOUT

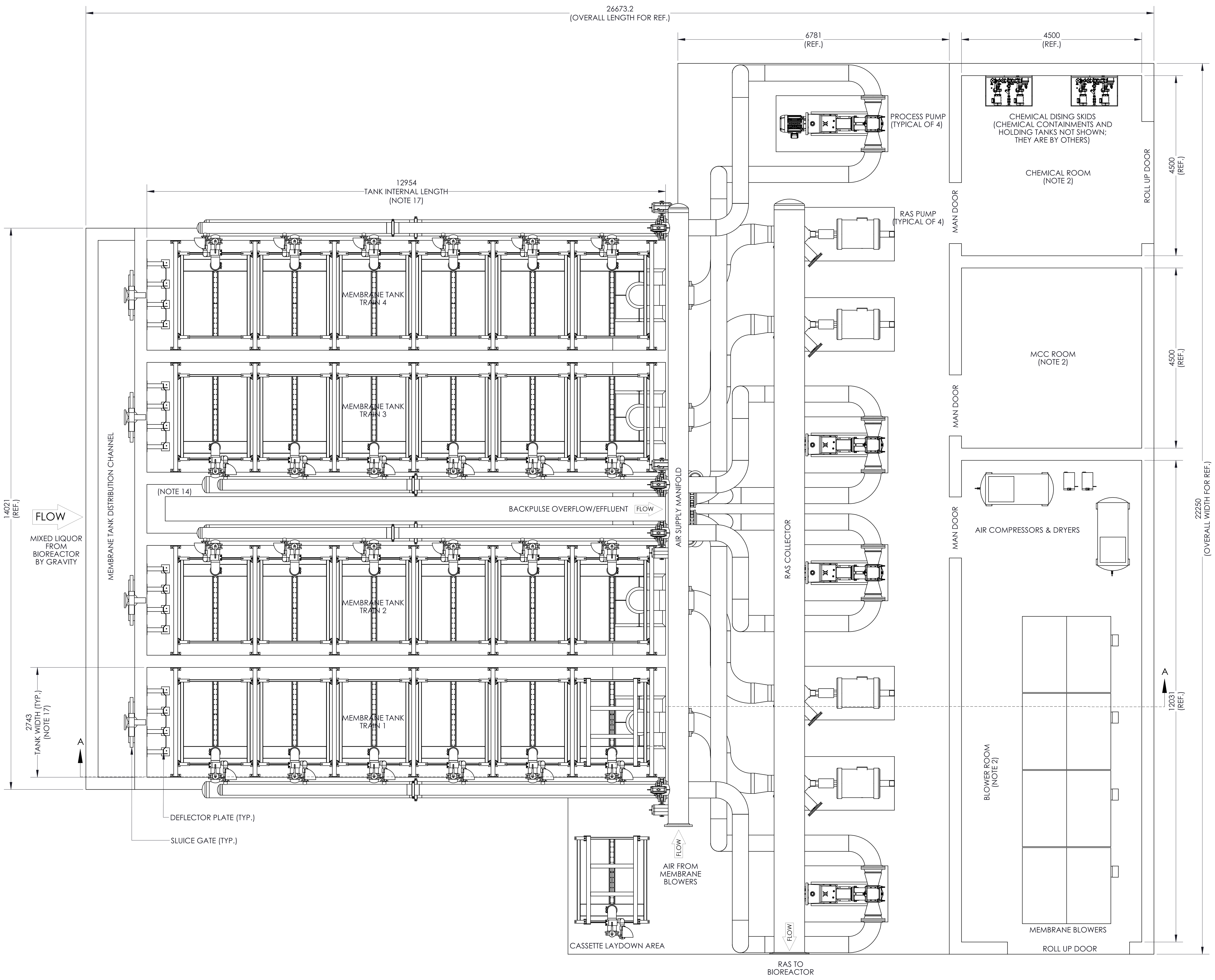
DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN12-DL-100	A

REF.:
DOC. OWNER:

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
495186		1:50	D	1 OF 3

LAST SAVED: Thursday, January 25, 2024 9:31:56 PM

FILE LOCATION: C:\SWPDM\NAM-ITO\495186 - CARLETON PLACE\2. Mechanical Drawings\



PLAN VIEW

NOTES:

1. FOR SCOPE OF VEOLIA-SUPPLIED EQUIPMENT AND TECHNICAL DATA REFER TO THE PROPOSAL AND P&IDs.
2. SIZE AND LOCATION OF LISTED ROOMS ARE PRESENTED FOR REFERENCE ONLY. SYSTEM INTEGRATOR TO DETERMINE SIZE AND LOCATION OF ALL AMENITIES.
3. SYSTEM INTEGRATOR IS RESPONSIBLE FOR DESIGN OF CONCRETE TANKS, GRAVITY CHANNELS, INFLUENT GATES, EMERGENCY OVERFLOW, WALKWAYS/HANDRAILS ON TOP OF WALLS (IF REQUIRED). THESE ARE NOT SHOWN IN THIS DRAWING FOR CLARITY.
4. TANK BOTTOM AND DRAIN SUMP DESIGNS ARE NOT BY VEOLIA. HOWEVER, IT IS RECOMMENDED THAT MEMBRANE TANK BOTTOM IS TO BE CONFIGURED AS A ONE WAY SLOPE TOWARDS DRAIN TRENCH CROSSING THE ENTIRE TANK WIDTH. DRAIN SUMP CAN BE LOCATED ANYWHERE INSIDE THE TRENCH, WITH A TRENCH SLOPE TAPERING INTO THE SUMP ON ONE OR BOTH SIDES OF IT, DEPENDING ON THE LOCATION OF THE DRAIN SUCTION NOZZLE.
5. DRAIN SUCTION NOZZLE OPENING HAS TO BE AT LEAST 6" BELOW ELEVATION OF A TANK BOTTOM AT ITS SHALLOW END.
6. TANKS TO BE COVERED FOR ACCESS TO CASSETTES AND EQUIPMENT. DESIGN, SUPPLY AND INSTALLATION OF MEMBRANE TANK COVERS ARE BY OTHERS (TANKS MUST BE VENTED).
7. MEMBRANE TANK INTERNALS WILL BE IN CONTACT WITH MEMBRANE CLEANING CHEMICALS - TYPICALLY SODIUM HYPOCHLORITE OR CITRIC ACID SOLUTIONS.
8. INFLUENT SLUICE GATE AND DEFLECTOR PLATE DESIGN AND SUPPLY ARE BY OTHERS.
9. DESIGN AND SUPPLY OF SUPPORTS FOR PERMEATE AND AIR HEADERS ARE BY OTHERS. SYSTEM INTEGRATOR TO DETERMINE DESIGN, NUMBER AND LOCATION OF SUPPORTS. VEOLIA TIE POINTS MUST NOT BE USED TO SUPPORT INTERCONNECTING PIPING.
10. SYSTEM INTEGRATOR TO CONSIDER PROVISION FOR FOAM/ SLUDGE SURFACE WASTING AT THE DETAILED ENGINEERING STAGE.
11. ESTIMATED CASSETTE SHIPPING WEIGHT 4,500 LBS [2,040 KG]. ESTIMATED CASSETTE MAX WEIGHT(SLUDGED) 10,000 LBS [4,535 KG]. MEMBRANE LIFTING DEVICE (TRAVELING BRIDGE-CRANE) TO BE SIZED FOR 5,000 KG.
12. THE FOLLOWING DESIGN GUIDELINES ARE AVILABLE FROM VEOLIA; MEMBRANE TANK CONSTRUCTION TOLERANCES; DEFLECTER PLATE DESIGN; TANK COVER DESIGN; CASSETTE LIFTING EQUIPMENT.
13. SPACING BETWEEN THE HEADERS CAN BE REDUCED. PIPE ELEVATIONS DETERMINED BY OTHERS BASED ON SUPPORTS DESIGN.
14. BACKPULSE TANK EFFLUENT PIPE EXTENDED THAT FAR INTO THE TANK TO PREVENT SHORT CIRCUITING AND DEAD ZONE IN THE TANK.
15. ALL DIMENSIONS ARE IN MILLIMETERS.
16. ALL EQUIPMENT DIMENSIONS ARE PRELIMINARY; THEY WILL BE CONFIRMED DURING DETAIL ENGINEERING STAGE.
17. VEOLIA'S STANDARD TANK DIMENSIONS ARE IN FEET (49' X 9'), AND VALUES ON THE DRAWING ARE DIRECT CONVERSION. THESE DIMENSIONS WILL BE ROUNDED AT A DETAIL ENGINEERING PHASE, AS PER TOWN'S PREFERENCE.
18. DIMENSIONS PROVIDED FOR EQUIPMENT, BLOWER, AND CHEMICAL ROOMS ARE FOR REFERENCE ONLY. ROOM SIZES MAY CHANGE DURING DETAILED ENGINEERING.

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		VM	KK		25 JAN 24

TOLERANCES UNLESS NOTED
DECIMALS .X .XX .XXX
ANGLES °
FRAC

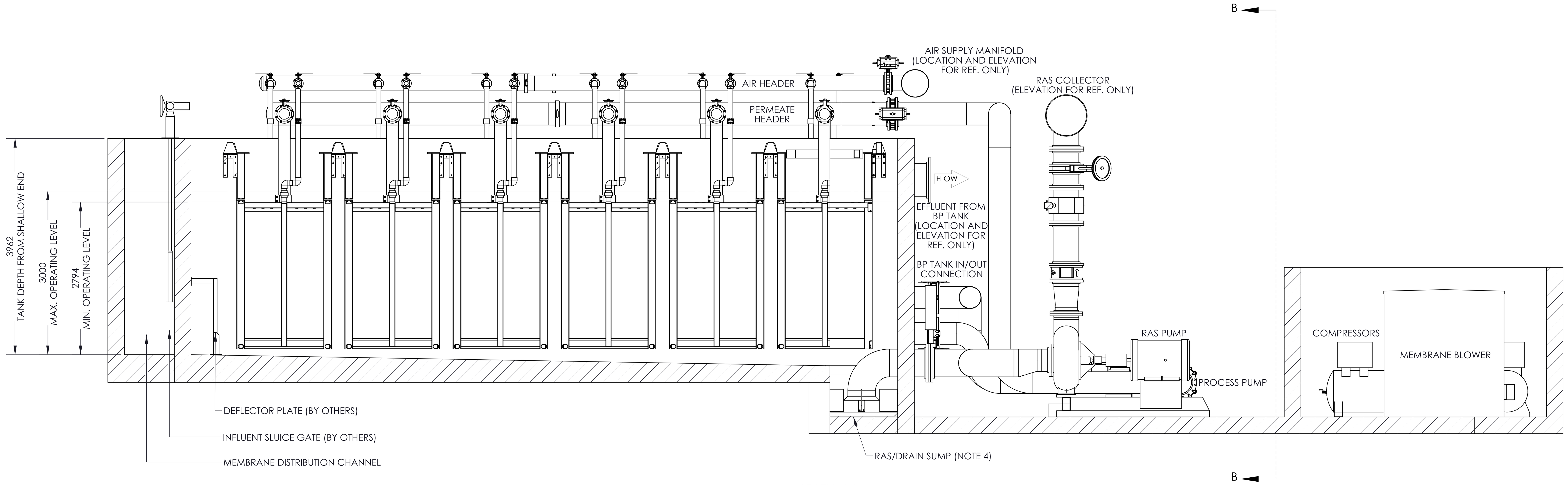
VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

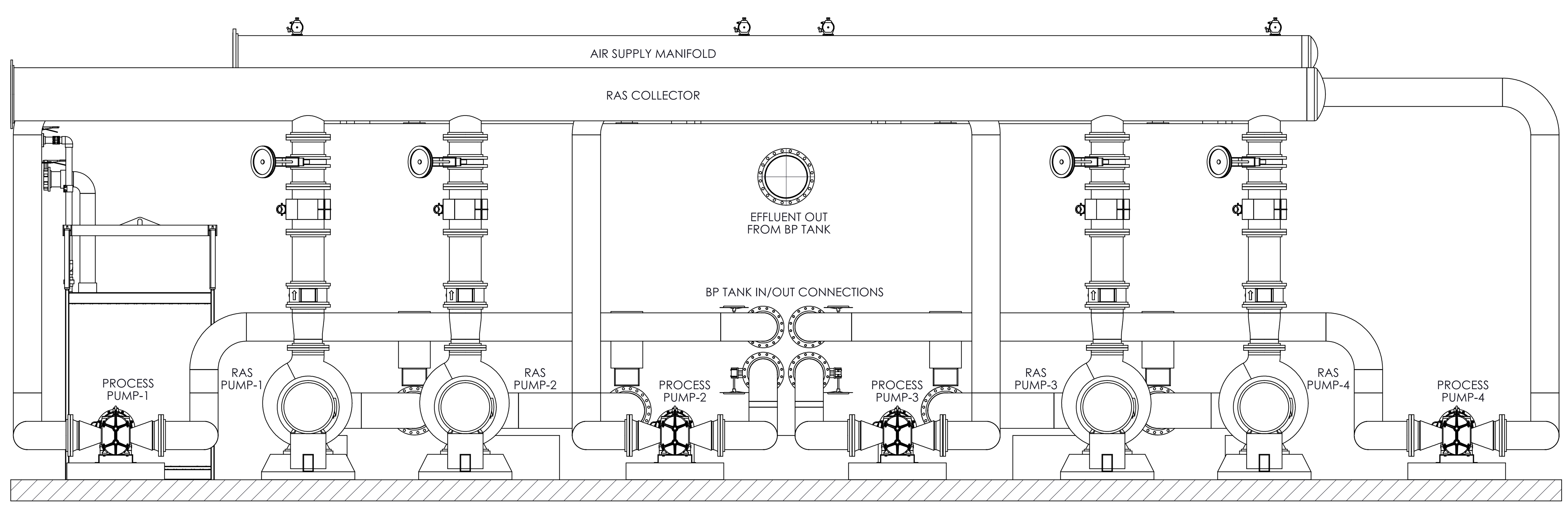
PRELIMINARY SYSTEM LAYOUT

DRAWING NUMBER: 495186-WTS-PR-SYS-EN12-DL-100
REVISION: A
REF.:
DOC. OWNER:
PROJECT NO.: 495186
PART/MATERIAL NO.:
SCALE: 1:55
SIZE: D
SHEET: 2 OF 3

LAST SAVED: Thursday, January 25, 2024 9:31:56 PM
FILE LOCATION: C:\SWPDM\AMAITO\495186 - CARLETON PLACE\2. Mechanical Drawings\



SECTION A-A
SCALE 1 : 50



SECTION B-B

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

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A	INITIAL RELEASE		VM	KK		25 JAN 24

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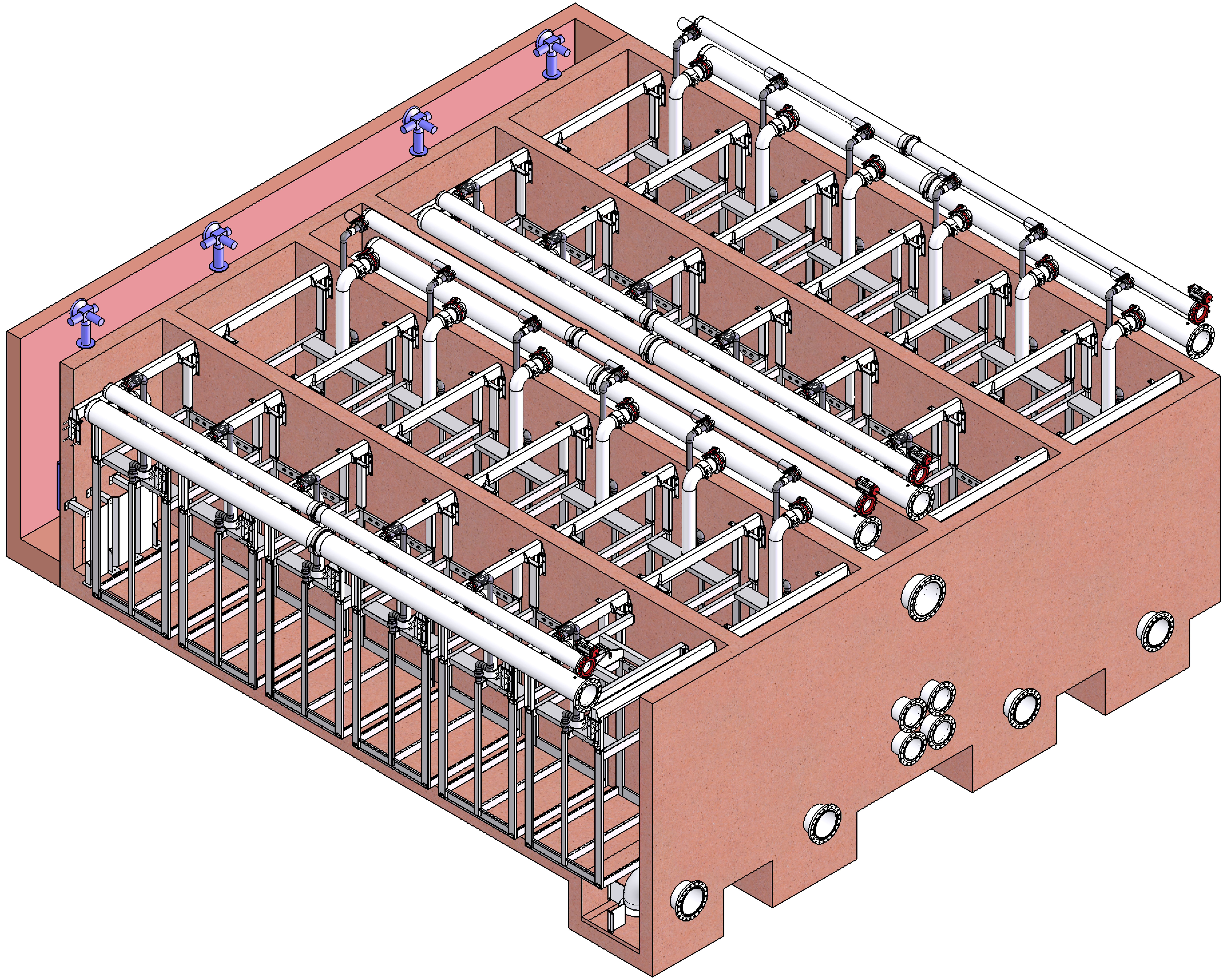

ISO VIEW
(SIDE WALL REMOVED FOR CLARITY)

VEOLIA

REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

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A	INITIAL RELEASE		VM	KK		25 JAN 24

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ANGLES °
FRAC

VEOLIA

CUSTOMER INFORMATION
SAMPLE FOR DUNDAS WWTP

GENERAL ARRANGEMENT DRAWING

DRAWING NUMBER	REVISION
495186-WTS-PR-SYS-EN12-DA-001	A

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DOC. OWNER:

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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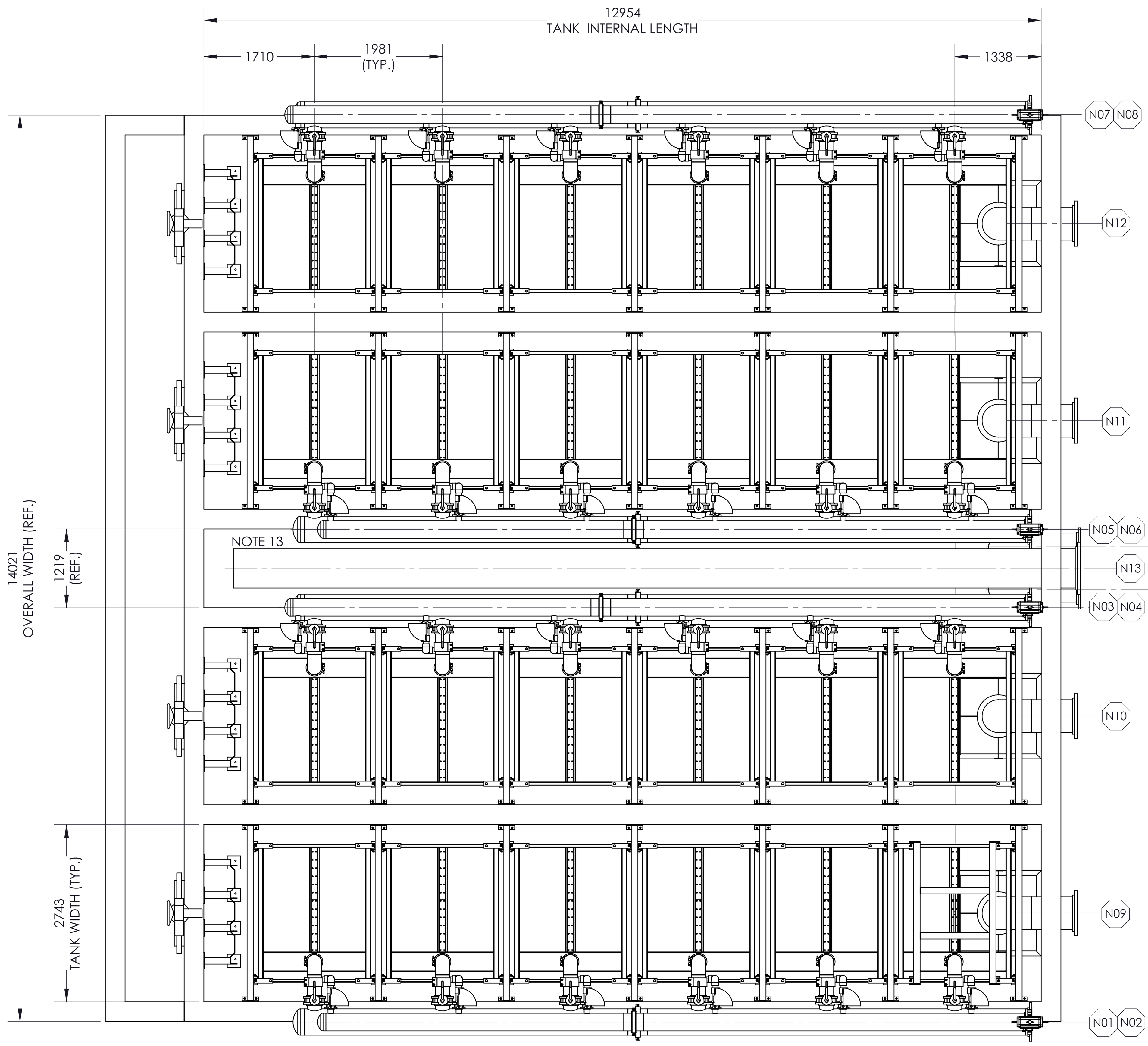
LAST SAVED: Thursday, January 25, 2024 8:46:35 PM

FILE LOCATION: C:\SWPDM\NAM-ITO\495186 - CARLETON PLACE\2. Mechanical Drawings\

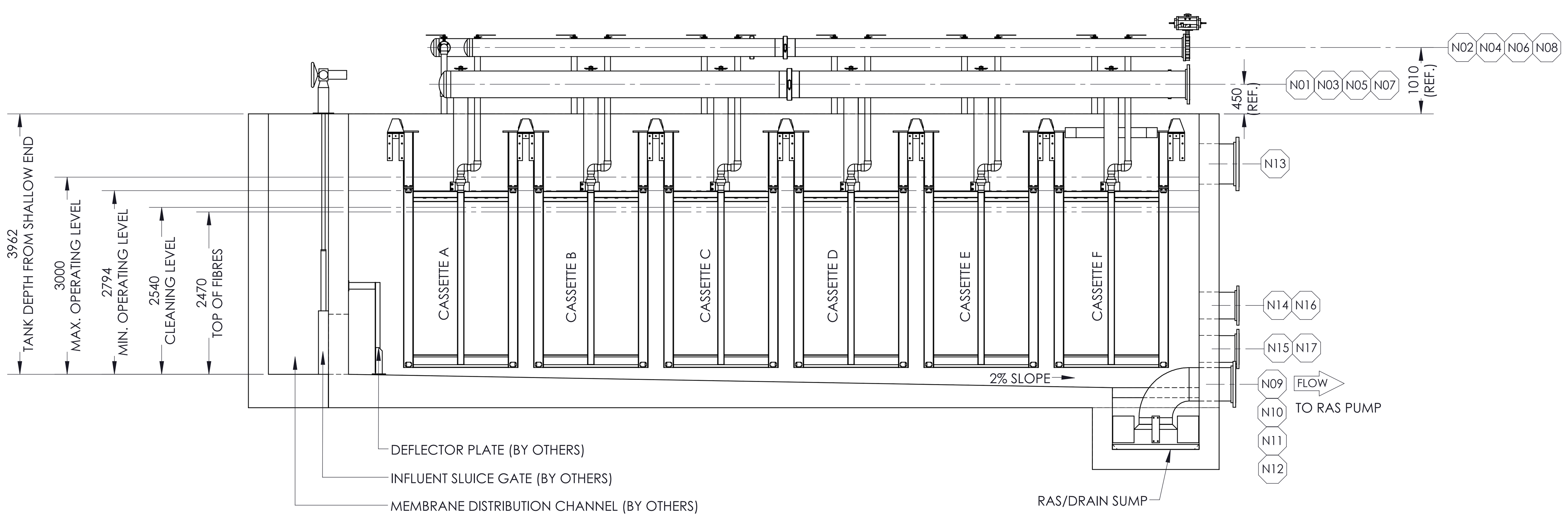
REFERENCE ONLY DO NOT USE FOR CONSTRUCTION

NOZZLE SCHEDULE

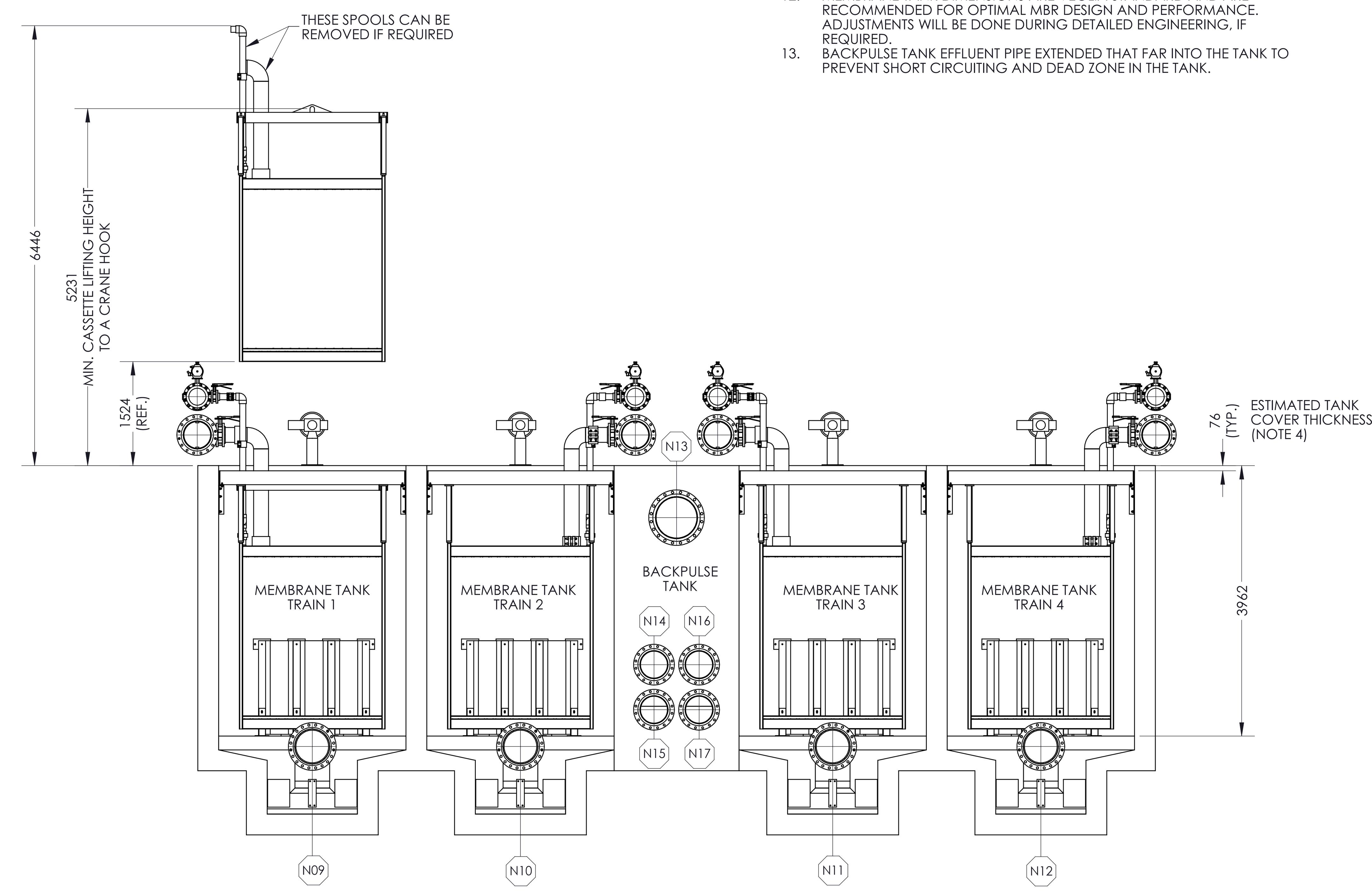
NOZZLE	DESCRIPTION	TYPE	SIZE
N01	TRAIN 1 - PERMEATE TO/FROM PROCESS PUMP	150# RF FLG	16"
N02	TRAIN 1 - AIR FROM MEMBRANE AERATION BLOWERS	150# RF FLG	10"
N03	TRAIN 2 - PERMEATE TO/FROM PROCESS PUMP	150# RF FLG	16"
N04	TRAIN 2 - AIR FROM MEMBRANE AERATION BLOWERS	150# RF FLG	10"
N05	TRAIN 3 - PERMEATE TO/FROM PROCESS PUMP	150# RF FLG	16"
N06	TRAIN 3 - AIR FROM MEMBRANE AERATION BLOWERS	150# RF FLG	10"
N07	TRAIN 4 - PERMEATE TO/FROM PROCESS PUMP	150# RF FLG	16"
N08	TRAIN 4 - AIR FROM MEMBRANE AERATION BLOWERS	150# RF FLG	10"
N09	TRAIN 1 - RAS TO RAS PUMP	150# RF FLG	16"
N10	TRAIN 2 - RAS TO RAS PUMP	150# RF FLG	16"
N11	TRAIN 3 - RAS TO RAS PUMP	150# RF FLG	16"
N12	TRAIN 4 - RAS TO RAS PUMP	150# RF FLG	16"
N13	BACKPULSE TANK EFFLUNT	150# RF FLG	24"
N14	TRAIN 1 - BACKPULSE TO/FROM PROCESS PUMP	150# RF FLG	16"
N15	TRAIN 2 - BACKPULSE TO/FROM PROCESS PUMP	150# RF FLG	16"
N16	TRAIN 3 - BACKPULSE TO/FROM PROCESS PUMP	150# RF FLG	16"
N17	TRAIN 4 - BACKPULSE TO/FROM PROCESS PUMP	150# RF FLG	16"



PLAN VIEW



SIDE VIEW
(SIDE WALL REMOVED FOR CLARITY)



FRONT VIEW
(FRONT WALL REMOVED FOR CLARITY)

NOTES:

1. FOR SCOPE OF VEOLIA-SUPPLIED EQUIPMENT AND TECHNICAL DATA REFER TO THE PROPOSAL AND P&IDs
2. TANK BOTTOM AND DRAIN SUMP DESIGNS ARE NOT BY VEOLIA. HOWEVER, IT IS RECOMMENDED THAT MEMBRANE TANK BOTTOM IS TO BE CONFIGURED AS A ONE WAY SLOPE TOWARDS DRAIN TRENCH CROSSING THE ENTIRE TANK WIDTH. DRAIN SUMP CAN BE LOCATED ANYWHERE INSIDE THE TRENCH, WITH A TRENCH SLOPE TAPERING INTO THE SUMP ON ONE OR BOTH SIDES OF IT, DEPENDING ON THE LOCATION OF THE DRAIN SUCTION NOZZLE.
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11. ALL EQUIPMENT DIMENSIONS ARE PRELIMINARY; THEY WILL BE CONFIRMED DURING DETAIL ENGINEERING STAGE.
12. MEMBRANE TANK DIMENSIONS ARE VEOLIA STANDARD AND ARE RECOMMENDED FOR OPTIMAL MBR DESIGN AND PERFORMANCE. ADJUSTMENTS WILL BE DONE DURING DETAILED ENGINEERING, IF REQUIRED.
13. BACKPULSE TANK EFFLUENT PIPE EXTENDED THAT FAR INTO THE TANK TO PREVENT SHORT CIRCUITING AND DEAD ZONE IN THE TANK.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE		VM	KK		25 JAN 24

TOLERANCES UNLESS NOTED: DECIMALS .X .XX .XXX; ANGLES; FRAC

CUSTOMER INFORMATION: SAMPLE FOR DUNDAS WWTP

GENERAL ARRANGEMENT DRAWING

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495186-WTS-PR-SYS-EN12-DA-001	A

REF.: | DOC. OWNER:

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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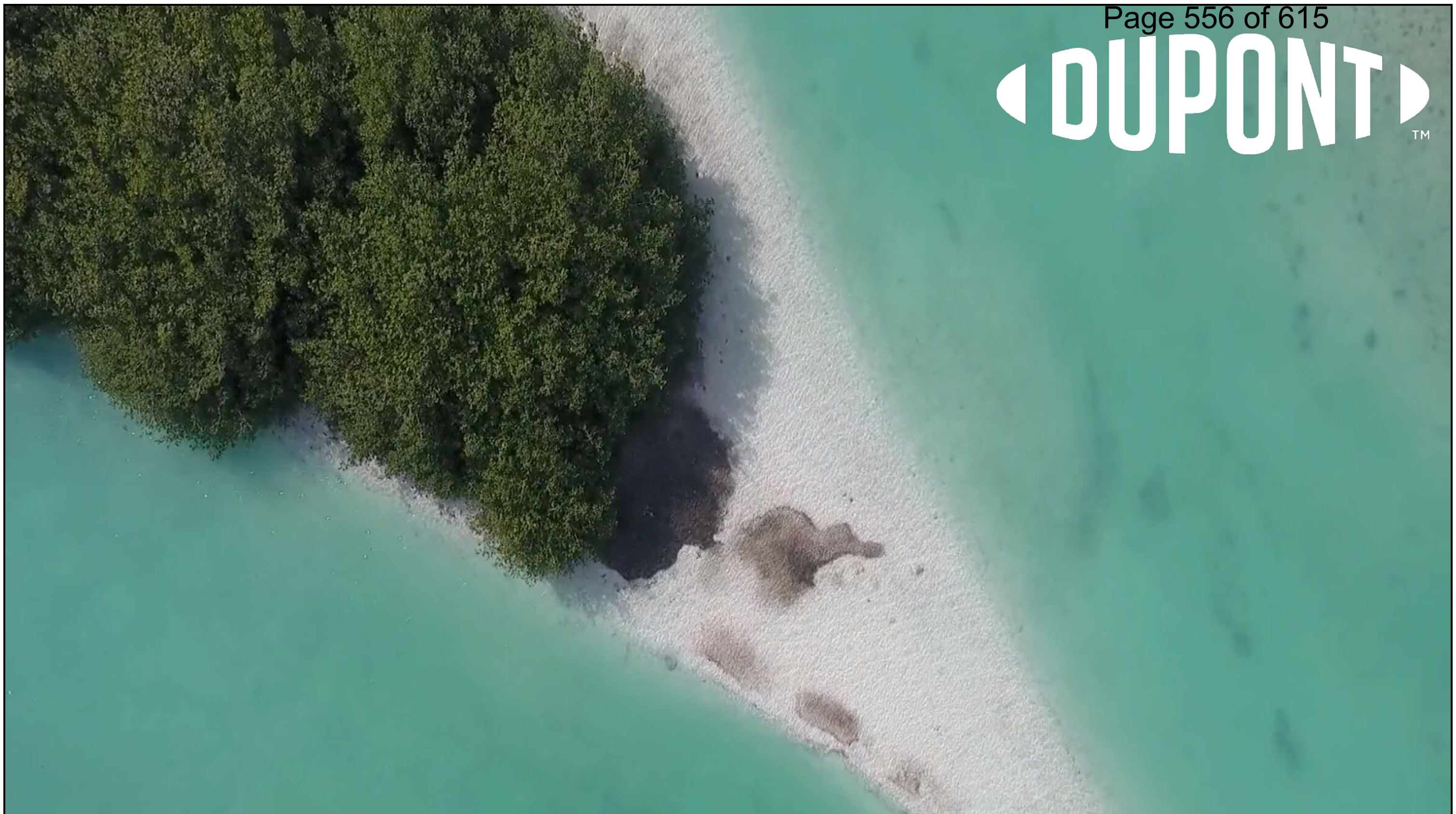


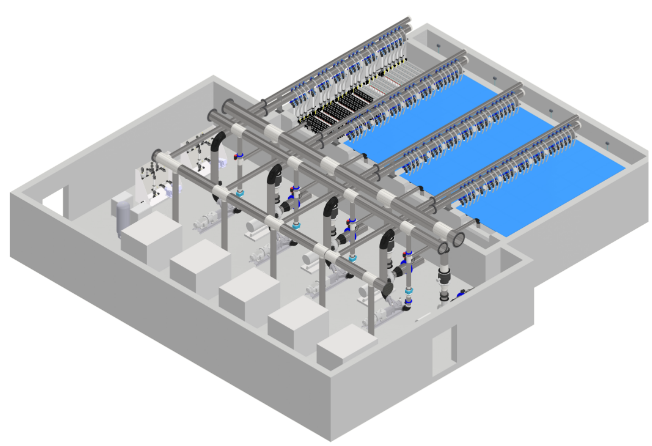
MEMPULSE™ MEMBRANE BIOREACTOR SYSTEM

City of Hamilton - Dundas WWTP

Membrane Equipment System

Proposal No. A-187125

May 24TH, 2024



EXECUTIVE SUMMARY

Thank you for your interest in MEMCOR's MemPulse Membrane Bioreactor (MBR) System. MemPulse MBR technology uses the latest advances in filtration specifically designed to create highly efficient membrane aeration in conjunction with the assurances of an absolute barrier provided by membrane filtration. MemPulse MBR offers several key advantages over both conventional treatment processes and competitive MBR membrane systems.

MEMCOR MemPulse MBR System – First in Class Design

MEMCOR's MemPulse MBR system combines superior membrane filtration technology enhanced over years of R&D and manufacturing expertise with an integrated design that provides the best overall value system to Gainesville Regional Utilities (GRU).

MEMCOR's entry into the MBR market began in the late 1990s and has since grown to over 200 MBR installations in operation or under contract. MEMCOR's PVDF MBR membrane has demonstrated long term performance and durability since its launch close to 15 years ago with a track record of installations in operation with that same module for over 10 years. The reliability of the N Series module and the warranty behind it offers the Owner a risk-free solution. Our plant references show the N Series module in use well beyond the projected life, still in operation, and still producing high quality effluent.

For first-hand evidence of the reliability and robustness of MEMCOR's MemPulse MBR with the N Series module, please click on the link below to view a brief YouTube video. In it, personnel at the Healdsburg Wastewater Treatment Plant in Healdsburg, California describe their experience of operating the plant equipped with the MemPulse MBR.

Video Link: Achieving Long Term Success with MBR Technology

Low Maintenance & Ease of Operation

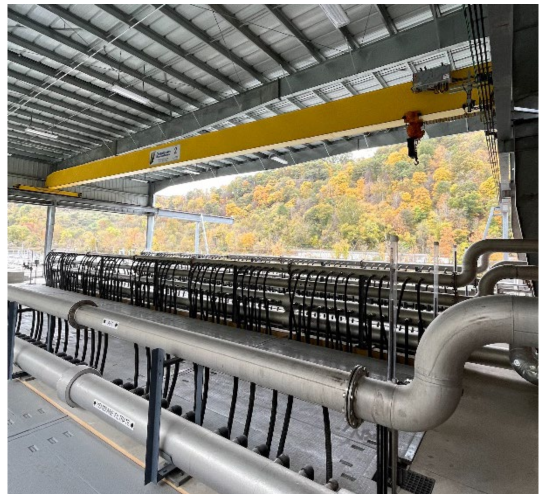
This superior, low maintenance membrane fiber is combined with the patented MemPulse aeration system that ensures the membranes are free of bulk solids hold-up and eliminates the need for in-tank maintenance as a part of standard system maintenance. We believe that this superior design will provide desired system performance at the lowest operational cost available.

MEMCOR's monolithic membrane fibers, due to the homogeneous fiber composition, do not become tensioned due to thermal variability. Because of this, MEMCOR membranes do not require any annual or regular rack removal for maintenance such as slack adjustment or manual removal of solids. The MemPulse system is the only proven MBR system on the market today with no regular maintenance on the in-tank membrane components. Most customers who use the MemPulse MBR have never removed a single rack for maintenance.

Additionally, the MemPulse air scour process is designed to be both efficient and powerful, preventing the accumulation of solids within the fiber bundles. The self-cleaning air scour allows MEMCOR MBR operation to be "hands-off", with little to no operator intervention.

Reduced Process Footprint

MEMCOR's monolithic PVDF fibers provide a high membrane area per unit of tank footprint– up to 25% smaller than other competitive systems. This means substantial savings in system footprint and concrete construction costs. Furthermore, the MemPulse process allows for elevated mixed liquor suspended solids up to 14,500 mg/L in the membrane tank, allowing the biological tank volume to be reduced compared to competitive systems.



With a small footprint available for increasing treatment capacity, the Morgantown Utility Board in West Virginia utilized a MemPulse® MBR system and experienced a tenfold increase in treatment efficiency.

Video Link: Maximizing Efficiency with Minimum Footprint - Memcor MemPulse® MBR systems

MINIMIZING MAINTENANCE REQUIREMENTS

Competitor membrane designs with reinforced MBR fibers require regular maintenance for slack adjustment or manual solids removal. Similarly, with less effective membrane aeration, flat sheet membranes often require periodic manual solids removal. MEMCOR's advanced fibers and aeration system require no regular in-tank maintenance or removal of the modules. Additionally, MemPulse provides uniform distribution of mixed liquor and scour air across the entire membrane rack ensuring a homogeneous environment for each sub-module and preventing preferential fouling of membranes.

Video Link: Jennings Tertiary Wastewater Treatment Plant + MemPulse® | Responding to Community Needs

We would like to thank you again for your interest in MEMCOR Products. We believe that every MEMCOR product comes with more than just equipment – it includes the expansive knowledge of MEMCOR's dedicated team of membrane scientists, engineers, and technicians who stand behind every installation. We are eager to share this expertise with those responsible for providing the world with clean, consistent, and high-quality water. Should you have any questions regarding this quotation or would like to request any additional information please contact the Technical Sales Manager listed below.

DuPont Sales Manager:

Arash Mozaffari
Sales Manager
Telephone: 905-464-4745
arash.mozaffari@dupont.com

Company Information

Company: DuPont (FilmTec Corporation)

DuPont (NYSE: DD) is a global innovation leader with technology-based materials and solutions that help transform industries and everyday life. Our employees apply diverse science and expertise to help customers advance their best ideas and deliver essential innovations in key markets including electronics, transportation, construction, and advanced materials and water.

For over 200 years, DuPont has been synonymous with life-changing discoveries and scientific know-how, reinventing ourselves along the way.

The history of DuPont is a history of scientific and technology breakthroughs. But more than that, it's a story of transformation. From the beginning, our company has changed and evolved, so that we can keep finding essential innovations to solve the most challenging problems and help people live safer, healthier lives.

DuPont is a leader in water purification and separation technology including ultrafiltration, reverse osmosis and ion exchange resins. The FilmTec™ brand is recognized globally and known for consistent and reliable performance. Each of the recent acquisitions, including Desalitech, and MEMCOR supports our strategy to drive growth and innovation through access to new manufacturing capabilities, geographies, and technologies.

Product Line: MEMCOR®

The first MEMCOR installation in the USA was at the Keystone Ski Resort in the late 1980's. MEMCOR pioneered the first dead end back-washable low-pressure membrane filtration process which is widely utilized today for drinking water, wastewater reuse, desalination pretreatment and MBR applications.

MEMCOR placed its first drinking-water system into operation in 1987, its first wastewater reuse system in 1990, and the first MBR system was installed in 1999. In 1997, MEMCOR supplied the world's first-drinking water system to be installed in a cold-weather climate at the Marquette, Michigan Water Treatment Plant; and our first cold-weather MBR was installed at the Grey Eagle Casino in Alberta in 2007.

MEMCOR continues to manufacture its own membrane modules, providing a high level of quality control and accountability to their customers. This allows MEMCOR continually invest in R&D and innovate with holistic improvements in membrane technology and system design to provide the best solutions for its customers.

Over its history, MEMCOR has brought several new products and technology improvements to the market. The benefits of the R&D developments and innovations are passed on to new customers as well as to existing ones. By partnering directly with a membrane manufacturer, customers are assured of a comprehensive warranty and access to new and improved solutions.

MEMCOR now has 350,000+ N membrane modules installed at some 2,000 sites worldwide. The history of supporting these installations is one of first-class service and excellent product knowledge. This knowledge base, strong commitment to product development and history of supporting customers for almost 30 years in the water filtration market makes MEMCOR the most reliable choice for any membrane facility.

MEMCOR® Business Locations

Membrane Manufacturing Location: Australia
MEMCOR membranes are manufactured at the DuPont facility in South Windsor, Australia:

15 Blackman Crescent
South Windsor, NSW 2756
Australia

Memcor Engineering Team

DuPont Water Solutions

New England Manufacturing & Technology Center
455 Forest Street
Marlborough, MA 01752 USA

FilmTec Corporation
FilmTec Corporation’s principle place of business is located Edina, MN with approximately 150 people in the office and 450 manufacturing operators, at the following location:

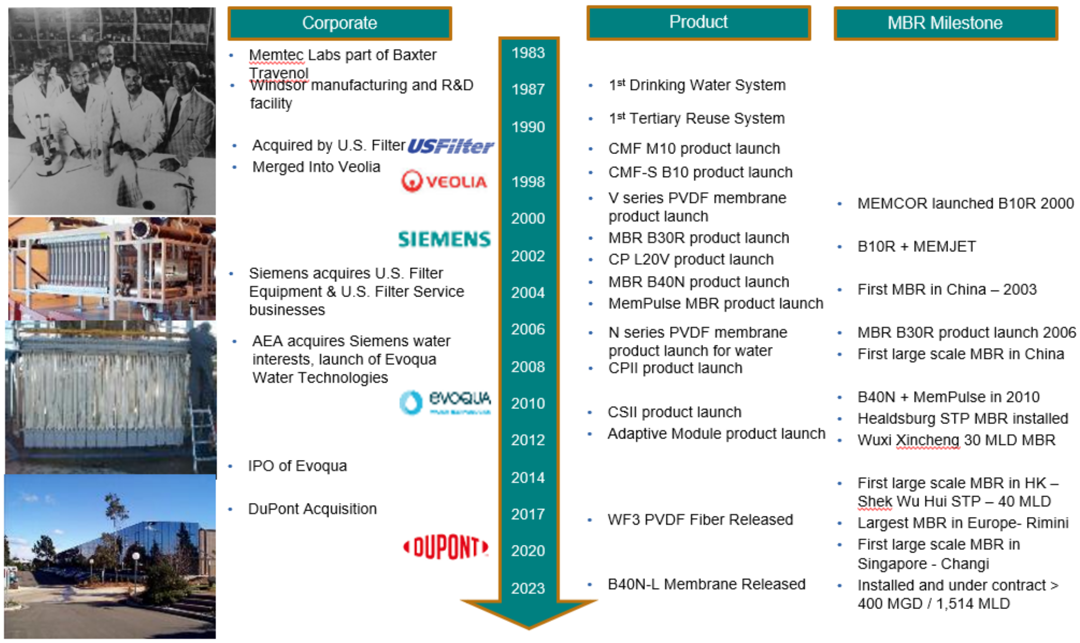
FilmTec Corporation
5400 Dewey Hill Road
Edina, MN, 55439, USA

DuPont de Nemours, Inc.
DuPont’s Corporate Headquarters is located at:

DuPont de Nemours, Inc
974 Centre Road
Wilmington, DE 19805, USA

MEMCOR® Corporate History

The MEMCOR® product line is a result of over 40 years of innovation in membrane technologies and systems for municipal and industrial applications. This MEMCOR product line has more than 2,000 installations worldwide and it is established as a global leader in wastewater reuse, drinking water treatment, RO pre-treatment, and industrial process water.



Where MEMCOR Began

MEMCOR's membrane technology originated in Australia in the late 1970's. In 1983, MEMCOR (known as Memtec) was spun off from the healthcare company Baxter Travenol. By working with our many valued customers and partners over the last 40+ years to engineer the world's most innovative membrane systems, MEMCOR continues to lead the way with state-of-the-art products, systems and services.

MEMCOR membranes are manufactured at the DuPont facility in South Windsor, Australia, where the R&D group focuses on new membrane and module development, and cost reductions for existing systems. The products are also supported at regional offices in North America, Europe, the Asia Pacific, the Middle East, and Latin America. Due to its commitment to product development, DuPont has seen a steady increase in the demand for its MEMCOR membrane products.

MEMCOR Technology Development

MEMCOR's roots and culture are firmly entrenched in research and product development (R&D). DuPont's culture also supports ongoing R&D, continuing MEMCOR's prominence as an innovator and market leader for membrane filtration in the water and wastewater industry. Our in-house R&D efforts continue to push hollow-fiber membrane-technology developments that reduce the cost of treating water and wastewater. MEMCOR R&D work is performed in Australia, Singapore, the UK, and the USA. MEMCOR is only one of two vertically integrated membrane companies to offer pressure, submerged and MBR hollow-fiber membrane technologies.

MEMCOR's track record of continuous improvement extends back to the days when the company was formed. Unlike some firms in the water industry, we complete our research and development is internally. Before launching a new product or process improvement, it is tested internally and benchmarked against existing, time tested products: it is not merely inserted for testing on the first few customers' installations.

MEMCOR® MBR History

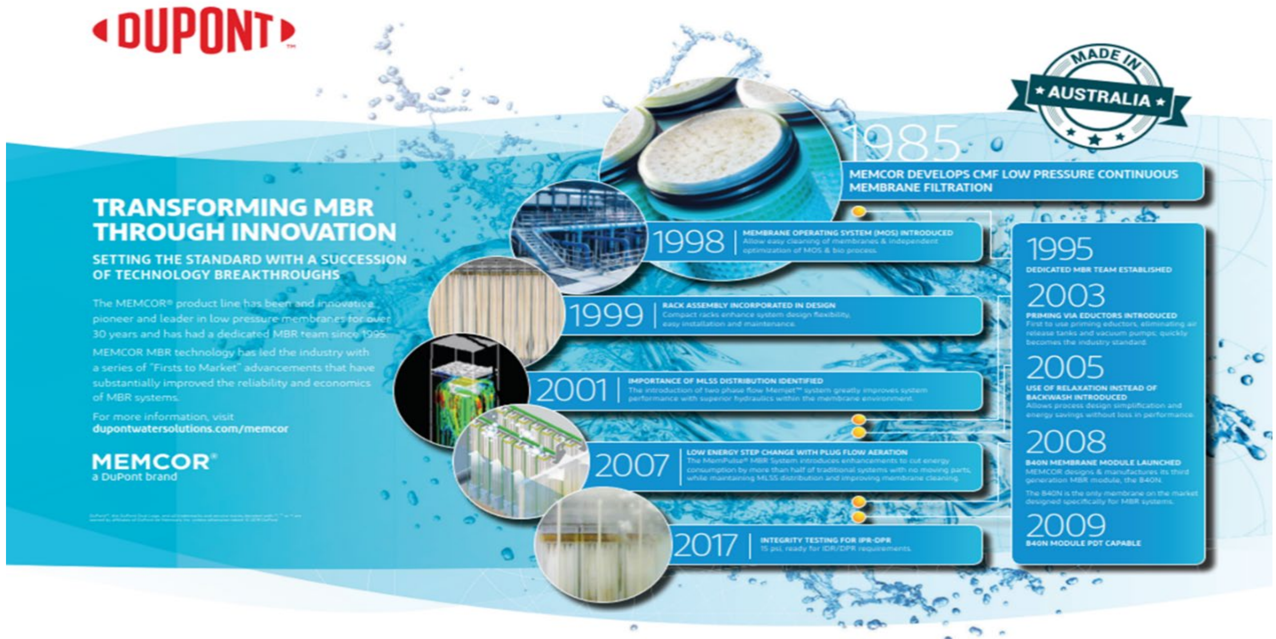
The Memcor MBR system was first placed into service in 2008. The same membrane, module construction and air scour device has been in use for over 12 years, with many plants operating with the same membranes for over 15 years. This ensures continues success for the Grand Forks MBR project, ensuring predictable, reliable and stable long-term performance. The Owner can rest assured that, with MEMCOR, they are getting a tried and tested system in every respect. A complete history of the MEMCOR MBR product history is provided below.

Proven to deliver greater effluent and productivity while reducing lifecycle cost, MemPulse MBR technology is preferred in the industry by those who value a low total cost of ownership. MemPulse uses a fully automated process that provides liquid/solid separation by combining biological oxidation and membrane separation. In the evolution of the MBR industry, MEMCOR pioneered such key innovations as pulsed aeration, efficient foulant removal and MBR integrity testing. MEMCOR's membrane filtration process expertise, product development and manufacturing capabilities have propelled MEMCOR into the MBR arena as an innovator, continually improving on past successes. Today, MemPulse MBR technology operates in hundreds of municipal and industrial plants across the globe.

Key Advantages

- ✓ Saves Footprint on Sites with Limited Space
- ✓ No Need to Use Clarifier or Sand
- ✓ Improves Effluent Quality, Allowing Water to Be Re-Used
- ✓ Allows for Plant Expansions in The Same Footprint
- ✓ Uses A Smaller Biological Process
- ✓ Fully Automated

The figure below presents a summary of the long history of the MEMCOR team's MBR process innovations, many of which now are industry standards.

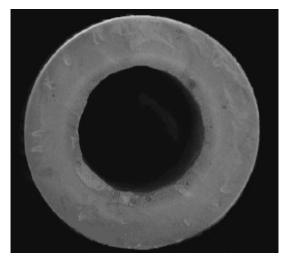


MEMCOR Technology Development

MEMCOR is a research-driven company with a strong culture of innovation and product development. With support from DuPont, the company maintains its standing as a market leader in the water and wastewater industry. MEMCOR's in-house R&D efforts are geared towards creating cost-effective hollow-fiber membrane technologies that improve water and wastewater treatment. The company conducts R&D in multiple countries, including Australia, Singapore, the UK, and the USA. MEMCOR stands out as one of two vertically integrated membrane companies to offer pressure, submerged, and MBR hollow-fiber membrane technologies. Unlike some firms, MEMCOR completes its R&D internally, and new products or process improvements undergo rigorous testing against existing, established products before launch.

A few examples of MEMCOR's MBR trend-setting industry innovations are:

- In 2001 MEMCOR identified the importance of mixed liquor suspended solids (MLSS) distribution in an MBR system. The introduction of the MemJet™ system greatly improved system performance with superior hydraulics in the membrane environment.
- In 2003 MEMCOR launched our second-generation PVDF membrane as an improved membrane fiber. Today over one billion gallons per day of treatment capacity has been installed utilizing this latest generation fiber, and the demand is accelerating!
- In 2007 the MemPulse® MBR was launched. Our innovative MemPulse device reduces the need for aeration energy in the MBR process and reduces the number of modulating valves in the system. The MemPulse process was designed to fit into the existing operating envelope of the previous MemJet process.
- In 2008 MEMCOR launched the 'N' series fiber: Improving the material science and production process behind membrane modules led MEMCOR to commercializing the 'N' family of membrane fibers. The 'N' fiber is manufactured with superior abrasion resistance than previous products—even greater than our original first-generation polypropylene hollow fibers. This greater abrasion resistance provides higher permeability and fewer maintenance events over the lifespan of a membrane module. MEMCOR "N" Series membranes have been in operation globally since 2010, with over 45,000 membrane modules in service. The images below show a cross-section and the outer surface of the N fiber.



- In 2009 MEMCOR developed the N Series module, which was designed to withstand the rigors of daily pressure decay testing (PDT). It features structurally reinforced potting that also enhances the life of the membrane module. This module was designed to fit within the operating envelope of customers using our previous generation B30R module, allowing them to upgrade without any modification to their existing system.
- In 2016, our manufacturing processes were improved to allow more area of the existing module to support membrane fibers, increasing the surface area of a module by 6.5% in the same fiber and operating envelope. This module is available to existing customers without any modifications required to their existing system.
- In 2017 MEMCOR developed a higher level of integrity-testable membrane, with the ability to perform a pressure decay test (PDT) in a membrane bioreactor application. As mentioned above, our approach is to make our newest innovations available to our existing installation base. Our current membrane platform supports plants going back to 2004, making several generations of innovations available to loyal customers and ensure our customers are prepared for whatever comes down the road.

- In 2023 MEMCOR developed the latest N Series module with a higher surface area module building on the legacy and successful performance of the B50N membrane module. The B50N is constructed from the same PVDF fiber but is 15.7" (400mm) taller, providing additional surface area. This reduces the number of modules and racks required, providing smaller plant footprint, lower civil construction costs, and aeration savings for customers, and providing improvements in the total lifecycle costs for owners.

MEMCOR Manufacturing

With more than 30 years of experience, MEMCOR understands how much clients value high quality products. Quality is an absolute requirement for success in the drinking water and water reuse markets and the robust and regularly audited quality program implemented in the membrane production facility in Windsor, Australia is a core component of the manufacturing practice.

In Windsor, the MEMCOR production facility is ISO 9001 and ISO 14001-certified, please reference the pages below for current copies of the certificates.

These standards guarantee the consistency and reliability of the manufacturing process while also ensuring that MEMCOR makes its products in an environmentally conscious fashion, mindful of the need to manage waste streams responsibly in a way that is not detrimental to the community in which the factory is located.

MEMCOR Facility in Windsor, New South Wales, Australia

MEMCOR has manufactured its product in the same location since 1987. Windsor houses the research and development group, capital project and manufacturing engineering services and other disciplines associated with the manufacturing process (procurement, planning, QA/QC lab and supporting disciplines). The co-location of these various disciplines is key to the production of high-quality products with high reliability and low cost.

MEMCOR manufactures its fibers and modules entirely from raw material. By extruding fibers and making modules in-house, product quality and cost is tightly controlled throughout the entire process. This provides confidence in the products and the ability to offer a true manufacturer's warranty. Windsor also uses highly specialized injection molding vendors in Australia and in China to produce high quality manifolds and other parts for the racks. Using injection molding is one of the many original contributions of MEMCOR to the MF/UF and MBR product development and is an important part of the intellectual property portfolio. This technology (popularized by Lego in the 1940s) ensures that MEMCOR systems have a small footprint and increased durability. The possibility to mold pipes in other pipes for example, plays a key role in reducing the bulk space occupied by connection manifolds while the use of raw material and glass filled plastic gives the parts greater durability over commercial PVC or CPVC plastic commonly used by other manufacturers.

The quality practice is supported by Qudos Management™, a leading service and software provider in Australia, dedicated to helping clients establish and maintain their compliance and risk management systems. Together with decentralized data collection and information software available at multiple key workstations throughout the Windsor facility, every activity, sub-production task and their outputs are carefully and continuously monitored. These systems interact with SAP Enterprise Resource Planning system through which the facility manages procurement, inventory, order processing and other tasks. All aspect of the production process is covered by a series of procedures and work instructions. Personnel is regularly trained and participate in Windsor's Lean-inspired continuous improvement program.

Quality is checked at every step of production starting with raw material (verification of compliance in our laboratory), fibers, modules, and module sub-parts as well as all incoming goods made by third party vendors (moldings, tie rods, gaskets, O-rings, etc.). The QA/QC department uses a combination of online instruments (e.g., to automatically reject fibers out of dimensions), gauges, measurements/verifications and purity analysis in Windsor's on-site laboratory.

The following table provides examples of activities performed by dedicated QA/QC personnel:

AREA	TYPE OF ACTIVITY
Fibers	QC check for dimensional (automated), geometrical, hydraulic, and mechanical performance. SPC tools are utilized to monitor and review quality performance of the bundles. Bundles are converted to modules after a quality sign off.
Potting Material (Polyurethane)	PO will highlight our purchase specifications with QC checks self-performed by supplier. All deliveries are accepted with COA outlining the checks done and actual measurements. Daily in process QC checks ensure the product meets MEMCOR's specifications.
Modules	All modules received an individualized identification number which can be interpreted to identify the production date, location out of the extrusion line, the extrusion line itself and a variety of other proprietary information. This number is permanently engraved on the module in the form of a 2D barcode. 100% of the modules are integrity tested before packaging. SPC tools are utilized to monitor and review quality performance of the modules.
Injection Molded Parts	Components are checked against drawings at supplier and standard sample is checked before receiving into production line. Where the part does not conform to specification, it is recorded as a quality incident and the supplier is asked to respond with a corrective and preventative action plan.
Fiberglass rods, tie rods, mechanical fasteners, etc.	Components are checked against drawings at supplier and standard sample is checked before receiving into production line. Where the part does not conform to specification, it is recorded as a quality incident and the supplier is asked to respond with a corrective and preventative action plan.

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**PRELIMINARY -
NOT FOR CONSTRUCTION**

Membrane System Design Outline

Project: City of Hamilton - Dundas WWTP A-187125 Date: 23-May-24

Design Conditions

Average Daily Flow (ADF)	4.808 MGD		Wastewater Type	Municipal
Max Monthly Flow (MMF)	6.010 MGD		Min. Wastewater Temp. (°F)	46.4
Peak Daily Flow (PDF)	8.414 MGD		Bioreactor MLSS (mg/L)	8,500
Peak Hourly Flow (PHF)	9.620 MGD		Site Elevation (ft)	500
Peak Hourly Flow (PHF)	11.150 MGD			

Membrane Tank Design

No. of Duty Tanks	3		Module Type	B50N + Mempulse
No. of Standby Tanks	1		Module Area (ft²)	538.2
Total No. of Tanks	4		Rack(set) Type	Single Rack

Per Tank	***Installed***	***Maximum***	***Dimensions of each tank:***	
Rack(set) Size (Modules per Rack(set))	16	16	Tank Length* (ft)	13.45
Rack(set)s per Tank	23	26	Tank Width* (ft)	35.25
Rack(set) Slots per Tank	3	0	Tank Depth (Top of Concrete) (ft)	11.7
Blinded Modules per Tank	0	0	Tank Weir Depth (ft)	9.6
Modules per Tank	368	416	Tank Operating Volume (gal)	34,210
Available Spare Modules per Tank	48	0	Tank CIP Volume (gal)	29,090
Percentage of Spare	11.5%	0%	Weight of Wet Rack(set) Assembly** (lb)	1,235
Membrane Area per Tank (ft²)	198,056	223,889	Weight of Fouled Rack(set) Assembly** (lb)	2,028

Total		
Total No. of Rack(set)s	92	104
Total No. of Modules	1,472	1,664
Total Membrane Area (ft²)	792,224	895,557

** If feeding along the racks, no baffle gap is required to be added to tank length.*
If feeding across the racks, 4.156166m baffle gap needs to be added to the tank w
*** Per rack. Includes weight of spreader bar.*

Design Fluxes

	ADF	MMF	PDF	PHF	PHF		Unit
Flow Condition	4.808	6.010	8.414	9.616	11.148		MGD
No. of Membrane Tanks in Operation	3	4	4	4	4		—
No. of Membrane Tanks in Standby	1	0	0	0	0		—
Design Water Temperature	8	8	8	8	8		ºC
Net Flux at Design Water Temperature	8.1	7.6	10.6	12.1	14.1		gfd
Net Flux (temperature-corrected to 20 deg C)	11.2	10.5	14.7	16.8	19.5		gfd
Instantaneous Flux at Design Water Temperature	8.9	8.3	11.6	13.3	15.4		gfd
Instantaneous Flux (temperature-corrected to 20 deg C)	12.3	11.5	16.1	18.4	21.4		gfd

Mixed Liquor Feed Flow Requirements

	ADF	MMF	PDF	PHF	PHF		Unit
Max operating MLSS Conc. in Membrane Tank	10,500	11,000	12,000	12,500	12,500		mg/L
Total Mixed Liquor Feed Flow Required	17,529	18,364	20,033	20,868	24,193		gpm
Total Return Activated Sludge Flow Required	14,190	14,190	14,190	14,190	16,451		gpm

Avg. Discharge Pressure	12.4	ft
Peak Discharge Pressure	11.5	ft

Air Scour Requirements for Installed Membranes

Average Air Flow per Tank	989	SCFM (68°F) (assuming ww T= 14 oC)	Avg Discharge Pressure	5.2	psig
Peak Air Flow per Tank	1,108	SCFM (68°F) (assuming ww T= 8 oC)	Peak Discharge Pressure	5.3	psig

Requirements for Air Scour Blower Design (including spare rack slots)

Minimum Flow per Tank	989	SCFM (68°F) (assuming ww T= 8 oC)	Avg Discharge Pressure	5.2	psig
Maximum Flow per Tank	1,295	SCFM (68°F) (assuming ww T= 8 oC)	Peak Discharge Pressure	5.3	psig

Power Requirements based on operation Average Daily Flow

Component	Quantity Installed	Quantity Operating	Flow per Component	Discharge Pressure	Assumed Efficiency	Power per Component	Total Power Consumption
RAS Pump	4	3	4967 gpm	12 ft	75%	23.5 HP	1,256 kWh/d
Filtrate Pump	4	3	1341 gpm	22 ft	65%	13 HP	636 kWh/d
MOS Air Scour Blower	4	3	1039 scfm	5.2 psig	72%	30.8 HP	1,645 kWh/d
Air Compressors	2	1	21.8 cfm	141.4 psig		6.9 HP	35 kWh/d
Total							**3,572 kWh/d**

Chemical Cleaning Requirements

Cleaning Procedure	**Cleaning Procedure Frequency**	**Bulk Chemical Concentration**	**Bulk Chemical per Clean (gal)**	**Annual Bulk Chemical Consumption (gal)**
Chlorine MC	7.0 days	12.5% w/w Liquid	22	3,370
Chlorine CIP	90.0 days	12.5% w/w Liquid	149	1,820
Citric Acid CIP	180.0 days	50% w/w Liquid	251	1,529

Total CIP Waste Volume per CIP: 28,314 gal

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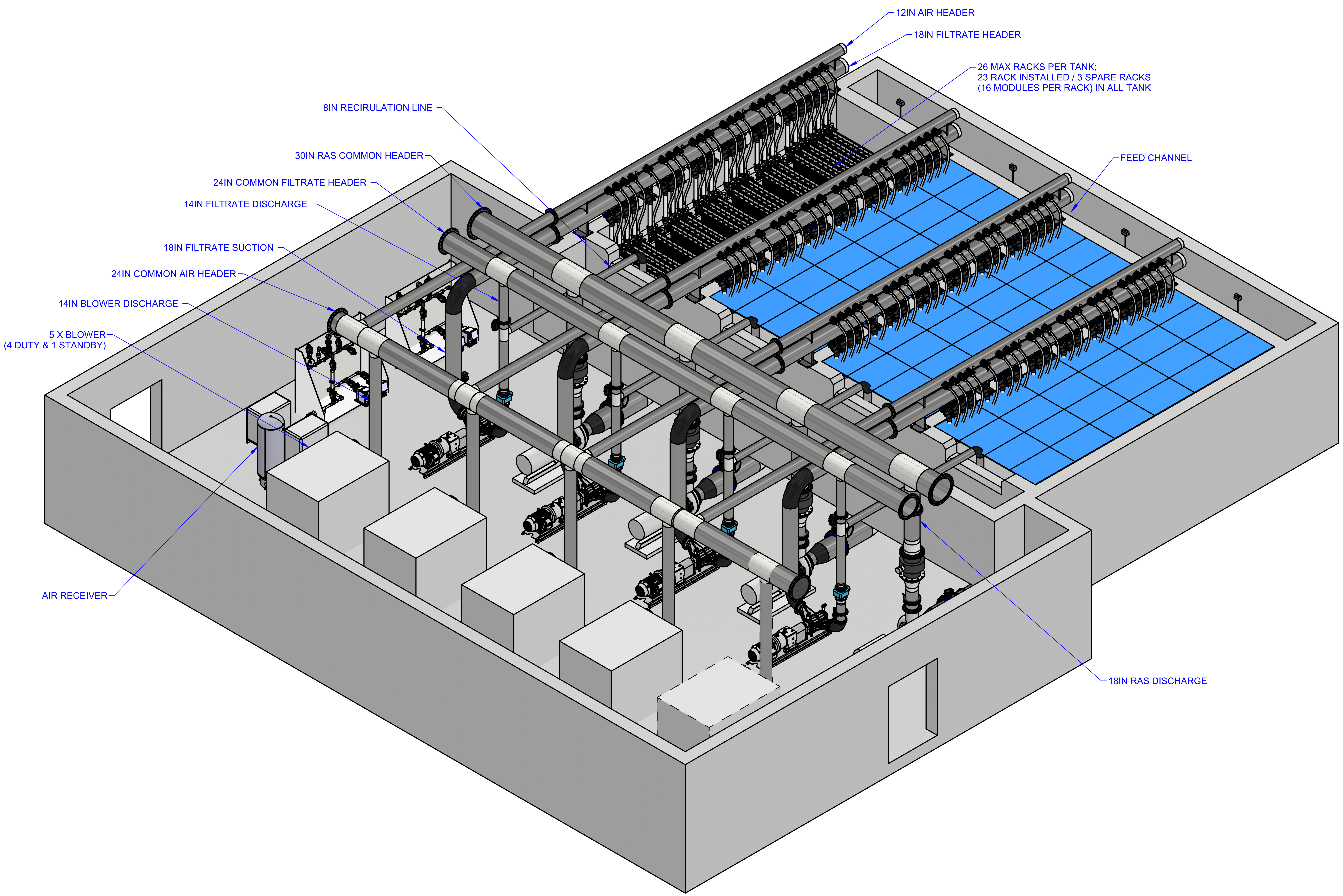
Ancillary Equipment Design Outline (Preliminary - Not for Construction)

Project: City of Hamilton - Dundas WWTP A-187125 Date: 23-May-24

Equipment Required	Type	Quantity Installed	Quantity in Service	Configu-ration	Max Capacity	Max Discharge Pressure	Average Capacity	Avg Discharge Pressure
Filtrate Pumps	End-suction centrifugal	4	3	One per cell	2406 gpm	38 ft	1341 gpm	22 ft
RAS Pumps	End-suction centrifugal	4	3	Manifolded	5758 gpm	11.5 ft	4967 gpm	12.4 ft
MOS Aeration Blowers	Positive displacement	4	3	Manifolded	1813 scfm	5.3 psig	1039 scfm	5.2 psig
MC Hypo Dosing Pumps	Metering Pump	1	1	-	117 gph	15 psig		
CIP Hypo Dosing Pumps	Metering Pump	1	1	-	1019 gph	15 psig		
CIP Citric Dosing Pumps	Metering Pump	1	1	-	2569 gph	15 psig		
Compressed Air System	Rotary-screw	2	1	-	21.8 CFM	141.4 psig		

Note:
1. Schedule to be used for estimating and not for construction.
2. Pump head based on preliminary plant levels and headloss calcs - to be confirmed during detailed piping design.
3. The MOS aeration blowers are sized to include the spare slots and modules.
4. Min. capacities of the pumps and blowers are to be checked to meet the turndown requirements.

ISOMETRIC VIEW



BAR = 1" AT PLOT SCALE   Y:\336.Carleton Place, ON - GA Drawing\Plan Layout.idw

REV	DESCRIPTION	DATE	DWN	CKD	APPD	ECN
0	PRELIMINARY ISSUE	08-01-2024	EMB			

DWN BY: EMB   DATE: 08-01-2024
CKD BY: DATE:
APPD BY: DATE:
MGD BY:
REF:
SCALE: NOT TO SCALE

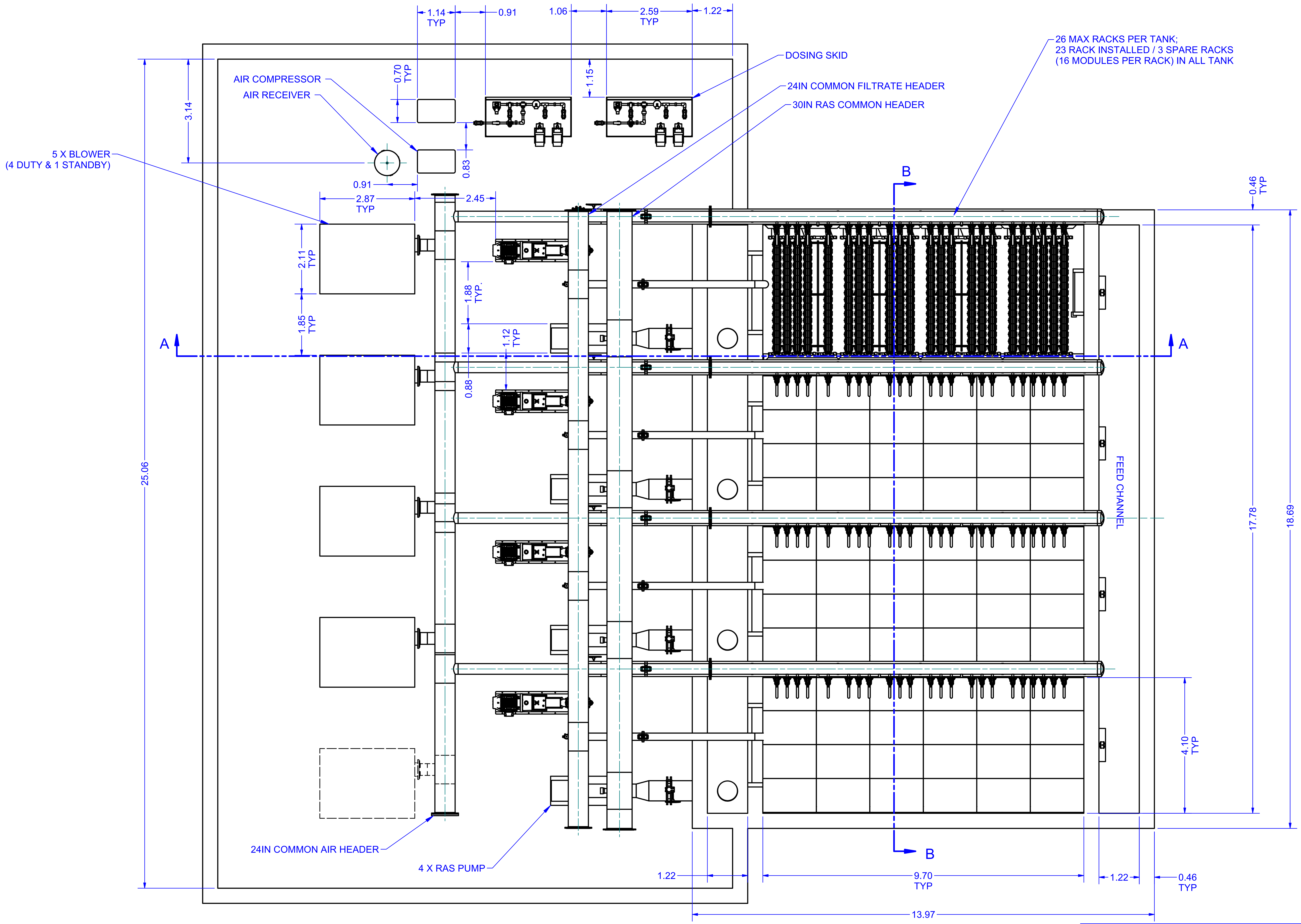
TITLE
GENERAL ARRANGEMENT DRAWING
MBR LAYOUT - B50N

CLIENT

DUPONT Water Solutions
MARLBOROUGH, MA, USA
1-800-636-2674

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			1 OF 4	0

PLAN VIEW



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BAR = 1" AT PLOT SCALE

NOTE:

ALL DIMENSIONS ARE IN METERS

DWN BY: EMB	DATE: 08-01-2024	TITLE: GENERAL ARRANGEMENT DRAWING MBR LAYOUT - B50N
CKD BY:	DATE:	CLIENT
APPD BY:	DATE:	
MGD BY:		DUPONT Water Solutions — MARLBOROUGH, MA, USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 2 OF 4 / REV 0

SECTION A-A

BAR = 1" AT PLOT SCALE

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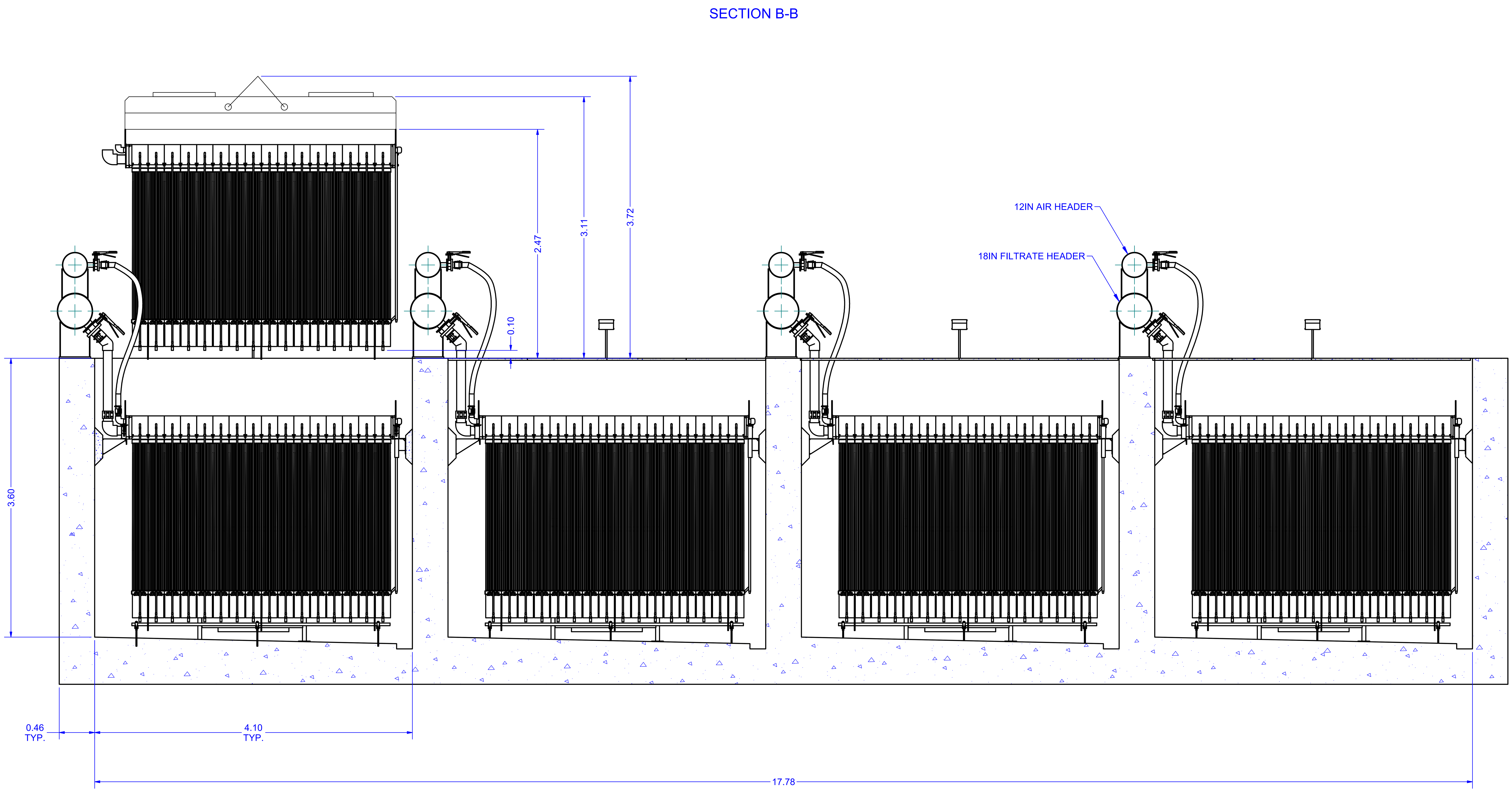
NOTE:

ALL DIMENSIONS ARE IN METERS

DWN BY: EMB	DATE: 08-01-2024	TITLE: GENERAL ARRANGEMENT DRAWING MBR LAYOUT - B50N
CKD BY:	DATE:	CLIENT
APPD BY:	DATE:	
MGD BY:		DUPONT Water Solutions MARLBOROUGH, MA, USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 3 OF 4 / REV 0



Y:\336.Carleton Place, ON - GA Drawing\Plan Layout.idw

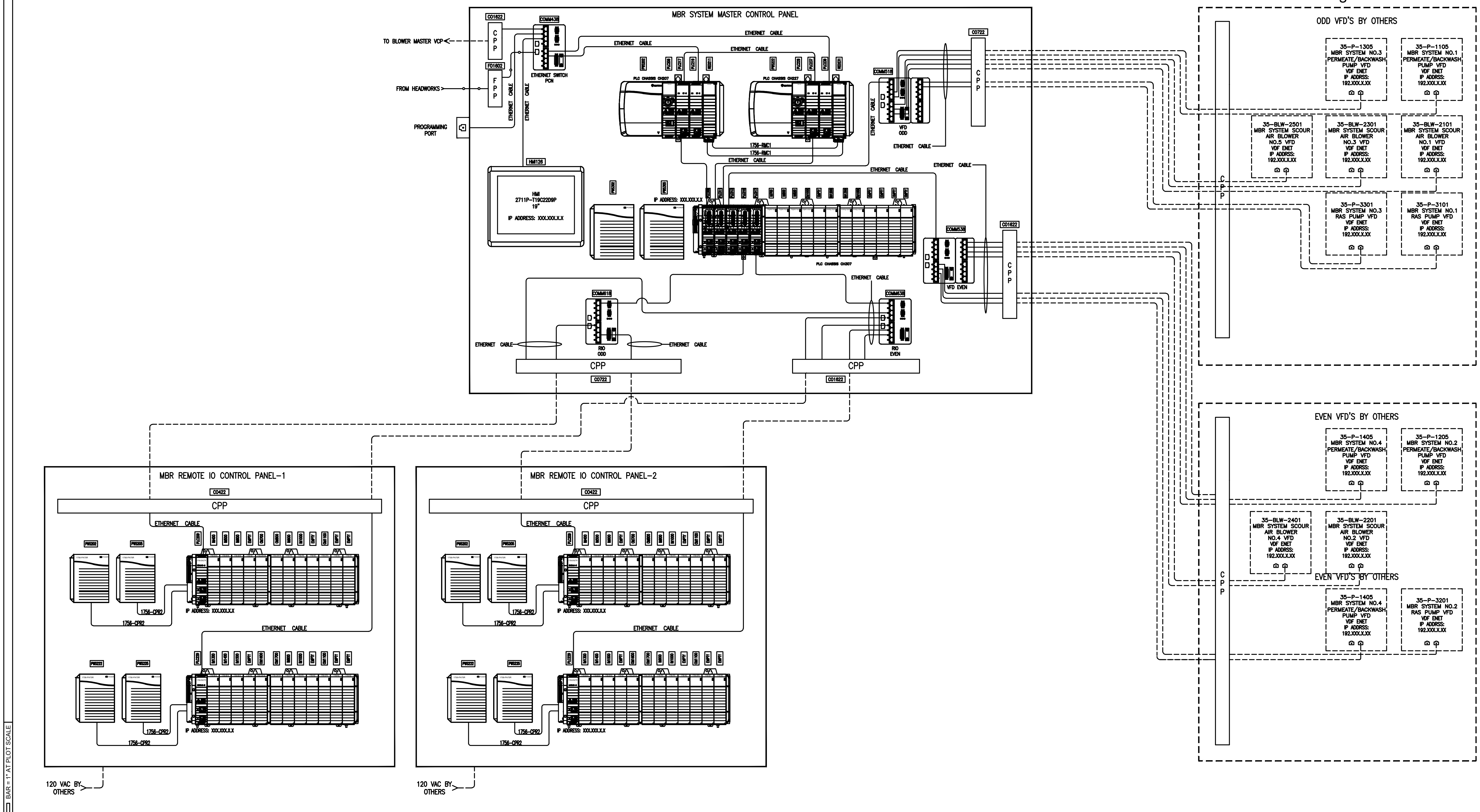
BAR = 1" AT PLOT SCALE

NOTE:

ALL DIMENSIONS ARE IN METERS

DWN BY:	DATE:	TITLE
EMB	08-01-2024	GENERAL ARRANGEMENT DRAWING MBR LAYOUT - B50N
CKD BY:	DATE:	
APPD BY:	DATE:	CLIENT
MGD BY:		DUPONT Water Solutions — MARLBOROUGH, MA, USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			4 OF 4	0



NOTE: 1. THIS IS JUST A REPRESENTATION OF THE PANELS THE SEQENCE MAY CHANGE AS PER SITE CONDITION.

2. DUPONT HAVE CONSIDERED ONLY SINGEL ETHERNET CABLE FROM VFD PANEL.

3. All THE VFD ARE SUPPLIED & INSTALLED BY OTHERS.

DWN BY: RP	DATE 01/29/2024	TITLE CONTROL SINGLE LINE DIAGRAM MEMCOR MEMPULSE MBR SYSTEM
CKD BY: SA	DATE 01/29/2024	CLIENT
APPD BY: RP	DATE 01/29/2024	MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
MGD BY: RP		
REF:		
SCALE: NOT TO SCALE		PROJECT: — PART NUMBER: — DMS REFERENCE: A-139652 — SHEET: 01 OF 01 — REV: 2

STD:22x34_D v1.41 BAR = 1" AT PLOT SCALE

DUPONT MEMCOR MEMPULSE MEMBRANE BIOREACTOR (MBR) SYSTEM

PIPING & INSTRUMENTATION DIAGRAM

DWN BY:	DATE
EMB	09/27/2022
CKD BY:	DATE
APPD BY:	DATE
MGD BY:	
REF:	
SCALE: NOT TO SCALE	

TITLE: PIPING & INSTRUMENTATION DIAGRAM
MEMCOR MEMPULSE MBR SYSTEM
TITLE SHEET

CLIENT

MEMCOR® a DuPont brand
MARLBOROUGH MA USA
1-800-636-2674

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			1 OF 10	0

8 7 6 5 4 3

FLOWS AND LINES

- NEW MAIN FLOW
- EXISTING MAIN FLOW
- FUTURE MAIN FLOW
- NEW SECONDARY FLOW
- EXISTING SECONDARY FLOW
- FUTURE SECONDARY FLOW
- MATERIAL SPECIFICATION CHANGE

CS SS

( ) AVERAGE FLOW
[ ] PEAK FLOW

ABBREVIATIONS

A TO C	-	AIR TO CLOSE
A TO O	-	AIR TO OPEN
AVG	-	AVERAGE
B/EL	-	BOTTOM ELEVATION
CL	-	CENTER LINE
CFM	-	CUBIC FEET PER MINUTE
CW	-	CITY WATER (POTABLE)
DIA	-	DIAMETER
DWG	-	DRAWING
EL	-	ELEVATION
F.C.	-	FAIL CLOSED
F.O.	-	FAIL OPEN
FRL	-	FILTER\REGULATOR\LUBRICATOR
GAL	-	GALLONS
GPD	-	GALLONS PER DAY
GPH	-	GALLONS PER HOUR
GPM	-	GALLONS PER MINUTE
HB	-	HOSE BIB
HG	-	INCHES OF MERCURY
HI	-	HIGH
HOA	-	HAND/OFF/AUTO
HP	-	HORSEPOWER
IA	-	INSTRUMENT AIR
ID	-	INSIDE DIAMETER
INV	-	INVERT
LO	-	LOW
MH	-	MANHOLE
MW	-	MANWAY
N.C.	-	NORMALLY CLOSED
N.O.	-	NORMALLY OPEN
OAL	-	OVERALL LENGTH
O.D.	-	OUTSIDE DIAMETER
PA	-	PLANT AIR
PSIG	-	POUNDS PER SQUARE INCH - GAUGE
PW	-	PLANT WATER
RED	-	REDUCER
RPM	-	REVOLUTIONS PER MINUTE
SCFM	-	STANDARD CUBIC FEET PER MINUTE
SCH	-	SCHEDULE
SG	-	SPECIFIC GRAVITY
SP	-	SETPOINT
SSH	-	STRAIGHT SIDE HEIGHT
STD	-	STANDARD
SW	-	SEAL WATER
SWD	-	SIDE WATER DEPTH
TDH	-	TOTAL DYNAMIC HEAD(FT OF FLUID)
T/EL	-	TOP ELEVATION
TYP	-	TYPICAL
VAC	-	VACUUM
VSD	-	VARIABLE SPEED DRIVE
WC	-	WATER COLUMN
WD	-	WATER DEPTH
WL	-	WATER LEVEL
WV	-	WORKING VOLUME (DOES NOT INCLUDE FREEBOARD OR HEEL)

LINE CONTINUATIONS

INDICATES A LINE GOING TO OR COMING FROM BATTERY LIMITS (CONTRACT LIMITS)

5 A 2 — INDICATES CONTINUATION OF LINE IS ON SHEET NUMBER 5 (SAME DRAWING NUMBER) IN ZONE A 2

SHT 5 — INDICATES CONTINUATION OF A SIGNAL IS ON SHEET NUMBER 5

VALVE SYMBOLS

- ANGLE
- BALL
- BUTTERFLY
- CHECK
- DIAPHRAGM
- GATE
- GLOBE
- KNIFE
- NEEDLE
- PINCH
- PLUG
- PRESSURE REDUCING
- RELIEF
- SOLENOID OR ELECTRONC DRAIN VALVE
- THREE WAY
- FOUR WAY
- VACUUM BREAKER
- AIR RELEASE
- HOSE BIBB
- INTEGRAL BLOCK & BLEED
- RUPTURE DISK

ACTUATORS

- CYLINDER
- DIAPHRAGM-SPRING
- ELECTRO HYDRAULIC
- ELECTRO PNEUMATIC
- MOTOR
- SOLENOID
- POSITIONER * - TYPE

SCOPE BREAKS

DUPONT | CLIENT

PIPING AND TUBING MATERIALS

ABS	-	ACRYLONTRILE BUTADIENE STYRENE TRUSS PIPE
ALM	-	ALUMINUM PIPE OR TUBING
ARP	-	ALUMINUM REINFORCED PLASTIC PIPE
BL	-	BLACK IRON PIPE
BPT	-	BRAIDED PLASTIC TUBING-PVC
CI	-	CAST IRON PIPE
CISP	-	CAST IRON SOIL PIPE
CMCP	-	CORRUGATED METAL CULVERT PIPE
CMH	-	CHEMICAL HOSE
CMP	-	CORRUGATED METAL PIPE
COP	-	COPPER PIPE
CPVC	-	CHLORINATED POLYVINYL CHLORIDE PIPE
CS	-	CARBON STEEL PIPE
DI	-	DUCTILE CAST IRON PIPE
ERP	-	EPOXY RESIN PIPE
FRP	-	FIBERGLASS REINFORCED PLASTIC PIPE
GS	-	GALVANIZED STEEL PIPE
HOSE	-	FLEXIBLE HOSE
HSI	-	HIGH SILICON IRON PIPE
KLS	-	PVDF LINED STEEL PIPE (KYNAR® LINED TYPICAL)
KYN	-	PVDF (KYNAR® TYPICAL)
MI	-	CARBON STEEL PIPE W/MALLEABLE IRON FITTINGS
NEO	-	NEOPRENE HOSE
NI	-	NICKEL ALLOY PIPE
NLS	-	NEOPRENE LINED STEEL PIPE
PEP	-	POLYETHYLENE PIPE
PETB	-	POLYETHYLENE TUBING
PLS	-	POLYPROPYLENE LINED STEEL PIPE
POP	-	POLYPROPYLENE PIPE
PRP	-	PHENOLIC RESIN PIPE
PVC	-	POLYVINYL CHLORIDE PIPE
PVC HOSE		POLYVINYL CHLORIDE HOSE
PVDF	-	POLYVINYLIDENE FLUORIDE PIPE
RBR	-	RUBBER HOSE
RCCP	-	REINFORCED CONCRETE CULVERT PIPE
RCP	-	REINFORCED CONCRETE PIPE
SAR	-	SARAN TUBING
SLH	-	SLUDGE HOSE
SLS	-	SARAN LINED STEEL PIPE
SS	-	STAINLESS STEEL PIPE OR TUBING
TEF	-	TEFLON TUBING
TI	-	TITANIUM ALLOY PIPE
TLS	-	TEFLON LINED STEEL PIPE
TYB	-	TYGON® TUBING-BRAIDED
TYG	-	TYGON® TUBING-UNBRAIDED

INSTRUMENTATION AND RELATED ITEMS

- CAPILLARY TUBING
- ELECTRICAL
- HYDRAULIC
- PNEUMATIC
- DATA LINK
- FLUME
- MAGNETIC FLOW METER
- ROTAMETER
- SONIC FLOW METER
- TURBINE FLOW METER
- VENTURI
- WEIR
- VORTEX SENSOR
- ANNUBAR
- ORIFICE PLATE
- TM — THERMAL DISPERSION FLOW METER

INSTRUMENT SYMBOLS

	PRIMARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	AUXILIARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS	1 * IP1**	2	3
SHARED DISPLAY, SHARED CONTROL	4	5	6
COMPUTER FUNCTION	7	8	9
PROGRAMMABLE LOGIC CONTROL	10	11	12

* SYMBOL SIZE MAY VARY ACCORDING TO THE USER'S NEEDS AND THE TYPE OF DOCUMENT. A SUGGESTED SQUARE AND CIRCLE SIZE FOR LARGE DIAGRAMS IS SHOWN ABOVE. CONSISTENCY IS RECOMMENDED.

** ABBREVIATIONS OF THE USER'S CHOICE SUCH AS IP1 (INSTRUMENT PANEL #1), IC2 (INSTRUMENT CONSOLE #2), CC3 (COMPUTER CONSOLE #3), ETC., MAY BE USED WHEN IT IS NECESSARY TO SPECIFY INSTRUMENT OR FUNCTION LOCATION.

*** NORMALLY INACCESSIBLE OR BEHIND-THE-PANEL DEVICES OR FUNCTIONS MAY BE DEPICTED BY USING THE SAME SYMBOL BUT WITH DASHED HORIZONTAL BARS, I.E.

PIPING ACCESSORIES

- DIAPHRAGM SEAL
- DRESSER COUPLING
- EJECTOR/EDUCTOR
- EXPANSION JOINT
- FLANGED CONNECTION
- FLEXIBLE HOSE
- HOSE CONNECTION
- INSULATION
- INSULATED PIPE WITH ELECTRIC HEAT TRACE
- INSULATED PIPE WITH STEAM HEAT TRACE
- PIPE TO TUBING ADAPTER
- PULSATION DAMPENER
- QUICK DISCONNECT
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- RUPTURE DISK
- ORIFICE PLATE
- SILENCER/MUFFLER
- SIGHT FLOW INDICATOR
- STRAINER
- UNION
- STEAM TRAP
- AIR FILTER
- AIR LUBRICATOR
- AIR REGULATOR
- COMB. AIR FILTER/ REGULATOR W/GAUGE
- FLOW ORIFICE
- SIGHT FLOW STRAINER
- OPEN — SPECTACLE BLIND
- CLOSE — SPECTACLE BLIND
- PIGTAIL SIPHON
- STRAINER
- COURSE BUBBLE AIR DIFFUSER
- FINE BUBBLE AIR DIFFUSER

ISA INSTRUMENT IDENTIFICATION TABLE

	FIRST LETTER		SUCCEEDING LETTERS	
	PROCESS VARIABLE	MODIFIER (IF NEEDED)	READOUT OR COMPUTER FUNCTION	MODIFIER (IF NEEDED)
A	ANALYSIS		ALARM	
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE		CONTROL	
D	USER'S CHOICE	DIFFERENTIAL		
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)	
F	FLOW RATE	RATIO (FRACTION)		
G	USER'S CHOICE		GLASS, VIEWING DEVICE	
H	HAND			HIGH
I	CURRENT (ELECTRICAL)		INDICATE	
J	POWER	SCAN		
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE	CONTROL STATION	
L	LEVEL		LIGHT	LOW
M	USER'S CHOICE	MOMENTARY		
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE (RESTRICTION)	
P	PRESSURE, VACUUM		POINT (TEST CONNECTION)	
Q	QUANTITY	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD	
S	SPEED, FREQUENCY	SAFETY	SWITCH	
T	TEMPERATURE		TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS		VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL	
X	UNCLASSIFIED	X-AXIS	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y-AXIS	RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z-AXIS	DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

LEGEND BASED ON ISA STANDARD S 5.1

INSTRUMENT TAG NUMBERS

TIC 103 - TAG NUMBER — INSTRUMENTATION IDENTIFICATION OR

103 - LOOP NUMBER

TIC - FUNCTIONAL IDENTIFICATION

NOTE: HYPHENS ARE OPTIONAL AS SEPARATORS

EQUIPMENT / VALVE TAG

P- 6 15-1A

- EQUIPMENT NO. NUMBER DENOTES MULTIPLE DEVICES USED IN IDENTICAL DUPLICATE SYSTEMS. LETTER DISTIGUISHES MULTIPLE SIMILAR DEVICES IN THE SAME INSTRUMENT LOOP.
- LOOP NO.
- PROCESS I.D.
- EQUIPMENT / VALVE IDENTIFICATION

ELECTRICAL AND RELATED ITEMS

- S — SELECTOR SWITCHES
- VFD — VARIABLE FREQUENCY DRIVE
- EM — EMERGENCY POWER
- I — INTERLOCK
- PILOT LIGHT

EQUIPMENT FUNCTIONAL IDENTIFICATION

B	BLOWER
M	MECHANICAL EQUIPMENT
P	PUMP
PD	PULSATION DAMPENER
STR	STRAINER
TK	TANK
CC	CALIBRATION COLUMN
IQ	INJECTION QUILL ASSEMBLY
ED	EDUCTOR

LINE NUMBER IDENTIFICATION

1"-PA-CS

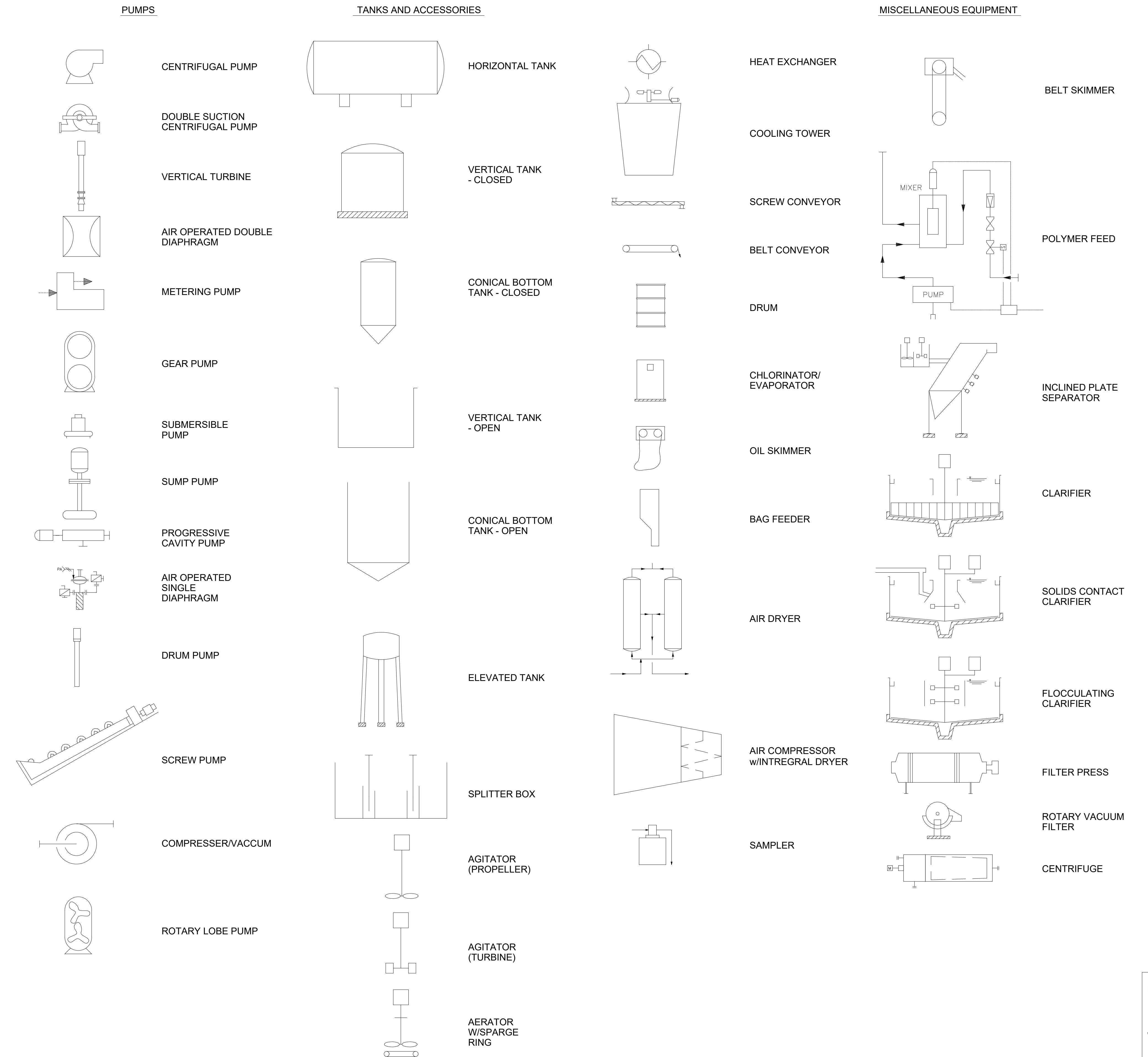
- MATERIAL CLASS
- FLOW STREAM INDENTIFICATION
- LINE SIZE

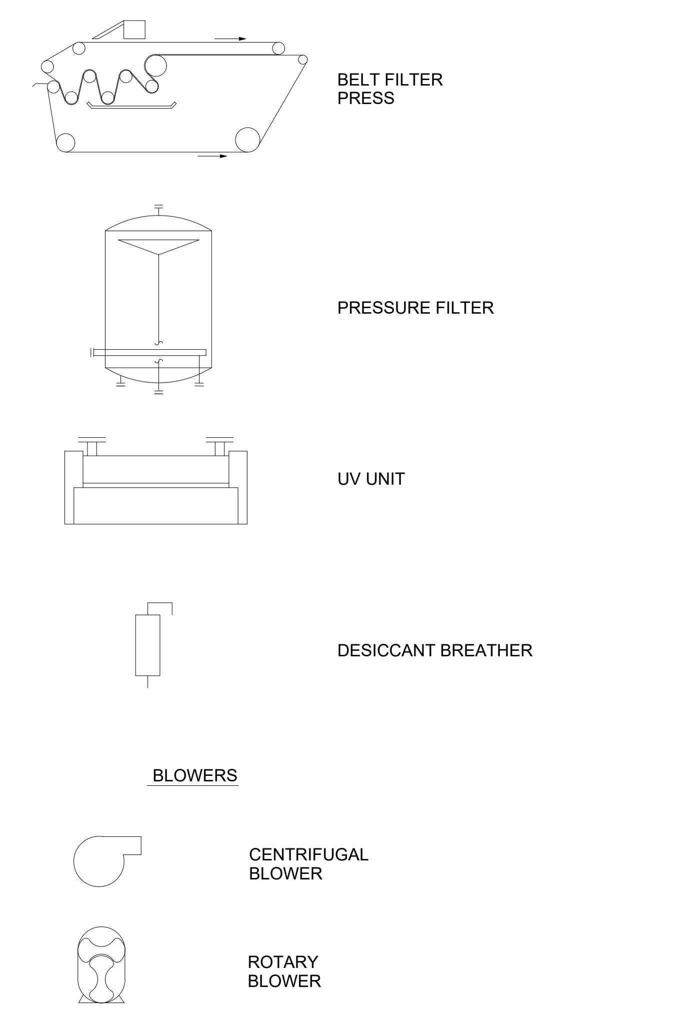
PIPING SCOPE OF SUPPLY

- INCLUDED IN SCOPE OR OPTIONAL PIPING SCOPE
- PIPING BY OTHERS

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM LEGEND SHEET 1
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY:		MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 2 OF 10 / REV 0

STD 22x34_D v1.41 — BAR = 1" AT PLOT SCALE — Doc Group: — Doc Type:





EQUIPMENT TEXT

TK-

TOTAL CAPACITY: XXX GALLONS
OPERATING CAPACITY: XXX GALLONS
DIMENSIONS: XX ' L X XX' W X XX' SWD
MATERIAL: CONCRETE

P-

TYPE: CENTRIFUGAL
DESIGN: XXX GPM @ XX 'TDH
DRIVER: XX HP
MATERIAL:
DUTY: (3) DUTY (0) STANDBY

B-

TYPE: POSITIVE DISPLACEMENT
DESIGN: XXX SCFM @ XX PSI
DRIVER: XX HP
MATERIAL:
DUTY: (3) DUTY (0) STANDBY

TK-
MEMBRANE TANK

CIP FILL VOLUME: XXX GALLONS
INSTALLED MODULES:
NO. OF RACK:
MODULES PER RACK: 16
MATERIAL CONCRETE

P-
FILTRATE PUMP

TYPE: CENTRIFUGAL
DESIGN: XXX GPM @ XX 'TDH
CIP/MC FLOW: XXX GPM
DRIVER: XX HP
MATERIAL:
DUTY: (1) DUTY (0) STANDBY

M-

TYPE: SUBMERSIBLE
DESIGN:
DRIVER: XX HP
MATERIAL: POLYURETHANE

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM LEGEND SHEET 2
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY:		MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			3 OF 10	0

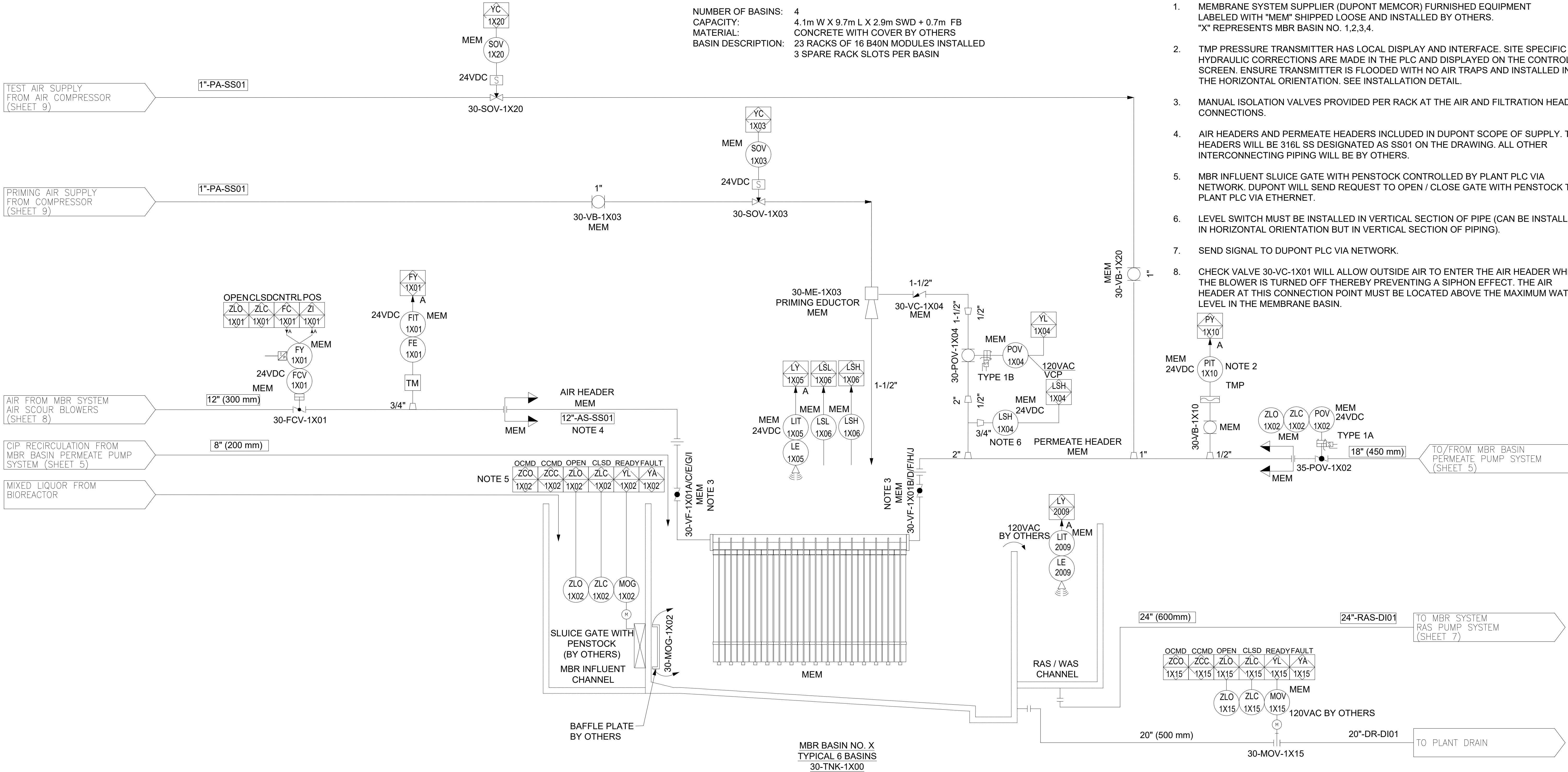
STD 22x34_D v1.41 | BAR = 1" AT PLOT SCALE | Doc Group: | Doc Type:

MBR SYSTEM

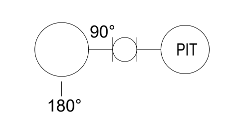
NUMBER OF BASINS:	4
CAPACITY:	4.1m W X 9.7m L X 2.9m SWD + 0.7m FB
MATERIAL:	CONCRETE WITH COVER BY OTHERS
BASIN DESCRIPTION:	23 RACKS OF 16 B40N MODULES INSTALLED 3 SPARE RACK SLOTS PER BASIN

NOTES:

1. MEMBRANE SYSTEM SUPPLIER (DUPONT MEMCOR) FURNISHED EQUIPMENT LABELED WITH "MEM" SHIPPED LOOSE AND INSTALLED BY OTHERS. "X" REPRESENTS MBR BASIN NO. 1,2,3,4.
2. TMP PRESSURE TRANSMITTER HAS LOCAL DISPLAY AND INTERFACE. SITE SPECIFIC HYDRAULIC CORRECTIONS ARE MADE IN THE PLC AND DISPLAYED ON THE CONTROL SCREEN. ENSURE TRANSMITTER IS FLOODED WITH NO AIR TRAPS AND INSTALLED IN THE HORIZONTAL ORIENTATION. SEE INSTALLATION DETAIL.
3. MANUAL ISOLATION VALVES PROVIDED PER RACK AT THE AIR AND FILTRATION HEADER CONNECTIONS.
4. AIR HEADERS AND PERMEATE HEADERS INCLUDED IN DUPONT SCOPE OF SUPPLY. THE HEADERS WILL BE 316L SS DESIGNATED AS SS01 ON THE DRAWING. ALL OTHER INTERCONNECTING PIPING WILL BE BY OTHERS.
5. MBR INFLUENT SLUICE GATE WITH PENSTOCK CONTROLLED BY PLANT PLC VIA NETWORK. DUPONT WILL SEND REQUEST TO OPEN / CLOSE GATE WITH PENSTOCK TO PLANT PLC VIA ETHERNET.
6. LEVEL SWITCH MUST BE INSTALLED IN VERTICAL SECTION OF PIPE (CAN BE INSTALLED IN HORIZONTAL ORIENTATION BUT IN VERTICAL SECTION OF PIPING).
7. SEND SIGNAL TO DUPONT PLC VIA NETWORK.
8. CHECK VALVE 30-VC-1X01 WILL ALLOW OUTSIDE AIR TO ENTER THE AIR HEADER WHEN THE BLOWER IS TURNED OFF THEREBY PREVENTING A SIPHON EFFECT. THE AIR HEADER AT THIS CONNECTION POINT MUST BE LOCATED ABOVE THE MAXIMUM WATER LEVEL IN THE MEMBRANE BASIN.



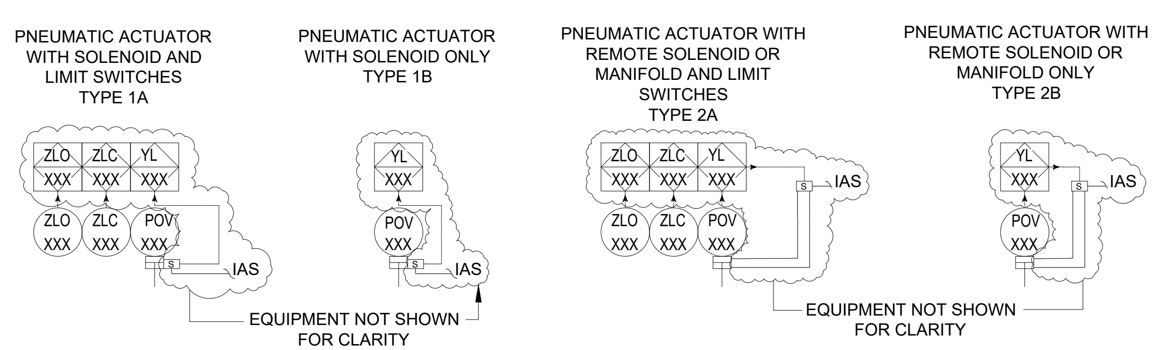
MBR BASIN NO. X
TYPICAL 6 BASINS
30-TNK-1X00



HORIZONTAL PIPE

PRESSURE TRANSMITTER INSTALLATION DETAIL

TYPICAL PNEUMATICALLY-ACTUATED VALVE CONTROL



NOTES:
1. AIR LINES SIZES: 1/2"
2. QUICK DISCONNECT FOR AIR LINES AT SOLENOID VALVE SUPPLIED BY OTHERS
3. SPEED CONTROL SUPPLIED BY MEM (NOT SHOWN FOR CLARITY)

DWN BY:	DATE
EMB	09/27/2022
CKD BY:	DATE
APPD BY:	DATE
MGD BY:	
REF:	
SCALE: NOT TO SCALE	

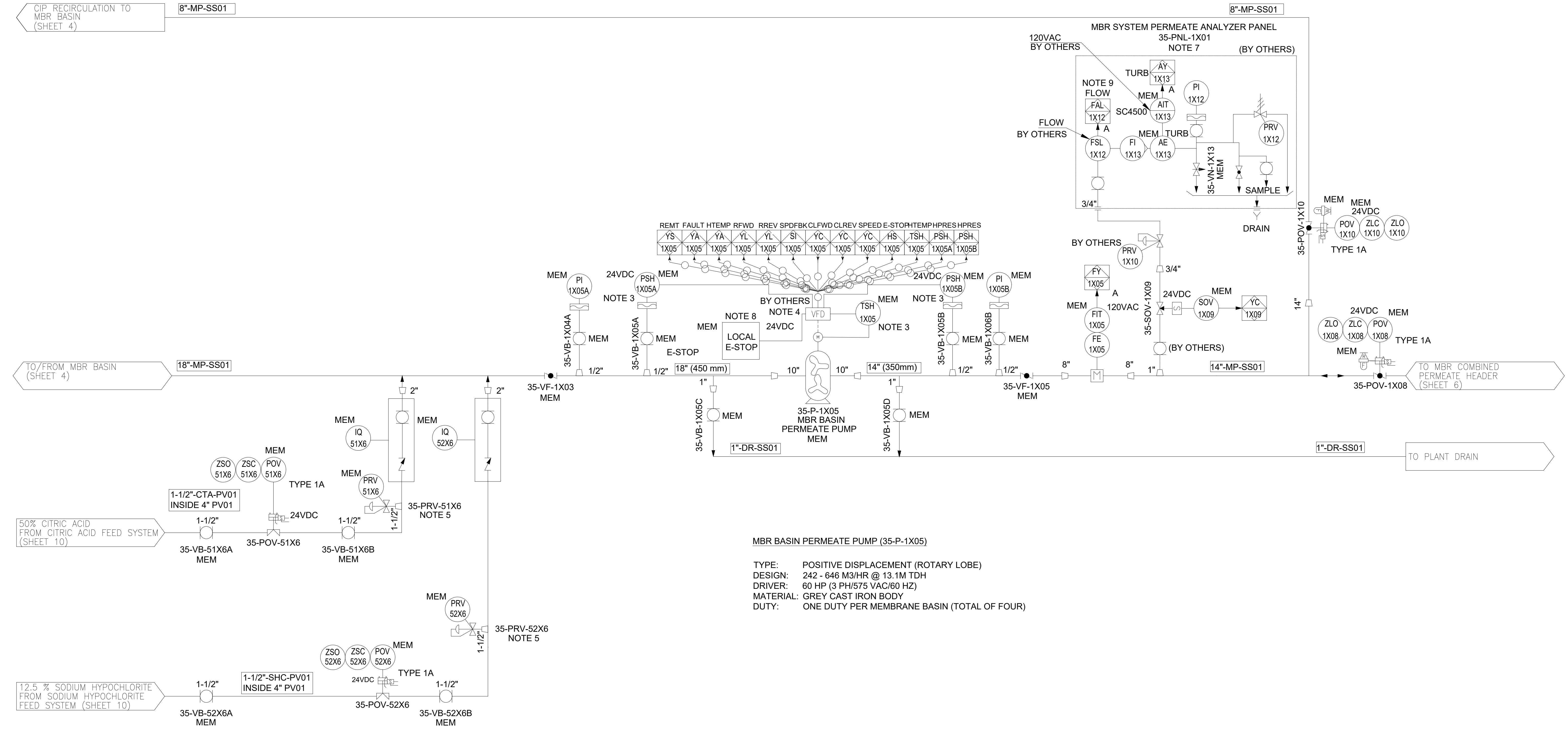
TITLE PIPING & INSTRUMENTATION DIAGRAM
MEMCOR MEMPULSE MBR SYSTEM
MBR BASIN (TYP 6)

CLIENT

MEMCOR® a DuPont brand MARLBOROUGH MA USA 1-800-636-2674

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			4 OF 10	0

STD:22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:



MBR BASIN PERMEATE PUMP (35-P-1X05)

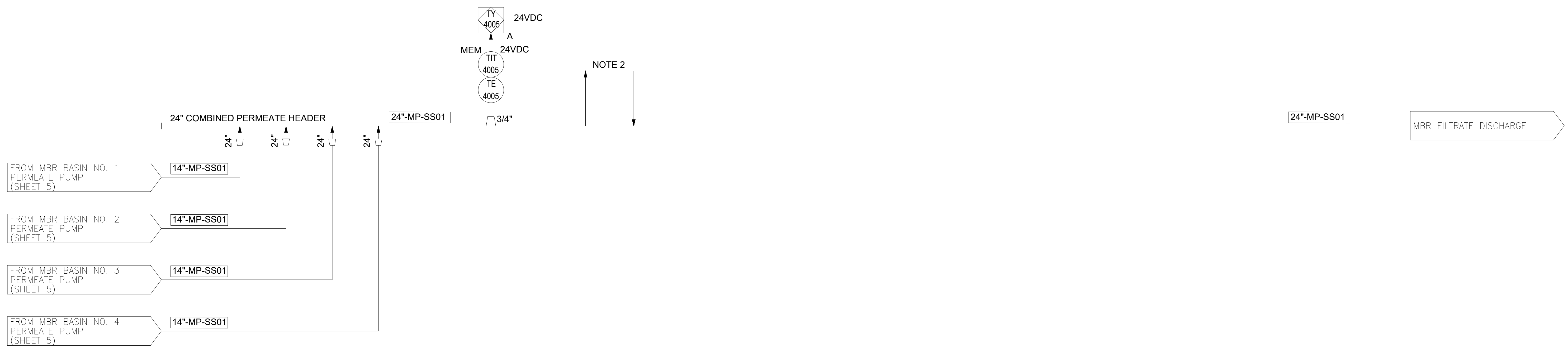
TYPE:	POSITIVE DISPLACEMENT (ROTARY LOBE)
DESIGN:	242 - 646 M3/HR @ 13.1M TDH
DRIVER:	60 HP (3 PH/575 VAC/60 HZ)
MATERIAL:	GREY CAST IRON BODY
DUTY:	ONE DUTY PER MEMBRANE BASIN (TOTAL OF FOUR)

NOTES:

1. MEMBRANE SYSTEM SUPPLIER (DUPONT MEMCOR) FURNISHED EQUIPMENT LABELED WITH "MEM" SHIPPED LOOSE AND INSTALLED BY OTHERS.
   "X" REPRESENTS MBR BASIN NO. 1,2,3,4,5,6
2. ALL EQUIPMENT AND INSTRUMENTS SHALL BE CONTROLLED BY DUPONT. WIRING BY OTHERS.
3. SHUT DOWN PERMEATE PUMP ON HIGH PRESSURE (PSH) AND HIGH TEMPERATURE (TSH). INTERLOCK FROM TSH AND PSH HARDWIRED TO VFD BY OTHERS. THE SIGNALS WILL BE SENT TO DUPONT PLC VIA NETWORK THRU VFD.
4. VFD PROVIDED BY OTHERS.
   VFD STOP/START/FAULT/SPEED CONTROLLED VIA ETHERNET.
5. IN-LINE BACKPRESSURE VALVES TO BE INSTALLED VERTICALLY NEAR INJECTION POINT AND AT HIGHEST POINT OF PIPING AND CLOSE TO INJECTION POINT.
6. SEND SIGNAL TO DUPONT PLC VIA NETWORK.
7. ANALYZER PANEL BY OTHERS. DUPONT TO ONLY SUPPLY TURBIDIMETER SENSOR WITH INCLUDED METERING VALVE, DIGITAL CONTROLLER, AND INLET SOLENOID VALVE PER MEMBRANE TANK LOOSE FOR FIELD INSTALLATION ON CUSTOM PANEL BY OTHERS. REFERENCE CONTRACT DRAWINGS FOR PANEL DESIGN DETAILS.
8. LOCAL E-STOP (SUPPLIED BY DUPONT) TO BE HARDWIRED TO VFD BY OTHERS. THE SIGNAL WILL BE SENT TO DUPONT PLC VIA NETWORK THRU VFD.
9. FLOW SIGNAL (SWITCH SUPPLIED BY OTHERS) TO BE HARDWIRED BY OTHERS TO DUPONT MBR RIO PANEL.

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR BASIN PERMEATE PUMP SYSTEM (TYP 6)
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY:		MEMCOR® a DuPont brand MARLBOROUGH MA USA 1-800-636-2674
REF:		PROJECT / PART NUMBER / DMS REFERENCE
SCALE: NOT TO SCALE		SHEET 5 OF 10 / REV 0

STD:22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:



NOTES:

1. ALL INTERCONNECTING PIPING WILL BE BY OTHERS.
2. IF REQUIRED: CONTRATOR TO INSTALL ELEVATED COMBINED PERMEATE HEADER OR VERTICAL PIPE LOOP TO PROVIDE BACK PRESSURE REQUIRED FOR PERMEATE INSTRUMENTATION AND THE MAINTENANCE CLEAN PROCESS. MINIMUM ELEVATION ABOVE HEADER IS ONE (1) FOOT.
3. SEND SIGNAL TO DUPONT PLC VIA NETWORK.
4. FLOW CONTROL VALVE SUPPLIED AND CONTROLLED BY OTHERS.

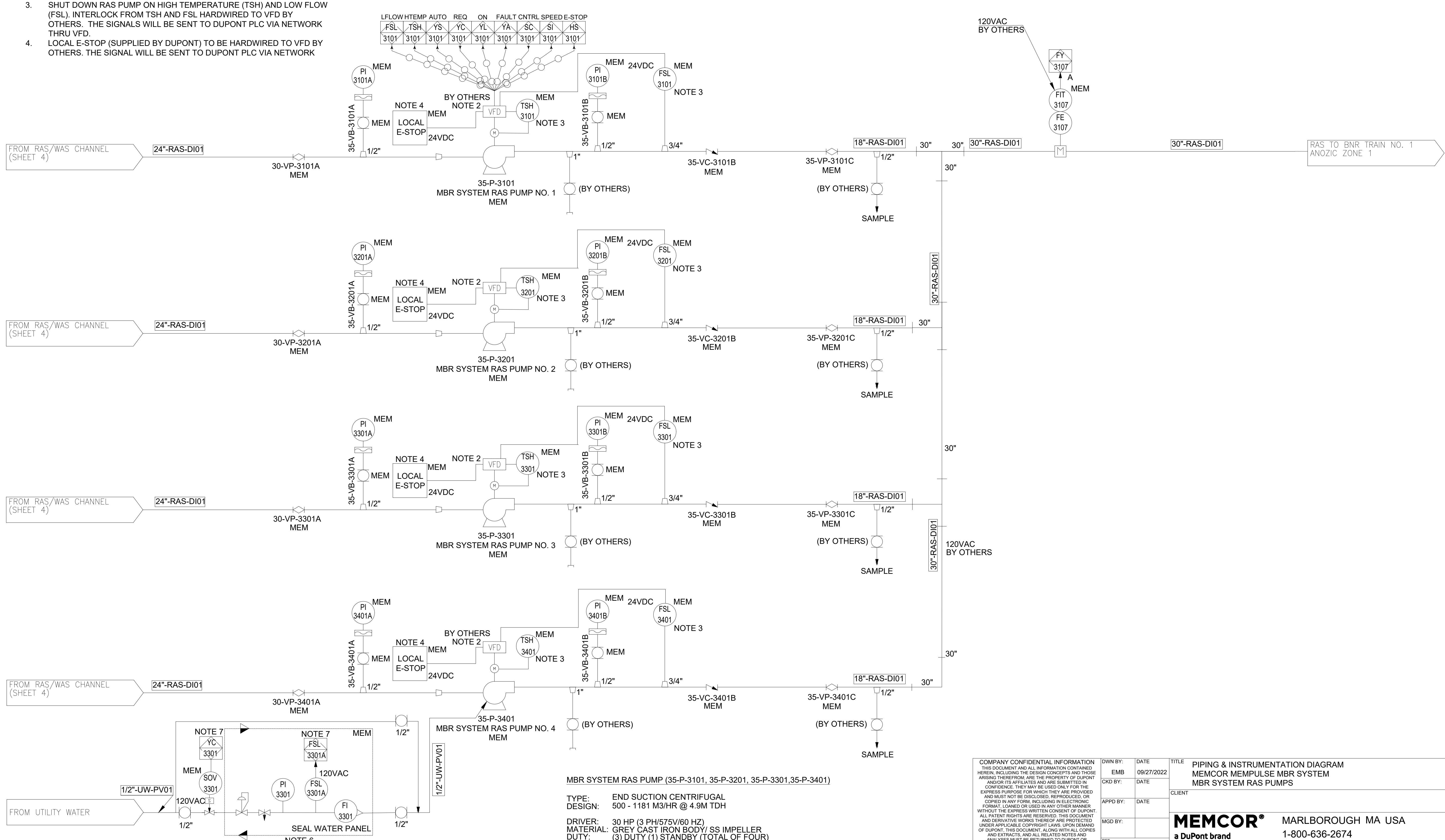
DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR COMBINED PERMEATE HEADER
CKD BY:	DATE	CLIENT
APPD BY:	DATE	MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
MGD BY:		
REF:		
SCALE:		

PROJECT	PART NUMBER	DMS REFERENCE	SHEET	REV
			6 OF 10	0

STD:22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:

NOTES:

1. ALL TAGGED COMPONENTS ON THIS PAGE SUPPLIED BY DUPONT UNLESS OTHERWISE INDICATED AS (BY OTHERS) AND SHIPPED LOOSE FOR INSTALLATION BY OTHERS. ALL INTERCONNECTING PIPING WILL BE BY OTHERS.
2. VFD'S PROVIDED BY OTHERS. VFD STOP/START/FAULT/SPEED CONTROLLED VIA ETHERNET.
3. SHUT DOWN RAS PUMP ON HIGH TEMPERATURE (TSH) AND LOW FLOW (FSL). INTERLOCK FROM TSH AND FSL HARDWIRED TO VFD BY OTHERS. THE SIGNALS WILL BE SENT TO DUPONT PLC VIA NETWORK THRU VFD.
4. LOCAL E-STOP (SUPPLIED BY DUPONT) TO BE HARDWIRED TO VFD BY OTHERS. THE SIGNAL WILL BE SENT TO DUPONT PLC VIA NETWORK



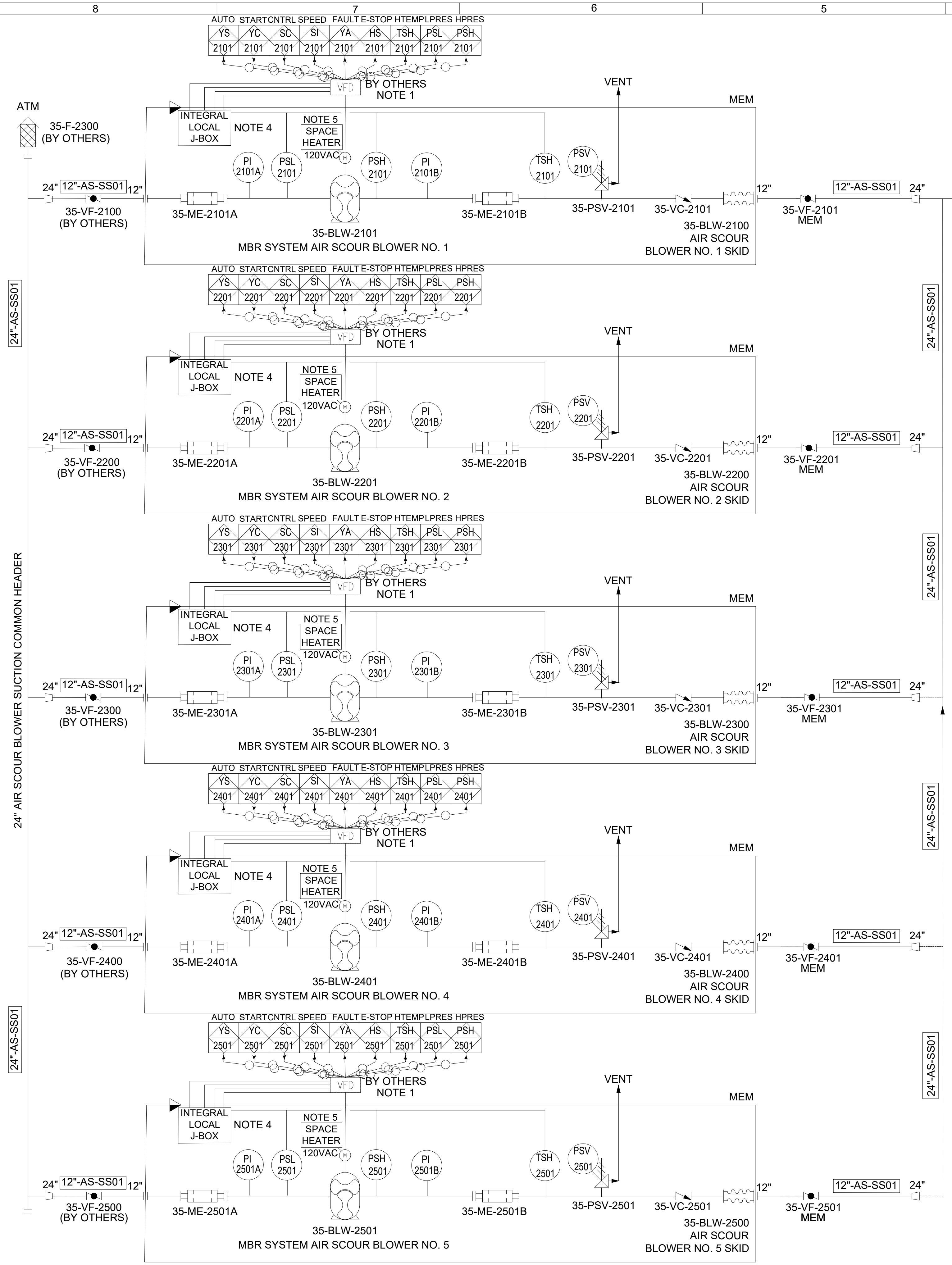
MBR SYSTEM RAS PUMP (35-P-3101, 35-P-3201, 35-P-3301,35-P-3401)

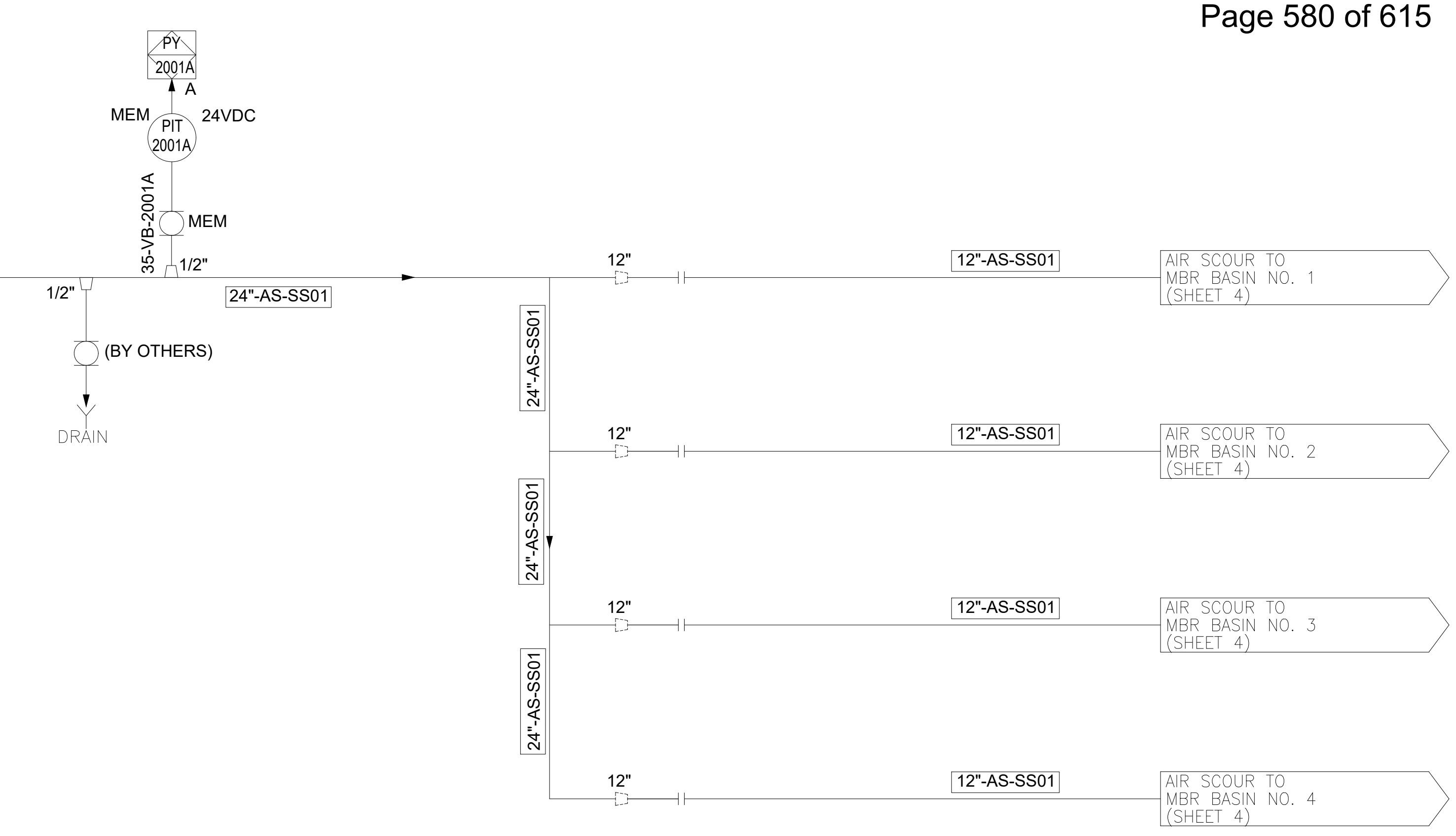
TYPE: END SUCTION CENTRIFUGAL
DESIGN: 500 - 1181 M3/HR @ 4.9M TDH

DRIVER: 30 HP (3 PH/575V/60 HZ)
MATERIAL: GREY CAST IRON BODY/ SS IMPELLER
DUTY: (3) DUTY (1) STANDBY (TOTAL OF FOUR)

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR SYSTEM RAS PUMPS
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY:		MEMCOR® a DuPont brand MARLBOROUGH MA USA 1-800-636-2674
REF:		PROJECT / PART NUMBER / DMS REFERENCE
SCALE:		SHEET 7 OF 10 / REV 0

STD-22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:





MBR SYSTEM AIR SCOUR BLOWER
(35-BLW-2101, 35-BLW-2201, 35-BLW-2301, 35-BLW-2401, 35-BLW-2501)

TYPE:	POSITIVE DISPLACEMENT ROTARY LOBE
DESIGN:	1129 - 3064 M3/HR @ 36.6 kPA (713 -1936 SCFM @ 5.3 PSIG)
DRIVER:	75 HP (3 PH/575VAC/60 HZ)
MATERIAL:	DI/CI CONSTRUCTION
DUTY:	(4) DUTY (1) STANDBY (TOTAL OF FIVE)

NOTES:

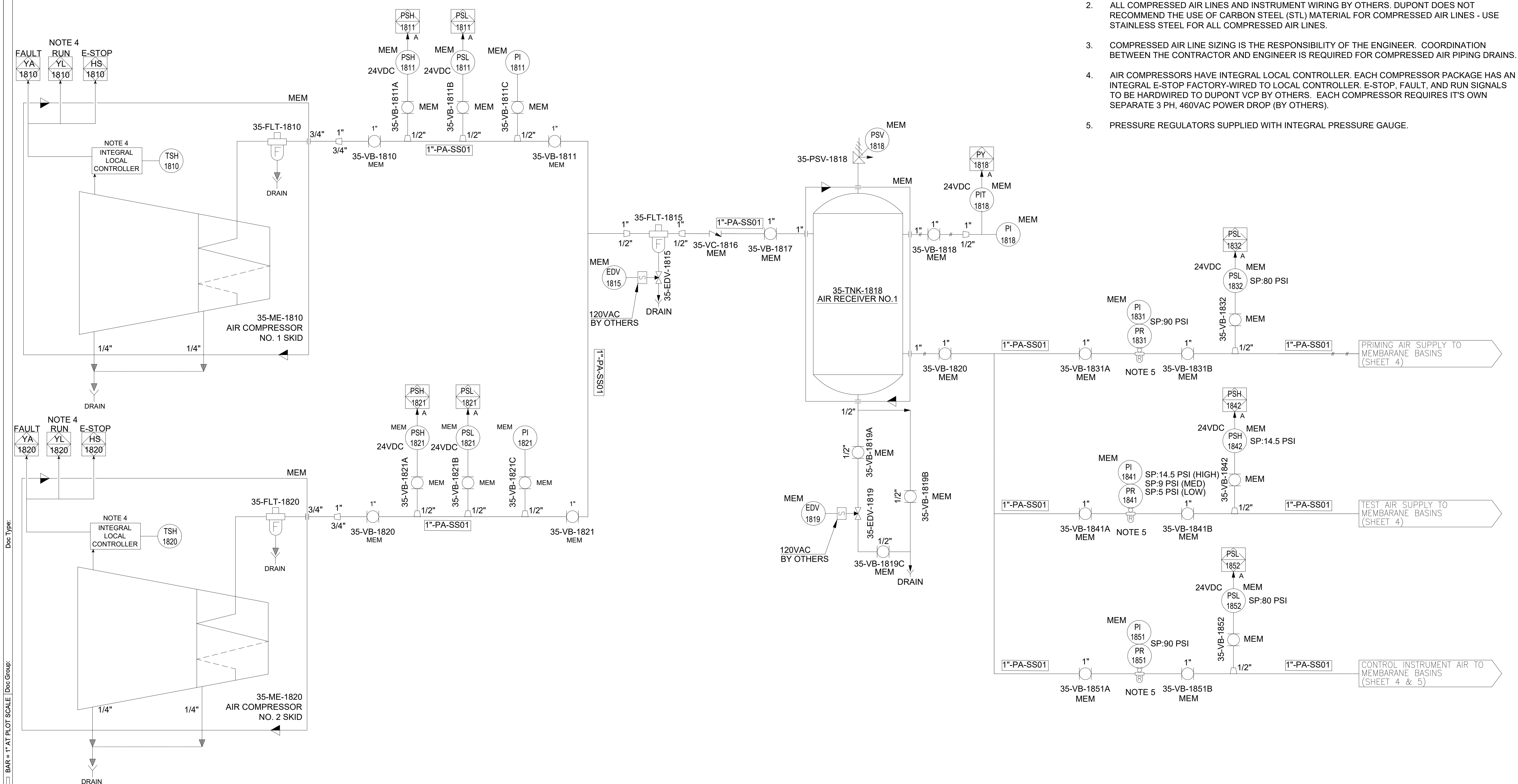
1. VFD PROVIDED BY OTHERS. VFD STOP/START/FAULT/SPEED CONTROLLED VIA ETHERNET. INTERLOCKS AND INSTRUMENTATION WILL BE HANDWIRED TO VFD BY OTHERS.
2. SHUT DOWN BLOWER ON PRESSURE (PSH & PSL) AND HIGH TEMPERATURE (TSH)
3. ALL TAGGED COMPONENTS ON THIS PAGE SUPPLIED BY DUPONT UNLESS OTHERWISE INDICATED (BY OTHERS) AND SHIPPED LOOSE FOR INSTALLATION BY OTHERS. ALL INTERCONNECTING PIPING WILL BE BY OTHERS.
4. EACH BLOWER PACKAGE HAS AN INTEGRAL JUNCTION BOX WITH E-STOP AND INSTRUMENTS FACTORY-WIRED TO BOX. E-STOP, LOW PRESSURE, HIGH PRESSURE, HIGH TEMPERATURE SIGNALS TO BE HARDWIRED TO VFD BY OTHERS. THE SIGNALS WILL BE SENT TO DUPONT PLC VIA NETWORK THRU VFD.
5. THE MOTOR SPACE HEATERS (2 X 28W) PROVIDED WITH BLOWER PACKAGE REQUIRE EXTERNAL 120VAC POWER SUPPLY (BY OTHERS) THAT MUST BE PROVIDED FROM THE MCC THROUGH THE VFD. THE REQUIRED 460VAC POWER SHALL BE SUPPLIED BY OTHERS. WHEN THE MOTOR IS RUNNING, THE SPACE HEATERS ARE TURNED OFF. WHEN THE MOTOR SHUTS OFF, THE SPACE HEATERS ARE TURNED ON. THE LOGIC FOR CONTROLLING THE HEATERS BASED ON MOTOR STATUS IS TO BE PROGRAMMED AND COORDINATED BY OTHERS THROUGH THE VFD.

DWN BY: EMB	DATE: 09/27/2022	TITLE: PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR SYSTEM AIR SCOUR BLOWERS
CKD BY:	DATE:	CLIENT
APPD BY:	DATE:	MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
MGD BY:	DATE:	
REF:		
SCALE:		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 8 OF 10 / REV 0

STD-22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:

NOTES:

1. ALL TAGGED COMPONENTS ON THIS PAGE SUPPLIED BY DUPONT AND SHIPPED LOOSE FOR INSTALLATION BY OTHERS.
2. ALL COMPRESSED AIR LINES AND INSTRUMENT WIRING BY OTHERS. DUPONT DOES NOT RECOMMEND THE USE OF CARBON STEEL (STL) MATERIAL FOR COMPRESSED AIR LINES - USE STAINLESS STEEL FOR ALL COMPRESSED AIR LINES.
3. COMPRESSED AIR LINE SIZING IS THE RESPONSIBILITY OF THE ENGINEER. COORDINATION BETWEEN THE CONTRACTOR AND ENGINEER IS REQUIRED FOR COMPRESSED AIR PIPING DRAINS.
4. AIR COMPRESSORS HAVE INTEGRAL LOCAL CONTROLLER. EACH COMPRESSOR PACKAGE HAS AN INTEGRAL E-STOP FACTORY-WIRED TO LOCAL CONTROLLER. E-STOP, FAULT, AND RUN SIGNALS TO BE HARDWIRED TO DUPONT VCP BY OTHERS. EACH COMPRESSOR REQUIRES IT'S OWN SEPARATE 3 PH, 460VAC POWER DROP (BY OTHERS).
5. PRESSURE REGULATORS SUPPLIED WITH INTEGRAL PRESSURE GAUGE.



MBR SYSTEM INSTRUMENT AIR COMPRESSOR
(35-ME-1810 & 35-ME-1820)

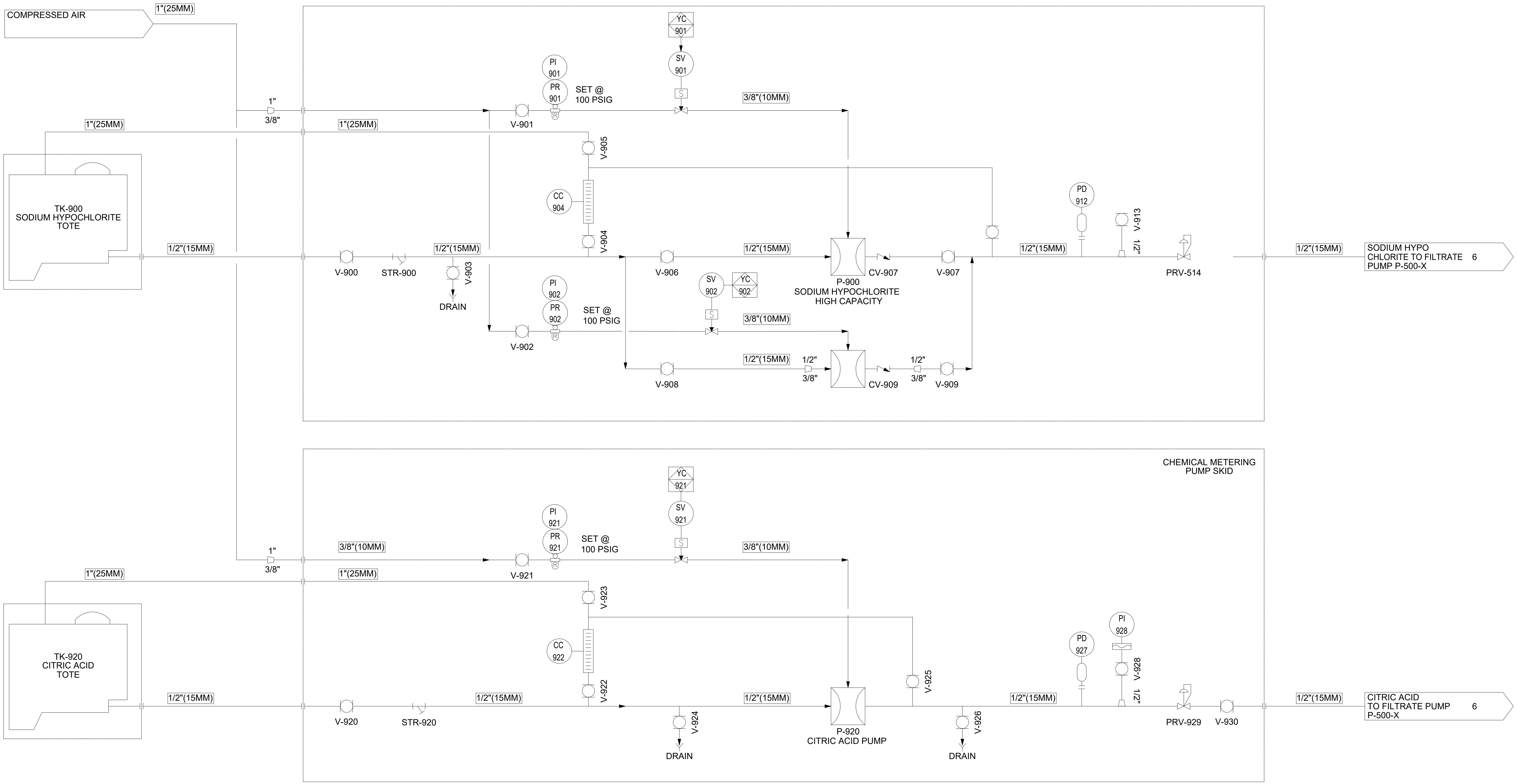
TYPE:	ROTARY SCREW (FLOOR MOUNT) WITH INTEGRAL DRYER AND FILTER
DESIGN:	14 L/s @ 7.5 BAR
DRIVER:	10 HP (3 PH/575VAC/60 HZ)
MATERIAL:	DI/CI
DUTY:	(1) DUTY (1) STANDBY (TOTAL OF TWO)

MBR SYSTEM INSTRUMENT AIR RECEIVER NO. 1/2
(35-TNK-1010)

TOTAL CAPACITY:	5000 LITRES
MATERIAL:	CARBON STEEL
PRESSURE RATING:	13.7 BAR
QTY:	(1) DUTY (1) STANDBY

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR INSTRUMENT AIR SYSTEM
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY:		MEMCOR® a DuPont brand MARLBOROUGH MA USA 1-800-636-2674
REF:		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 9 OF 10 / REV 0
SCALE:		

STD:22x34_D v1.41
BAR = 1" AT PLOT SCALE
Doc Group:
Doc Type:



CITRIC ACID DOSING PUMP SKID
(35-P-5110 & 35-P-5120)

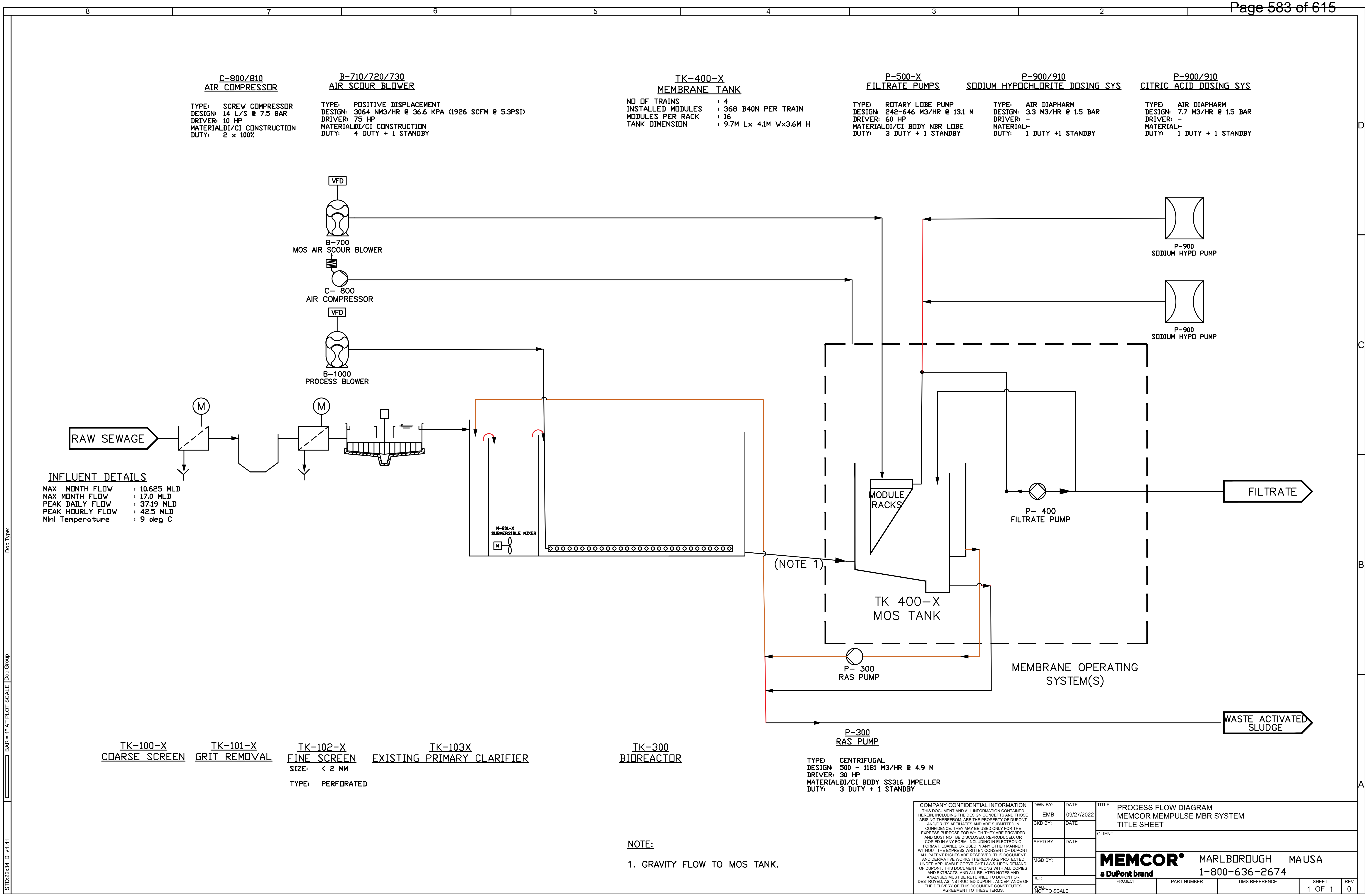
TYPE: AIR DIAPHRAGM PUMP
DESIGN: 7.7 M3/HR @ 1.5 BAR
DRIVER: -
MATERIAL: HDPE SKID WITH 304SS PAN
DUTY: (1) DUTY (1) STANDBY (TOTAL OF TWO)

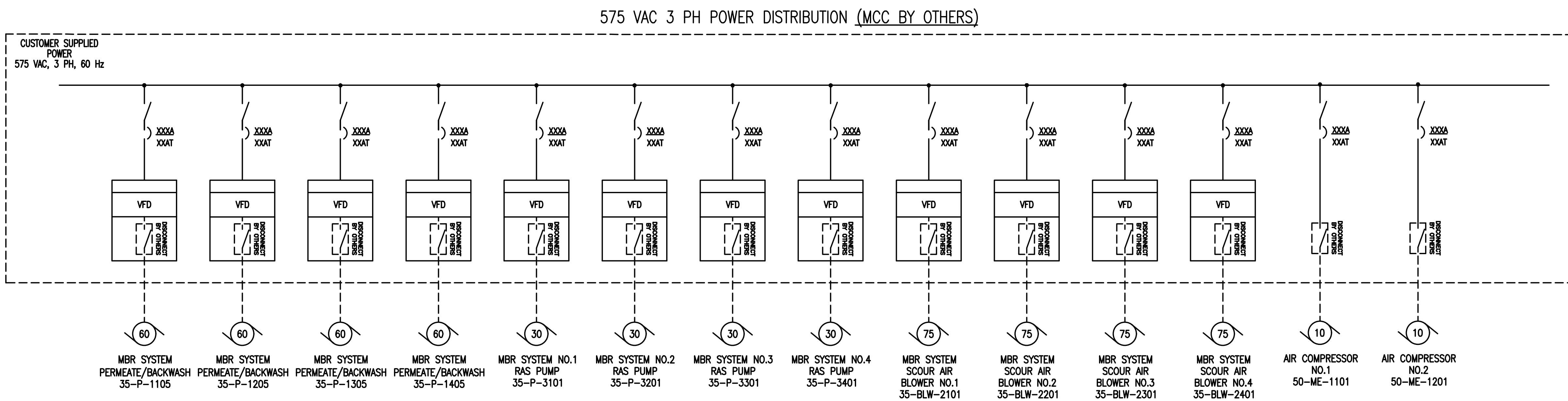
SODIUM HYPOCHLORITE DOSING PUMP SKID
(35-P-5210 & 35-P-5220)

TYPE: AIR DIAPHRAGM PUMP
DESIGN: 3.3 M3/HR @ 1.5 BAR
DRIVER: -
MATERIAL: HDPE SKID WITH 304SS PAN
DUTY: (1) DUTY (1) STANDBY (TOTAL OF TWO)

DWN BY: EMB	DATE 09/27/2022	TITLE PIPING & INSTRUMENTATION DIAGRAM MEMCOR MEMPULSE MBR SYSTEM MBR CHEMICAL STORAGE AND FEED SYSTEM
CKD BY:	DATE	CLIENT
APPD BY:	DATE	MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
MGD BY:		
REF:		
SCALE:		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 10 OF 10 / REV 0

STD 22x34_D v1.41 BAR = 1" AT PLOT SCALE Doc Group: Doc Type:

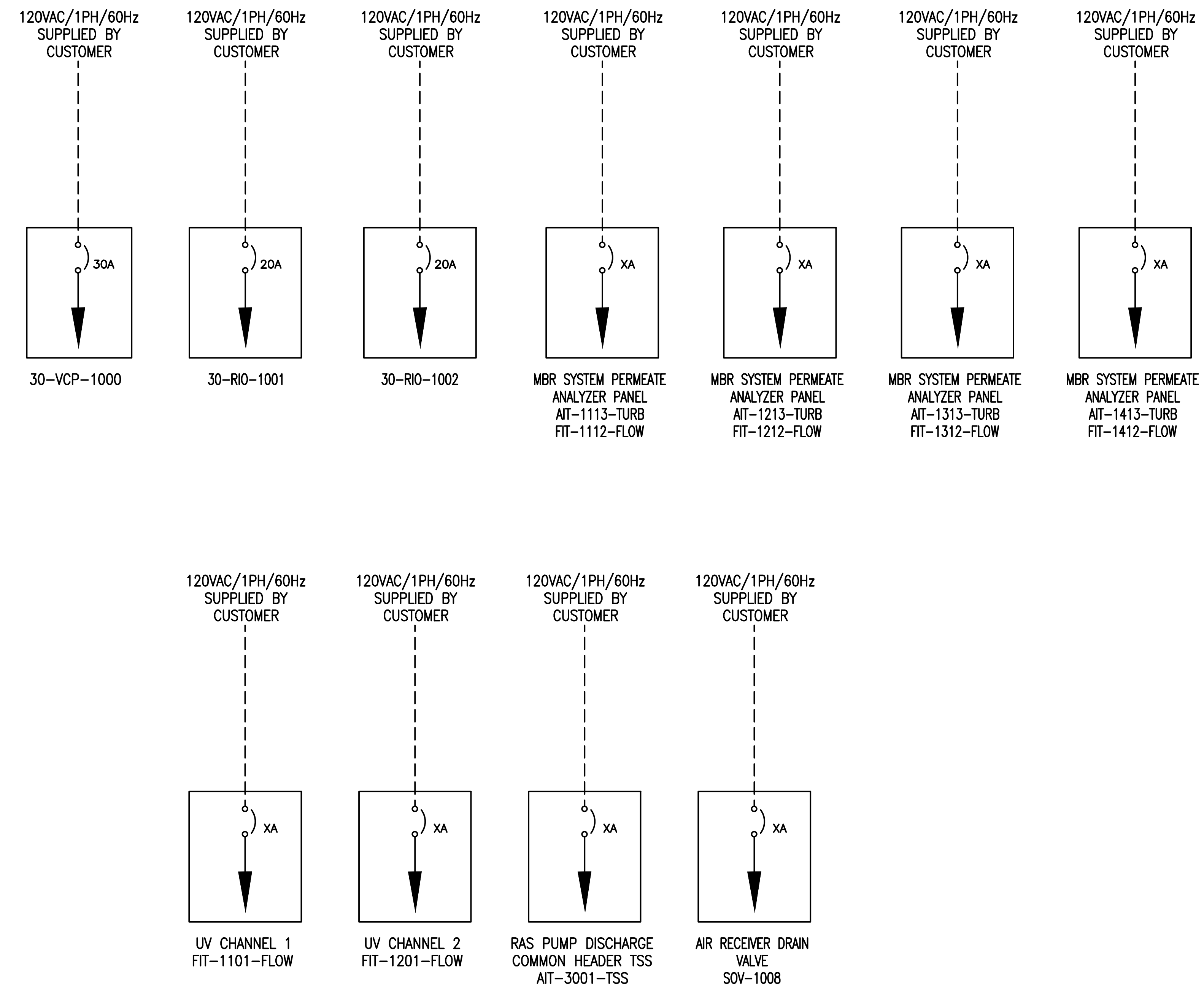

C-800/810
AIR COMPRESSOR
TYPE: SCREW COMPRESSOR
DESIGN: 14 L/S @ 7.5 BAR
DRIVER: 10 HP
MATERIAL: DI/CI CONSTRUCTION
DUTY: 2 x 100%
B-710/720/730
AIR SCOUR BLOWER
TYPE: POSITIVE DISPLACEMENT
DESIGN: 3064 NM3/HR @ 36.6 KPA (1926 SCFM @ 5.3PSI)
DRIVER: 75 HP
MATERIAL: DI/CI CONSTRUCTION
DUTY: 4 DUTY + 1 STANDBY
TK-400-X
MEMBRANE TANK
NO OF TRAINS : 4
INSTALLED MODULES : 368 B40N PER TRAIN
MODULES PER RACK : 16
TANK DIMENSION : 9.7M Lx 4.1M Wx3.6M H
P-500-X
FILTRATE PUMPS
TYPE: ROTARY LOBE PUMP
DESIGN: 242-646 M3/HR @ 13.1 M
DRIVER: 60 HP
MATERIAL: DI/CI BODY NBR LOBE
DUTY: 3 DUTY + 1 STANDBY
P-900/910
SODIUM HYPOCHLORITE DOSING SYS
TYPE: AIR DIAPHARM
DESIGN: 3.3 M3/HR @ 1.5 BAR
DRIVER: -
MATERIAL: -
DUTY: 1 DUTY +1 STANDBY
P-900/910
CITRIC ACID DOSING SYS
TYPE: AIR DIAPHARM
DESIGN: 7.7 M3/HR @ 1.5 BAR
DRIVER: -
MATERIAL: -
DUTY: 1 DUTY + 1 STANDBY
VFD
B-700
MOS AIR SCOUR BLOWER
C- 800
AIR COMPRESSOR
VFD
B-1000
PROCESS BLOWER
P-900
SODIUM HYPO PUMP
P-900
SODIUM HYPO PUMP
M
M
RAW SEWAGE
INFLUENT DETAILS
MAX MONTH FLOW : 10.625 MLD
MAX MONTH FLOW : 17.0 MLD
PEAK DAILY FLOW : 37.19 MLD
PEAK HOURLY FLOW : 42.5 MLD
Mini Temperature : 9 deg C
M-201-X
SUBMERSIBLE MIXER
M
MODULE RACKS
(NOTE 1)
TK 400-X
MOS TANK
P- 400
FILTRATE PUMP
FILTRATE
P- 300
RAS PUMP
MEMBRANE OPERATING SYSTEM(S)
WASTE ACTIVATED SLUDGE
TK-100-X
COARSE SCREEN
TK-101-X
GRIT REMOVAL
TK-102-X
FINE SCREEN
SIZE: < 2 MM
TYPE: PERFORATED
TK-103X
EXISTING PRIMARY CLARIFIER
TK-300
BIOREACTOR
P-300
RAS PUMP
TYPE: CENTRIFUGAL
DESIGN: 500 - 1181 M3/HR @ 4.9 M
DRIVER: 30 HP
MATERIAL: DI/CI BODY SS316 IMPELLER
DUTY: 3 DUTY + 1 STANDBY
NOTE:
1. GRAVITY FLOW TO MOS TANK.
COMPANY CONFIDENTIAL INFORMATION
DWN BY: EMB
DATE 09/27/2022
CKD BY:
APPD BY:
MGD BY:
REF:
SCALE: NOT TO SCALE
TITLE
PROCESS FLOW DIAGRAM
MEMCOR MEMPULSE MBR SYSTEM
TITLE SHEET
CLIENT
MEMCOR
a DuPont brand
MARLBOROUGH MAUSA
1-800-636-2674
PROJECT
PART NUMBER
DMS REFERENCE
SHEET 1 OF 1
REV 0
STD 22x34 D v1.41
BAR = 1" AT PLOT SCALE
Doc Group:
Doc Type:



NOTE:
1. ALL MOTOR CONTROL AND POWER DISTRIBUTION EQUIPMENT BY OTHERS UNLESS OTHERWISE NOTED. NOT ALL PLANT LOADS ARE SHOWN. CUSTOMER TO CONFIRM ACTUAL BREAKER SIZE.
2. FOR 120VAC POWER REQUIRED INSTRUMENT REFER PROJECT P&ID FOR DETAILS.
3. All THE VFD ARE SUPPLIED & INSTALLED BY OTHERS.
4. POWER REQUIRMENT FOR THE PANELS IS SUPPLIED BY OTHERS.

DWN BY: RP	DATE 01/29/2024	TITLE POWER SINGLE LINE DIAGRAM MEMCOR MEMPULSE MBR SYSTEM
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY: PM_XX		MEMCOR® a DuPont brand — MARLBOROUGH MA USA 1-800-636-2674
REF:		PROJECT / PART NUMBER / DMS REFERENCE / SHEET 1 OF 2 / REV 0
SCALE: NOT TO SCALE		

STD:22x34_D v1.41 | BAR = 1" AT PLOT SCALE | C:\USERS\EJ2635\ONEDRIVE - DUPONT\DESKTOP\CARLETON ON\SINGLE LINE DIAGRAM_R1.DWG



NOTE:
1. ALL MOTOR CONTROL AND POWER DISTRIBUTION EQUIPMENT BY OTHERS UNLESS OTHERWISE NOTED. NOT ALL PLANT LOADS ARE SHOWN. CUSTOMER TO CONFIRM ACTUAL BREAKER SIZE.
2. FOR 120VAC POWER REQUIRED INSTRUMENT REFER PROJECT P&ID FOR DETAILS.
3. All THE VFD ARE SUPPLIED & INSTALLED BY OTHERS.
4. POWER REQUIRMENT FOR THE PANELS IS SUPPLIED BY OTHERS.

DWN BY: RP	DATE 01/29/2024	TITLE POWER SINGLE LINE DIAGRAM MEMCOR MEMPULSE MBR SYSTEM
CKD BY:	DATE	CLIENT
APPD BY:	DATE	
MGD BY: PM_XX		MEMCOR® a DuPont brand MARLBOROUGH MA USA 1-800-636-2674
REF:		
SCALE: NOT TO SCALE		PROJECT IS.XX / PART NUMBER W3TXXXX / DMS REFERENCE / SHEET 2 OF 2 / REV 0

STD:22x34_D v1.41 | BAR = 1" AT PLOT SCALE | C:\USERS\EJ2635\ONEDRIVE - DUPONT\DESKTOP\CARLETON ON\SINGLE LINE DIAGRAM_R1.DWG

C4

Appendix C4: UV

Engineering
for **people**

TROJANUVSIGNA™

PROPOSAL FOR DUNDAS WWTP, ONTARIO
QUOTE: 241690
08/24/2023

TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

ROB JANSEN | REGIONAL SALES MANAGER
TROJANUV | SALSNES FILTER
(519) 457-3400 ext. 2830 *office* | (519) 851-2253 *mobile*
rjansen@trojantechnologies.com

Representative:
Jeff Dobbin
Director of Municipal Sales
H2Flow Equipment Inc.
580 Oster Lane, Vaughan, Ontario, Canada L4K 2C1
Tel: (905) 660-9775 x31 Fax: (905) 660-9744 Cell: (416) 500-5388
jeff@h2flow.com

TROJANUVSIGNA™

DESIGN CRITERIA

Peak Design Flow:	**34.60 ML/d**
UV Transmittance:	**65%** (minimum)
Total Suspended Solids:	**30 mg/l (30 Day Average,** grab sample)
Disinfection Limit:	**100 E.coli per 100 ml**, 30 day Geometric Mean of consecutive daily grab samples

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	
Number of Channels:	**1**
Approximate Channel Length Required:	**34 ft**
Channel Width at UV Banks:	**39.5 in**
Channel Depth Recommended:	**7 ft 8 in**
Head loss through banks @ 34.6 ML/d	**2.01 in**
Upstream Water Lever with weir @ 34.6 ML/D	**68.3 in**
UV BANKS	
Number of Banks per Channel:	**3 (2 in Duty + 1 Redundant)**
Number of Lamps per Bank:	**12**
Total Number of UV Lamps:	**36 (Including 12 Redundant Lamps)**
Maximum Power Draw:	**37.9 kW**
UV PANELS	
Power Distribution Center Quantity:	**1**
Hydraulic System Center Quantity:	**1**
System Control Center Quantity:	**1**
ANCILLARY EQUIPMENT	
Level Controller Quantity and Type:	**1 Fixed Weir**
Integral Bank Walls:	**Included**
On-line UVT Monitoring:	**Hach UVAS sc Sensor**
Other Equipment:	**4 Lamps, 4 Sleeves**
ELECTRICAL REQUIREMENTS	

1. Each Power Distribution Center requires an electrical supply of one (1) 480/277V 60Hz, 38.9 kVA
2. Electrical supply for Hydraulic System Center will be (1) 480V 60Hz, 2.5 kVA
3. Electrical supply for System Control Center will be (1) 120V 60Hz, 1.8 kVA
4. The On-line UVT monitor requires (1) 120 Volts, 1 phase, 2 wire + ground, 1A
5. Electrical disconnects are not included in this proposal. Refer to local electrical codes

TROJANUVSIGNA™

COMMERCIAL INFORMATION

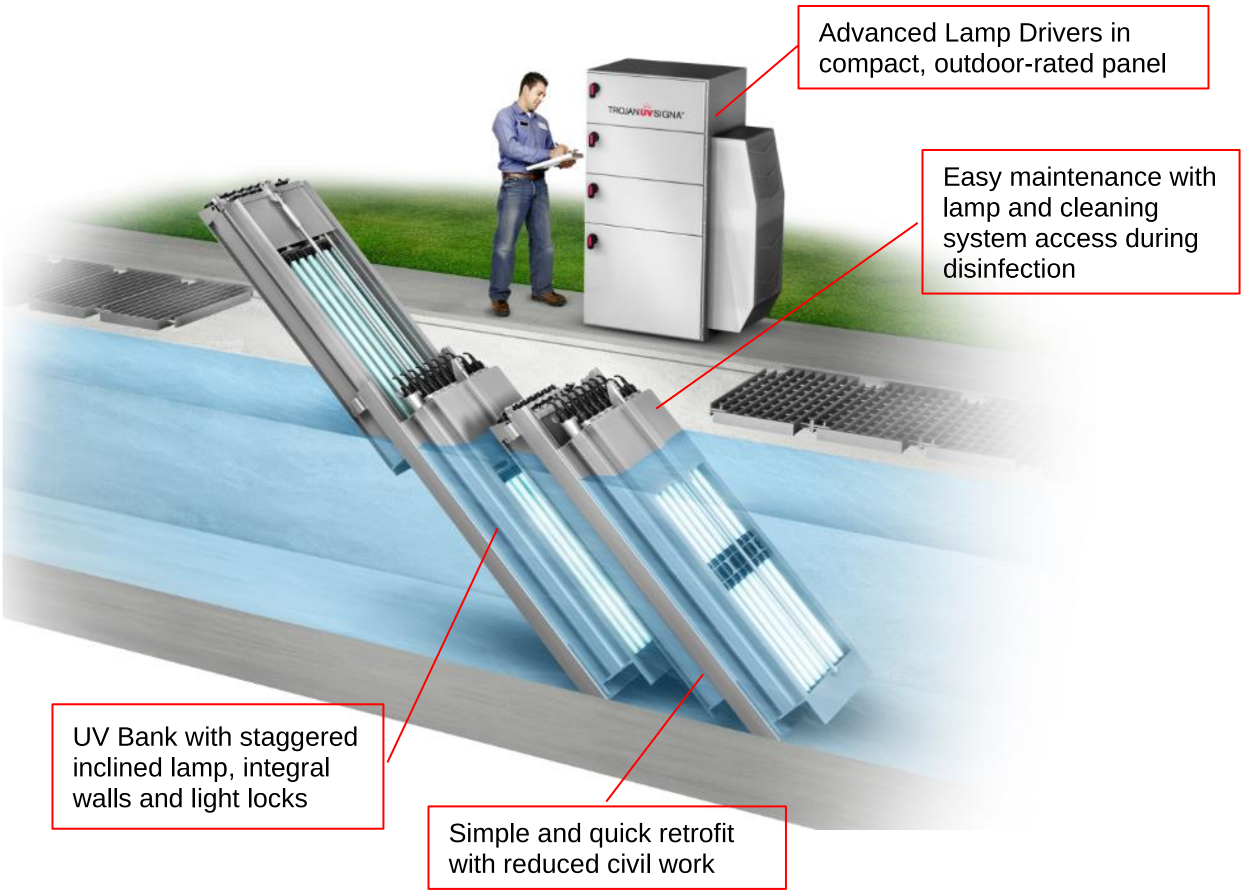
Total Capital Cost: $ 587 945 (CAD)

This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

SYSTEM OVERVIEW



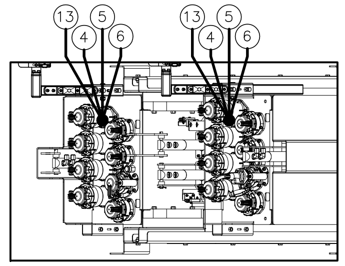
Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

Supported by Trojan Technologies

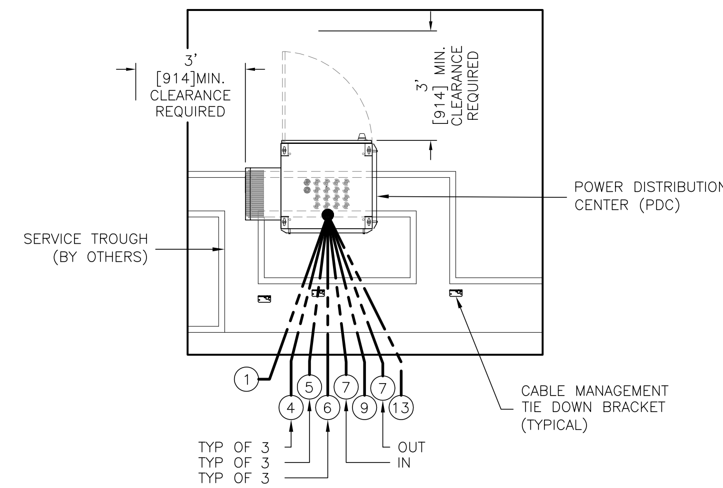
- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

PRELIMINARY, NOT FOR CONSTRUCTION
VERIFY DIMENSIONS BEFORE COMMENCING CIVIL OR DESIGN WORK



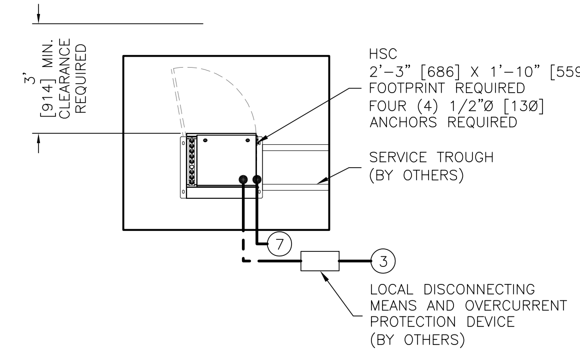
UV BANK INTERCONNECT DETAIL

SCALE: NOT TO SCALE
NOTE: TYPICAL FOR ALL UV BANKS. TROUGH NOT SHOWN FOR CLARITY.



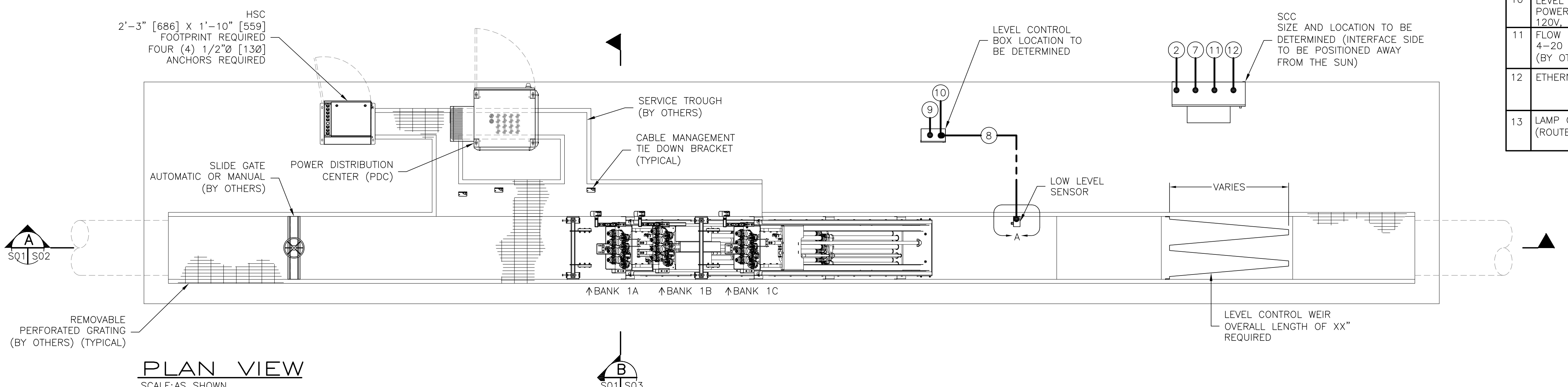
PDC INTERCONNECT DETAIL

SCALE: NOT TO SCALE



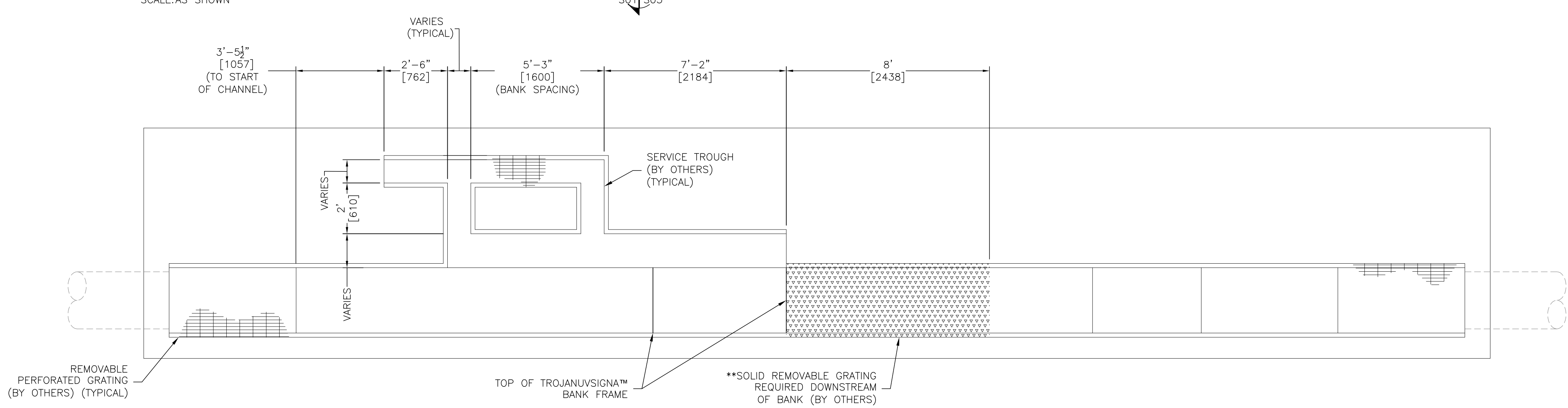
HSC INTERCONNECT DETAIL

SCALE: NOT TO SCALE



PLAN VIEW

SCALE: AS SHOWN



GRATING AND TROUGH DETAIL

SCALE: AS SHOWN
NOTE: DESIGN OF GRATING SECTIONS SHOULD BE SIZED TO ALLOW FOR EASY REMOVAL BY SERVICING TECHNICIANS.
SOLID GRATING MUST BE PROVIDED IN AREA INDICATED TO BLOCK UV LIGHT.

TROJAN UV SIGNA™

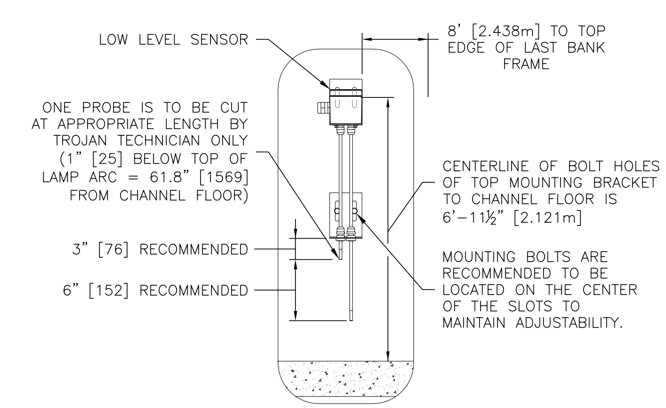
EQUIPMENT INTERCONNECTIONS

No.	DESCRIPTION	FROM	TO
1	POWER DISTRIBUTION CENTER (PDC)* POWER SUPPLY 480Y/277V, 3 PHASE, 4 WIRE + GROUND XX AMPS MAXIMUM CURRENT/PHASE XX kVA/PDC POWER DRAW	DISTRIBUTION PANEL (DP) (BY OTHERS) (NOT SHOWN)	PDC
2	SYSTEM CONTROL CENTER (SCC)* POWER SUPPLY 120V, 1 PHASE, 2 WIRE + GROUND, 1.8 kVA	DP (BY OTHERS) (NOT SHOWN)	SCC
3	HYDRAULIC SYSTEM CENTER (HSC)* POWER SUPPLY 480V, 3 PHASE, 3 WIRE + GROUND, 2.5 kVA	DP (BY OTHERS) (NOT SHOWN)	HSC
4	BONDING CONDUCTOR (CABLE BY OTHERS) 8 AWG TYPE TWH STRANDED	PDC (UNDERSIDE OF PANEL)	UV BANK(s)
5	UV INTENSITY 4–20mA ANALOG INPUT	UV BANK(s)	PDC (UNDERSIDE OF PANEL)
6	BANK IN PLACE PROXIMITY SENSOR 3 CONDUCTOR CABLES (SUPPLIED)	PROXIMITY SENSOR(s)	PDC (UNDERSIDE OF PANEL)
7	MODBUS BELDEN 3106A OR EQUIVALENT (1 LINE PER CHANNEL)	SCC	HSC(s) & PDC (UNDERSIDE OF PANEL) (DAISY CHAINED)
8	DISCRETE LOW LEVEL SIGNAL 12 VDC – 2 CONDUCTORS	LOW LEVEL SENSOR	LEVEL SENSOR CONTROL BOX (LVL)
9	DISCRETE WATER LEVEL SIGNAL 2 CONDUCTORS	LEVEL SENSOR CONTROL BOX (LVL)	PDC (UNDERSIDE OF PANEL)
10	LEVEL SENSOR CONTROL BOX (LVL)* POWER SUPPLY 120V, 1 PHASE, 2 WIRE + GROUND, 72 VA	DP (BY OTHERS) (NOT SHOWN)	LEVEL SENSOR CONTROL BOX (LVL)
11	FLOW METER 4–20 mA, DC ANALOG INPUT (BY OTHERS)	FLOW METER PANEL (NOT SHOWN) (BY OTHERS)	SCC
12	ETHERNET/IP COMMUNICATION	SCC	PLANT SCADA (BY OTHERS) (NOT SHOWN)
13	LAMP CABLES (SUPPLIED BY TROJAN) (ROUTED BY OTHERS)	UV BANK	PDC

NOTES:

- DO NOT SLOPE CHANNEL FLOOR.
- CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF –/+1½" [38mm].
- ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
- SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
- ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY.
- REMOVABLE GRATING SECTIONS SHALL BE EASILY REMOVED BY ONE PERSON. MAXIMUM WEIGHT OF THE SECTIONS SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF THE APPLICABLE JURISDICTION.
- CONTRACTOR TO REVIEW ALL TROJAN TECHNOLOGIES INSTALLATION INSTRUCTIONS PRIOR TO EQUIPMENT INSTALLATION.
- **EFFLUENT LEVELS SHOWN REFLECT HYDRAULICS ASSOCIATED WITH TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY BE ALTERED DUE TO CHANNEL DEBRIS OR GEOMETRY.**
- **HYDRAULIC HOSE RUN BETWEEN HSC AND UV BANK(s) IS 45' [13.7m] MAXIMUM.**
- **HYDRAULIC LINE ELEVATIONS NOT TO EXCEED 12" [305mm] ABOVE HSC ELEVATION.**
- **MAXIMUM DISTANCE FROM PDC TO UV BANK IS 75' [22.8m].**
- **SITE TO PROVIDE APPROVED (ENGINEERED) ANCHOR POINTS FOR PERSONNEL TO USE AS PART OF THEIR FALL RESTRAINT SYSTEM AROUND OPEN CHANNELS. THE ANCHOR POINTS MUST BE POSITIONED SO THAT THE PREFERRED RETRACTABLE LIFELINE OF 8 FEET [2.4m] IS OF SUFFICIENT LENGTH TO ACCESS THE WORK AT THE CHANNEL.**

** **SOLID GRATING REQUIRED TO BLOCK ULTRAVIOLET (UV) LIGHT.**



DETAIL A

SCALE: NOT TO SCALE

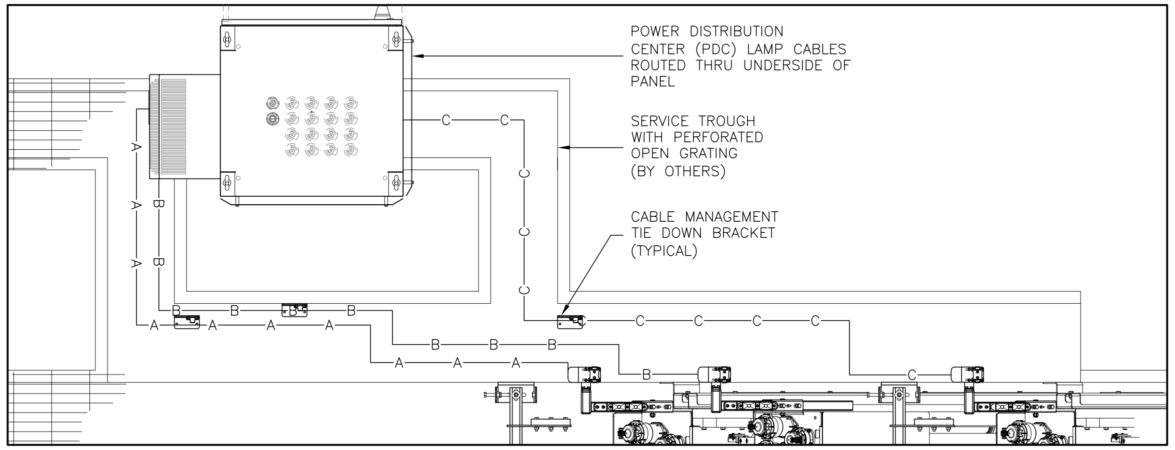
DESIGN CRITERIA	
PEAK FLOW	XX MGD
U.V TRANSMITTANCE AT 253.7 nm	XX%
SUSPENDED SOLIDS	XX mg / L
DISINFECTION STANDARD	XX FC / 100mL

TROJAN UV
A TROJAN TECHNOLOGIES BUSINESS

DESCRIPTION: LAYOUT, TROJANUVSIGNA 1 CHANNEL, 3 BANKS WITH WEIR

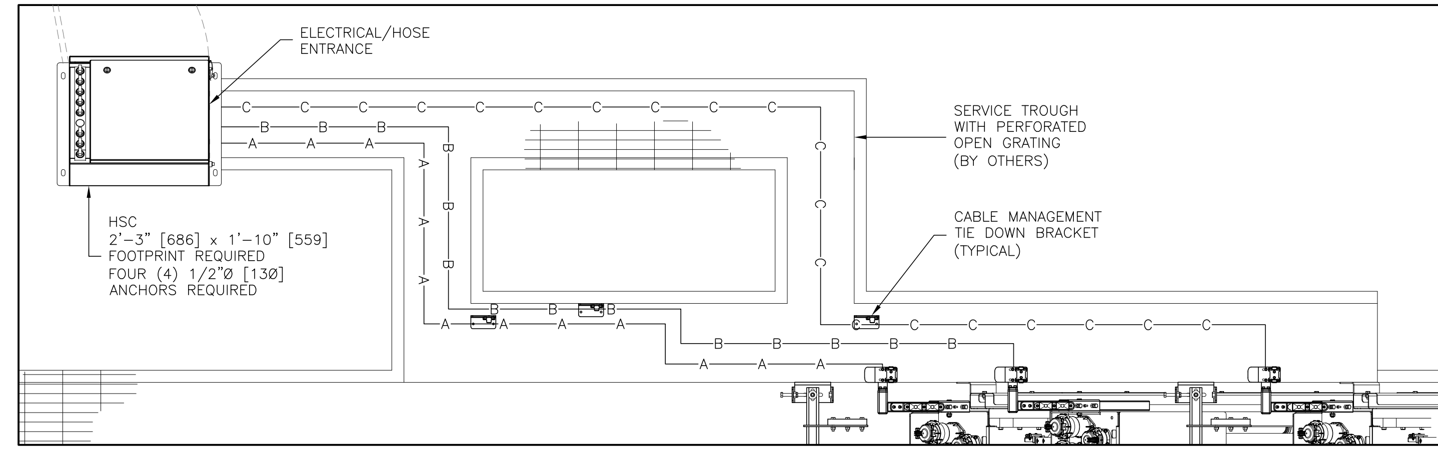
DRAWN BY : RLM/SPM	DATE : 18JL17
CHECKED BY : JRN	DATE : 18AU01
APPROVED BY : SPM	DATE : 18AU01
SCALE (11x17) : 3/16"=1'-0"	LOG NUMBER : N/A

QUOTE NO. SG0034
PROJECT NO. N/A
DWG NO. S01
REV. A



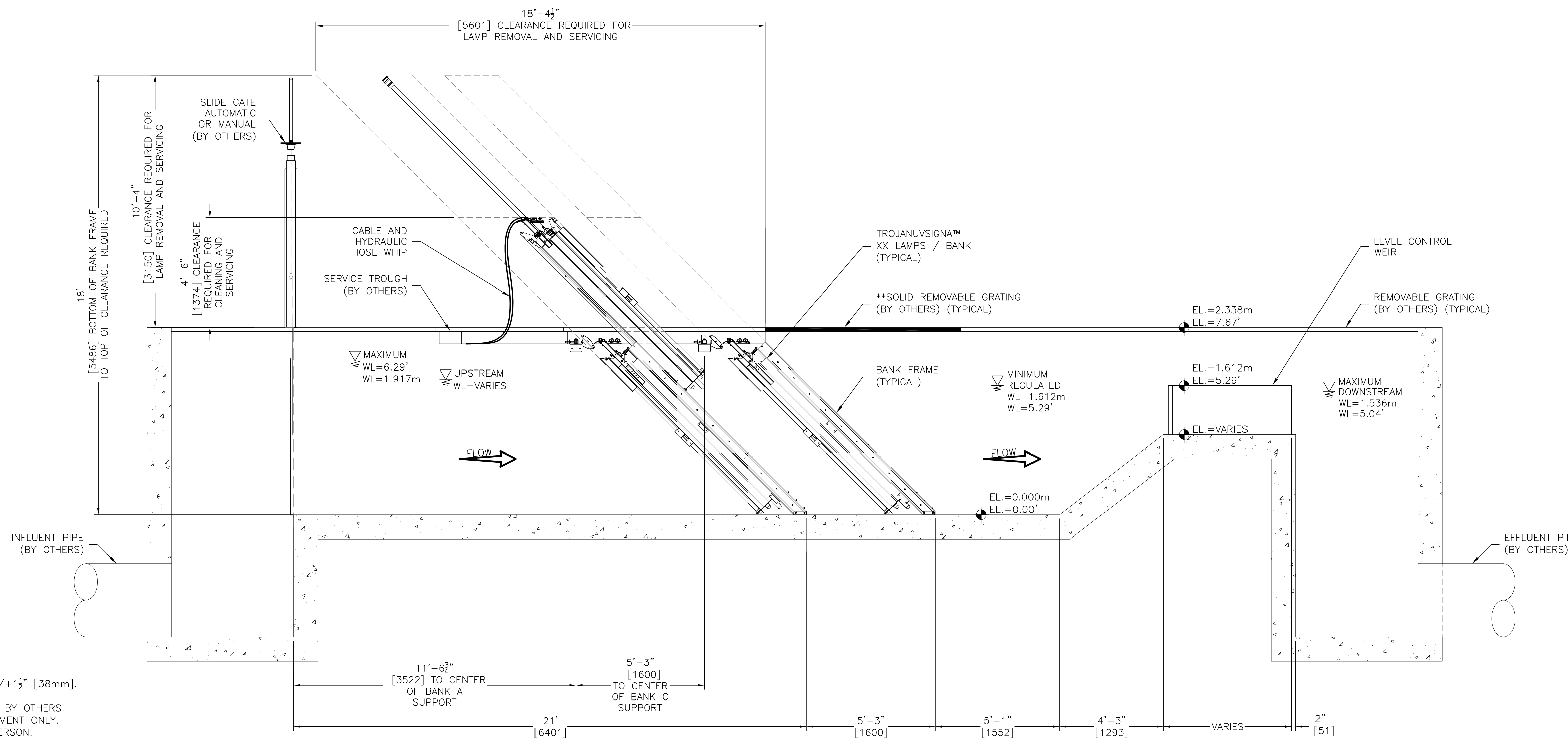
LAMP CABLE ROUTING PLAN

SCALE:NOT TO SCALE
NOTE: REFER TO TROJAN INSTALLATION GUIDELINE DC000601-017 PRIOR TO TROUGH CONSTRUCTION.



HYDRAULIC HOSE ROUTING PLAN

SCALE:NOT TO SCALE



NOTES:
: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF −/+1½" [38mm].
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY.
: REMOVABLE GRATING SECTIONS SHALL BE EASILY REMOVED BY ONE PERSON. MAXIMUM WEIGHT OF THE SECTIONS SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF THE APPLICABLE JURISDICTION.
: CONTRACTOR TO REVIEW ALL TROJAN TECHNOLOGIES INSTALLATION INSTRUCTIONS PRIOR TO EQUIPMENT INSTALLATION.
: EFFLUENT LEVELS SHOWN REFLECT HYDRAULICS ASSOCIATED WITH TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY BE ALTERED DUE TO CHANNEL DEBRIS OR GEOMETRY.
: HYDRAULIC HOSE RUN BETWEEN HSC AND UV BANK(s) IS 45' [13.7m] MAXIMUM.
: HYDRAULIC LINE ELEVATIONS NOT TO EXCEED 12" [305mm] ABOVE HSC ELEVATION.
: MAXIMUM DISTANCE FROM PDC TO UV BANK IS 75' [22.8m].
: SITE TO PROVIDE APPROVED (ENGINEERED) ANCHOR POINTS FOR PERSONNEL TO USE AS PART OF THEIR FALL RESTRAINT SYSTEM AROUND OPEN CHANNELS. THE ANCHOR POINTS MUST BE POSITIONED SO THAT THE PREFERRED RETRACTABLE LIFELINE OF 8 FEET [2.4m] IS OF SUFFICIENT LENGTH TO ACCESS THE WORK AT THE CHANNEL.
**** SOLID GRATING REQUIRED TO BLOCK ULTRAVIOLET (UV) LIGHT.**

A SECTION

S01 S02 AS SHOWN

PRELIMINARY, NOT FOR CONSTRUCTION

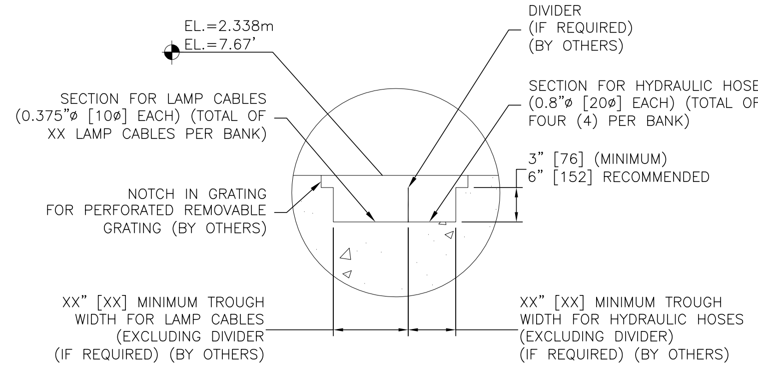
VERIFY DIMENSIONS BEFORE COMMENCING CIVIL OR DESIGN WORK

TROJAN UV
A TROJAN TECHNOLOGIES BUSINESS

CONFIDENTIALITY NOTICE

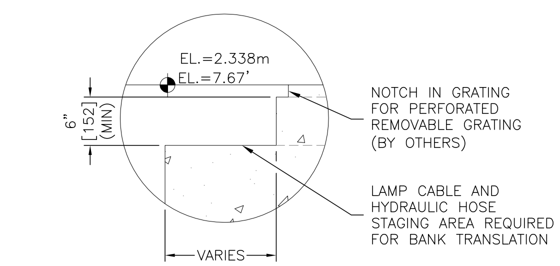
DESCRIPTION: LAYOUT, TROJANUVSIGNA 1 CHANNEL, 3 BANKS WITH WEIR		QUOTE NO.	SG0034
DRAWN BY : RLM/SPM	DATE : 18JL17	PROJECT NO.	N/A
CHECKED BY : JRN	DATE : 18AU01		
APPROVED BY : SPM	DATE : 18AU01	DWG NO. S02	REV. A
SCALE (11x17) : 3/16"=1'-0"	LOG NUMBER : N/A		

NOTES:
: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF −/+1½" [38mm].
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY.
: REMOVABLE GRATING SECTIONS SHALL BE EASILY REMOVED BY ONE PERSON. MAXIMUM WEIGHT OF THE SECTIONS SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF THE APPLICABLE JURISDICTION.
: CONTRACTOR TO REVIEW ALL TROJAN TECHNOLOGIES INSTALLATION INSTRUCTIONS PRIOR TO EQUIPMENT INSTALLATION.
: EFFLUENT LEVELS SHOWN REFLECT HYDRAULICS ASSOCIATED WITH TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY BE ALTERED DUE TO CHANNEL DEBRIS OR GEOMETRY.
: HYDRAULIC HOSE RUN BETWEEN HSC AND UV BANK(s) IS 45' [13.7m] MAXIMUM.
: HYDRAULIC LINE ELEVATIONS NOT TO EXCEED 12" [305mm] ABOVE HSC ELEVATION.
: MAXIMUM DISTANCE FROM PDC TO UV BANK IS 75' [22.8m].
: SITE TO PROVIDE APPROVED (ENGINEERED) ANCHOR POINTS FOR PERSONNEL TO USE AS PART OF THEIR FALL RESTRAINT SYSTEM AROUND OPEN CHANNELS. THE ANCHOR POINTS MUST BE POSITIONED SO THAT THE PREFERRED RETRACTABLE LIFELINE OF 8 FEET [2.4m] IS OF SUFFICIENT LENGTH TO ACCESS THE WORK AT THE CHANNEL.
**** SOLID GRATING REQUIRED TO BLOCK ULTRAVIOLET (UV) LIGHT.**



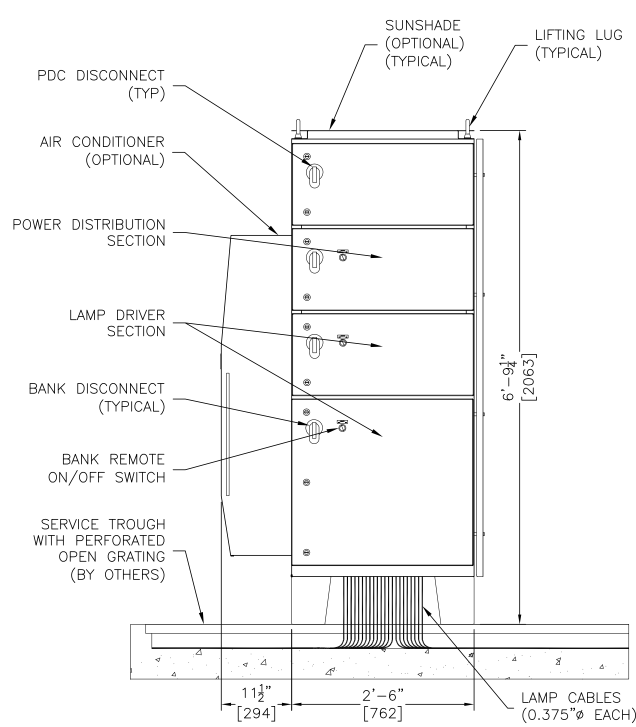
DETAIL B

SCALE:NOT TO SCALE
NOTE: REFER TO TROJAN TROUGH CABLE INSTALLATION GUIDELINE DC000601-017 OR LOCAL CODE IF MORE RESTRICTIVE.



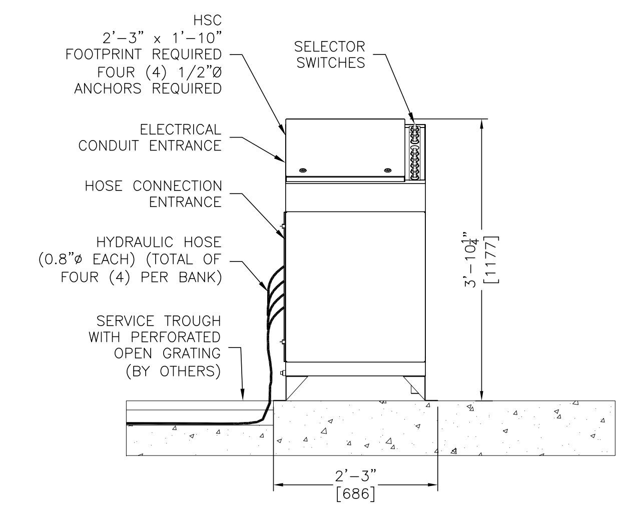
DETAIL C

SCALE:NOT TO SCALE
NOTE: CABLE MANAGEMENT TIE DOWN BRACKETS NOT SHOWN. REFER TO TROJAN TROUGH CABLE INSTALLATION GUIDELINE DC000601-017 OR LOCAL CODE IF MORE RESTRICTIVE.



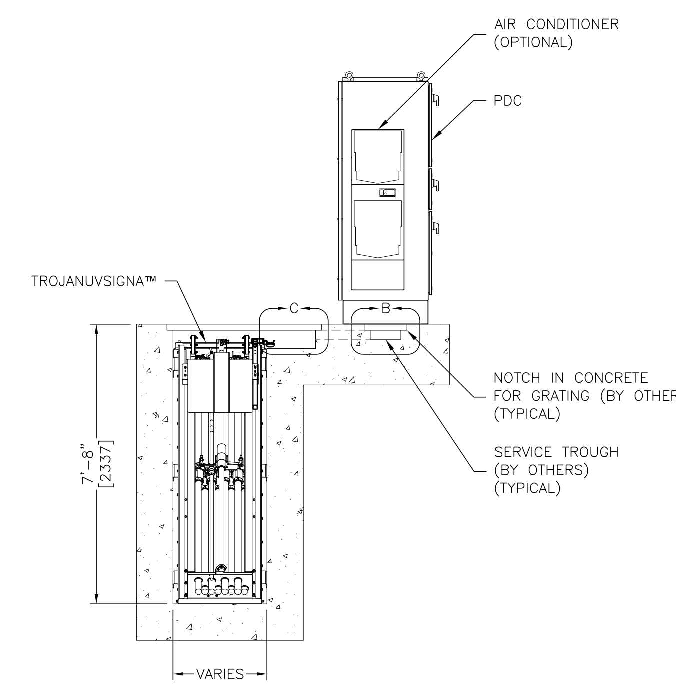
FRONT VIEW OF PDC

SCALE:NOT TO SCALE
NOTE: OPTIONAL AIR CONDITIONER CAN BE MOUNTED ON EITHER SIDE OF ENCLOSURE. PLEASE REFER TO TROJAN GENERIC PDC DRAWINGS SG0035 AND SG0036 FOR ADDITIONAL INFORMATION.



FRONT VIEW OF HSC

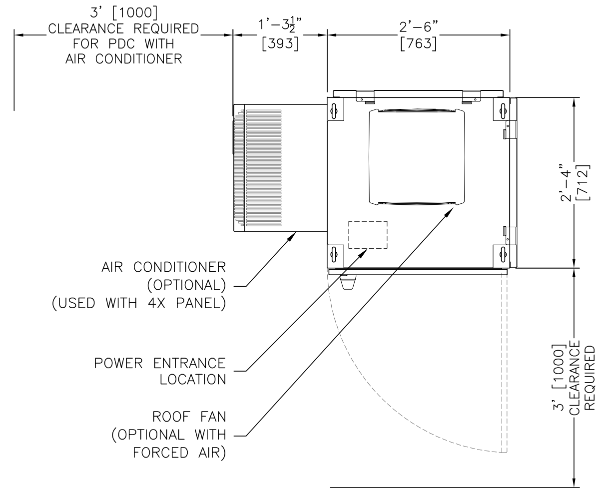
SCALE:NOT TO SCALE
NOTE: PLEASE REFER TO TROJAN GENERIC HSC DRAWING SG0024 FOR ADDITIONAL INFORMATION.



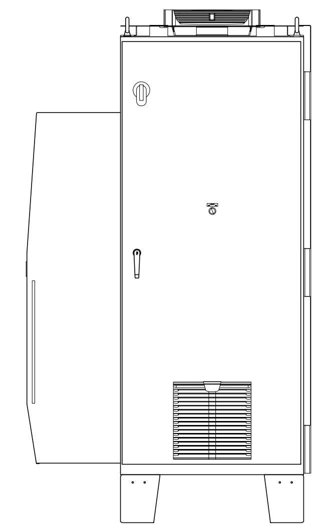
B SECTION

S01 S03 AS SHOWN
NOTE: CABLE MANAGEMENT BRACKETS, LAMP CABLES, AND HYDRAULIC HOSES NOT SHOWN FOR CLARITY.

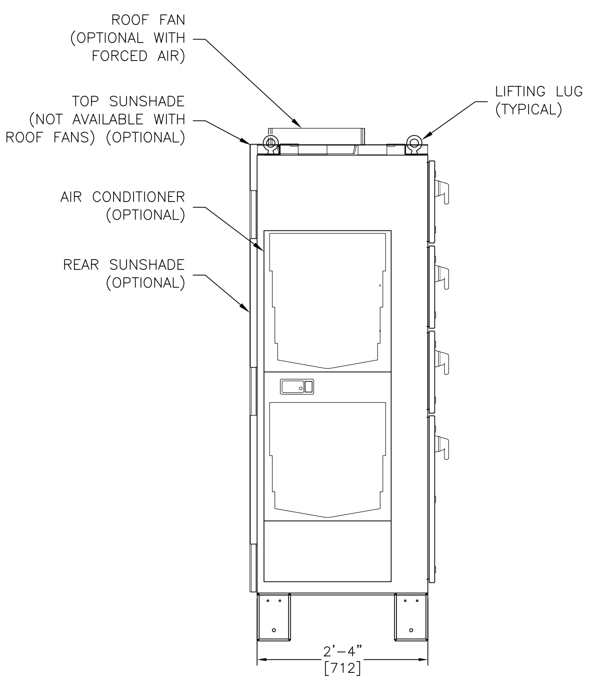
TROJANUV — A TROJAN TECHNOLOGIES BUSINESS	DESCRIPTION: LAYOUT, TROJANUVSIGNA 1 CHANNEL, 3 BANKS WITH WEIR		QUOTE NO. SG0034	
CONFIDENTIALITY NOTICE	DRAWN BY : RLM/SPM	DATE : 18JL17	PROJECT NO. N/A	
	CHECKED BY : JRN	DATE : 18AU01		
	APPROVED BY : SPM	DATE : 18AU01	DWG NO. S03	REV. A
	SCALE (11x17) : 3/16"=1'-0"	LOG NUMBER : N/A		



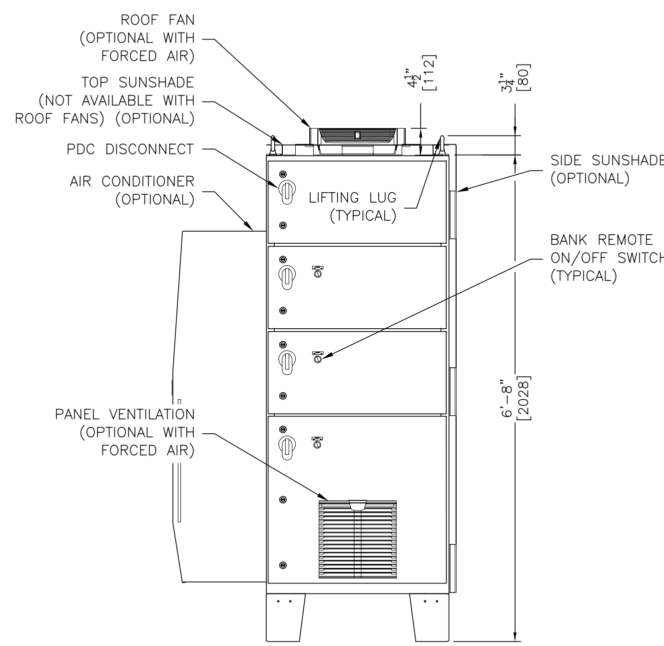
PLAN VIEW
SCALE:AS SHOWN



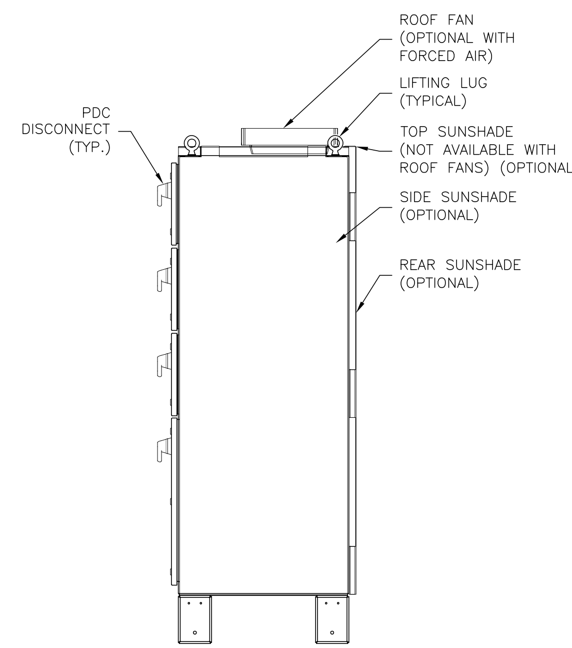
FRONT VIEW (1 BANK)
SCALE:AS SHOWN
NOTE: MAXIMUM 1 BANK OF 8 TO 24 UV LAMPS PER BANK.



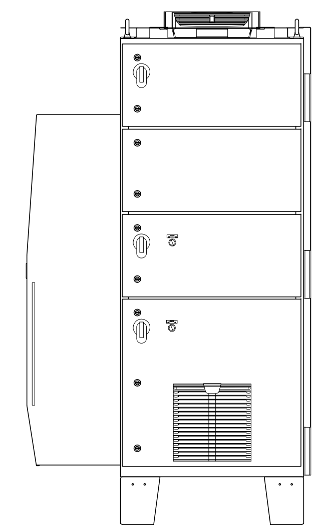
LEFT SIDE VIEW
SCALE:AS SHOWN



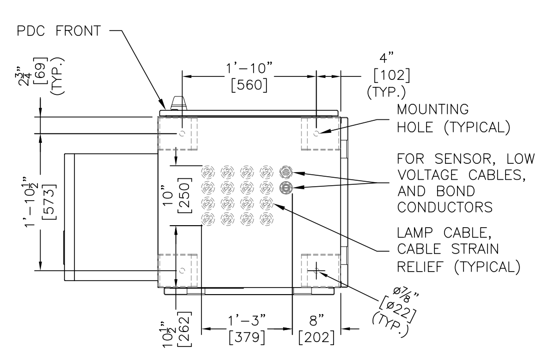
FRONT VIEW OF (3 BANK)
SCALE:AS SHOWN
NOTE: MAXIMUM 3 BANKS OF 8 TO 16 UV LAMPS PER BANK.
ONE (1) DOOR PER BANK.



RIGHT SIDE VIEW
SCALE:AS SHOWN



FRONT VIEW (2 BANK)
SCALE:AS SHOWN
NOTE: MAXIMUM 2 BANKS OF 8 TO 16 UV LAMPS PER BANK.
ONE (1) DOOR PER BANK.



BOTTOM VIEW
CONDUIT ENTRANCE)
SCALE:AS SHOWN

NOTES:
: [ ] INDICATES DIMENSIONS IN mm UNLESS OTHERWISE SPECIFIED.
: METRIC DIMENSIONS SHOWN ARE CONVERSIONS FROM IMPERIAL.
: 304 SST, TYPE 4X (WITH A/C) (STANDARD), 316 SST, TYPE 4X (WITH A/C) (OPTIONAL).
: OPTIONAL AIR CONDITIONER CAN BE MOUNTED ON RIGHT SIDE OR LEFT SIDE OF PDC. LEFT-SIDED A/C IS SHOWN.
: 304SST/316SST, TYPE 12 (WITH FORCED AIR – INSTALLED IN ENVIRONMENTALLY CONTROLLED ROOM (MAXIMUM AMBIENT TEMPERATURE OF 82°F [30°C]) (OPTIONAL)
: PDC TO BE FLOOR MOUNTED.
: APPROXIMATE SINGLE PDC WEIGHT = 1000 lbs. [454 kg]
: CONDUIT CUT OUTS ARE SHOWN IN APPROXIMATE LOCATIONS ONLY AND WILL VARY SLIGHTLY DUE TO SITE SPECIFIC PANEL REQUIREMENTS.

TROJANUV
A TROJAN TECHNOLOGIES BUSINESS

DESCRIPTION: TROJANUVSIGNA 2 ROW, SINGLE POWER DISTRIBUTION CENTER		STD. DRAWING NO. 338040G	
DRAWN BY : MMB	DATE : 19MR04	REFERENCE NO. SG0035	
CHECKED BY : SPM	DATE : 19MY27		
APPROVED BY : EC	DATE : 19MY27	DWG NO. D01	REV. D
SCALE (11x17) : 3/8" = 1'-0"	LOG NUMBER : N/A		

D

Appendix D: Planned Upgrades to Maintain Existing WWTP

CIMA+ Engineering for people

Dundas Wastewater Treatment Plant Urgent Needs

Item	Location	Deficiency	Scope of Work	Notes/Comments	Scope required and shall not be integrated to the overall plant upgrade (throwaway cost)	Scope required and can be integrated to the overall plant upgrade	Scope is not critical and not required for the plant to continue operating until upgrade completed
1	Dundas Sludge Holding Tanks (DSDIG)	Tanks are at 30% capacity	Decomission faulty tank, provide full capacity	Concrete works and replacment of process equipment. Rehabilitate roofing.		X	
2	Large scale	Safety concerns - gas monitors	Review gas monitoring systems, upgrade as required	Brian may be replacing these. Smoke detectors might be facilities related. Follow up with MG try to get audit to identify gaps. We might be able to fill these gaps.	X		
3	Dundas Chemical Station	Improper Spill Containment	Building concrete chemical containment with underground catchment area to contain chemical in case of a spill.	Eye-wash and shower station need to be relocated	X		
4	Plant A Primary Clarifier (DSPRI/DSSEC)	Longitudinal flights and collectors at/approaching end-of-life	Replacement of longitudinal flights and collectors for the primary and secondary clarifiers (completed every 8-10 years)		X		
5	Ferric Sulphate System	Equipment at end-of-life	New Chemical Tank, system to be upgraded		X		
6	Plant A Control Room	No cellular signal in the basement in case of emergency operators will not be able to radio / call others	Provide means for workers within this space to contact those outside of it		X		
7	Filter Building	Sand filters at the end of their life	Sand filters require replacement		X		
8	Dundas Filter Building (DSFIL)	No emergency eyewash/shower in the filter building (PRF)	Provide new emergency eye-wash and shower station. Filter building does not have plumbing for potable water and requires a connection from the chemical building.	Only required during warm weather (May-Oct) with the opportunity to have the line isolated/drained every year.	X		
9	Dundas Primary Plant A	Concrete is in poor condition	Rinse out tank, rehabilitate concrete	Review notes - may be concrete rehab	X		
10	Plant A Primary Clarifier (DSPRI/DSSEC)	Bypass currently inoperable	Bypass from headworks to be redone			X	
11	Barns	No grates	Add in grates	What grates? What does this mean? Maybe headworks?			
12	Plant A Control Room	Currently no sensors to detect flood	Capacity check / flood level drainage sump pump		X		
13	General	Too frequent entry into high risk blower room	Replace door with a door with a window		X		
14	General	Difficult for operators to work at night due to darkness	Provide outdoor lighting		X		
15	Blower Room	Operators required to access equipment in location of higher risk.	Variable Frequency Drives (VFDs) moved out to adjacent room, move readers as well		X		
16	Blower Room	Concrete channel leaking onto the ground	Concrete channel repair		X		
17	Headworks	Cracking on outside* (confirm)	Concrete works		X		
18	Headworks/Screens Bins	Moving hazard and safety concerns for staff	Conveyor screw system - automated extension to the existing conveyor system using equipment (e.g. winches, hydraulics, etc.).	Opportunity to connect with the company that provides the equipment - may have a feasible solution.	X		
19	Filter Building	Bridges deteriorated	Bridges require replacement		X		
20	Ferric Sulphate System	System upgrade required and equipment at end-of-life	Re-wrap of storage tanks		X		
21	Dundas Filter Building (DSFIL)	Travelling bridges and sand media approaching end-of-life	Replace travelling bridges and sand media replacement	Estimated 2030	X		
22	OutdoorAeration Tanks	Grating deteriorated	Replace grating	Might be within Sameh's scope	X		
23	Electrical Building	Roof leaking	Replace roof	Coordinate with Michael Gladysz	X		
24	Chemical Storage Tanks	Only able to use 1/3 of the tank volume (SBS and Hypochlorite) due to positioning	Raise tanks to improve operating function	A more cost-effective and long-term solution may exit.	X		
25	Plant A Primary Clarifier (DSPRI/DSSEC)	Concrete in disrepair	Concrete Works		X		
26	Blower Room	Lighting in blower room outdated	Improve Inside Lighting	Potential facilities projects	X		
27	Dundas Sludge Holding Tanks (DSDIG)	Mould growth on main floor and basement	Install new HVAC to manage and minimize growth	Electrical replaced fans and PMATS to reassess mould growth	X		
28	Plant A Control Room	Outdated lighting	LED Lighting		X		
29	Ferric Building	No way to access from driveway	Add concrete stairs up to this building		X		
30	Plant A & B Chlorine Contact Chamber (CCC)	Unable to read chlorine concentration levels at CCC inlets	Install 2 additional chlorine analyzers upstream, could make do with only one. These readers are only used from May 1 - October 31. Would include conduits.	Trevor looking at replacing chlorine with UV.	X		
31	Ferric Sulphate System	Concrete spalling	Repair and re-coat of concrete containment		X		
32	Chemical Storage Tanks	Shelter rusted	Rehabilitation of shelter		X		
33	Plant A Primary Clarifier (DSPRI/DSSEC)	Currently no SCADA communications with backflow preventer	Add SCADA to backflow preventer	To review scope	X		
34	OutdoorAeration Tanks	Solid waste removal currently manual	Automate solid waste removal	To review scope	X		
35	Small pump control room	Current concrete is more susceptible to wear.	Epoxy coating		X		
36	General	HVAC inoperable	Review of HVAC systems throughout plant		X		
37	Small pump control room	Name plates have fallen and are corroded	Name plates	To review scope	X		
38	Plant A Control Room	Concrete is spalling, and floor and walls are damaged from flooding	Concrete spalling repair		X		
39	Plant A Primary Clarifier (DSPRI/DSSEC)	Grit removal system is currently manual	Automated grit removal	To review scope	X		
40	DC008	Noise control is an issue for residents west of building	Build wall between back of DC008 building and residential area	Bharathi Murali is completing an ECA study to determine requirements. Installation must be prioritized once ECA is complete. Anticipate design/construction 2023. *may take priority depending on MECP demands.	X		
41	General	Walls, ceilings, and floors throughout the facility show chipping, faded, or discolored paint	Indoor painting		X		

E

Appendix E: Conceptual Cost Estimates

Engineering
for **people**

Hamilton Water
Vertical Project Cost Estimate Worksheet V1.2 AUG 2020

Project Charter ID:		CCE Document Issue Date:	2024
Projects Name:	Dundas	Est. Design Start Date:	2025
Project Description:		Est. Construction Start Date:	2028
			(year ####)

Cost Estimate Class:	Class D Planning and Conceptual Design	These are Mandeory Fields
Project Complexity:	High	

ITEM	DESCRIPTION		
1) CONSTRUCTION COSTS			
1A.	Construction Cost		$ 136,000,000.00
1B.	Construction Contingency (Varies based on Complexity, % of 1A.)	15%	$ 20,400,000.00
1C.	Project Contingency (Varies based on Complexity and Class, % of 1A.)	30%	$ 40,800,000.00
SUB TOTAL CONSTRUCTION COST = 1A + 1B + 1C			**$ 197,200,000.00**
1D.	Inflation Rate (based on projected construction price index)	4%	
1E.	Number of Years	4	
Projected CONSTRUCTION Inflation = 4(1+5a)5b-4			**$ 29,091,535.72**
TOTAL CONSTRUCTION COST			**$ 226,291,535.72**
2) CONSULTANT COST (SOFT COSTS)			
2A.	Design and Contract Administration (Varies based on Complexity, % of 1A.)	15%	$ 20,400,000.00
2B.	Investigative Services (Varies based on Complexity, % of 1A.)	0.0%	$ -
2C.	Permits and Approvals (0%-1% of item 2A.)	0%	$ -
2D.	Utility Connections and Relocations (Varies based on Complexity, % of 1A.)		$ -
2E.	Sub Total Consultant Cost (Soft Costs) = 2A + 2B + 2C + 2D		$ 20,400,000.00
2F.	Project Contingency (Varies based on Complexity and Class, % of 2E.)	25%	$ 5,100,000.00
SUB TOTAL CONSULTANT COST = 2E + 2F			**$ 25,500,000.00**
2G.	Inflation Rate (based on Consulting Engineering Services price index)		
2H.	Number of Years	1	
Projected CONSULTANT Inflation = 4(1+5a)5b-4			**$ -**
TOTAL CONSULTANT COST			**$ 25,500,000.00**
3) LAND COSTS			
3A.	Land Acquisition		$ -
3B.	Legal/Real Estate Fees (10% 0f 3A.)	10%	$ -
3C.	Sub Total Land Costs = 3A + 3B		$ -
3D.	Project Contingency (Varies based on Complexity and Class, % of 3C.)		$ -
SUB TOTAL LAND COSTS = 3C + 3D			**$ -**
3E.	Inflation Rate		
3F.	Number of Years		
Projected LAND Inflation = 4(1+5a)5b-4			**$ -**
TOTAL LAND COST			**$ -**
TOTAL PROJECT COST			**$ 251,791,535.72**

Notes:
1. **All green fields must have an entered value**
2. **Sections 2 and 3 are applicable for Class D only, as costs are finalized prior to Class A-C**

3 This document is meant for estimating only, it is not intended for budget monitoring

Conceptual Cost Estimate (Class D)
Dundas WRRF

New WWTP (MBR)

1) CONSTRUCTION COSTS		
Cost Estimate Summary by Area		**Estimated Cost (Total)**
Division 01 - General Requirements		$27,200,000
Division 02 - Site Work Total		$13,000,000
Sewage Pumping Station		$5,000,000
Headworks Building		$14,000,000
Blower Building		$6,500,000
Aeration Tanks		$11,000,000
MBR & UV Building		$30,000,000
Sludge Storage		$9,300,000
Administration Building		$7,000,000
COE		$3,000,000
Soil Anchors		$10,000,000
1A. Construction Cost		**$136,000,000**
1B. Construction Contingency (Steel Price, Concrete price, etc.)	15%	$20,400,000
1C. Project Contingency and Estimating Allowance (Exchange Rate, Tariff Uncertainty & Labour U	30%	$40,800,000
SUB TOTAL CONSTRUCTION COST = 1A + 1B + 1C		$197,200,000
1D. Inflation Rate	3.5%	
1E. Number of Years	4	
Project Construction Inflation		$29,100,000
TOTAL CONSTRUCTION COST		$226,300,000
2) CONSULTANT COSTS (SOFT COSTS)		
2A. Engineering Design and Contract Administration	15%	$20,400,000
2B. Investigative Services	0%	$0
2C. Permits and Approvals	0%	$0
2D. Utility Connections and Relocations		$0
2E. Sub-total Consultant Costs (Soft Costs) = 2A + 2B + 2C + 2D		$20,400,000
Project Contingency	25%	$5,100,000
SUB TOTAL CONSULTANT COST = 2E + 2F		$25,500,000
2G. Inflation Rate	0.0%	
2E. Number of Years	1	
Project Consultant Inflation		$0
TOTAL CONSULTANT COST		$25,500,000
3) LAND COSTS		
3a. Land Acquisition		$0
3B. Legal / Real Estate	10%	$0
3C. Sub-total Consultant Costs (Soft Costs) = 3A + 3B		$0
Project Contingency		$0
SUB TOTAL CONSULTANT COST = 2E + 2F		$0
3E. Inflation Rate	0.0%	
3F. Number of Years	0	
Project Land Inflation		$0
TOTAL LAND COST		$0
TOTAL PROJECT COST		**$252,000,000**
Note: Tax is excluded.		

Conceptual Cost Estimate (Class D)

Dundas WRRF

New WWTP (MBR)

4) O&M COSTS		
Cost Estimate		**Estimated Cost (Total)**
Energy (Aeration)		$230,000
Energy (Mixing)		$10,000
Energy (Recirculation)		$30,000
Energy (Membrane Filtration)		$170,000
Energy (UV)		$40,000
Chemical Consumption (Ferric Sulphate)		$210,000
Chemical Consumption (Citric Acid)		$180,000
Chemical Consumption (Sodium Hypochlorite)		$30,000
Biosolids Handling		$30,000
Equipment Maintenance / Replacement		$2,280,000
Labour		$530,000
TOTAL O&M COST		$3,800,000
5) LIFECYCLE COST		
30-year Life Cycle Cost (NPV) for Capital		$227,000,000
30-year Life Cycle Cost (NPV) for Consultant Services		$26,000,000
30-year Life Cycle Cost (NPV) for O&M		$89,000,000
		$342,000,000

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PREPARED BY: Kang-Young Ko
SUBJECT: Division 2/Site Works
PROJ. NO.: T001744A
DATE: June 19, 2024

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 2 SITE WORKS									
	Roads									
	Asphalt Pavement	4,100	m^2	$90	$370,000	-	-	Incl.	$370,000	$370,000
	Granular Base (Granular A)	615	m^3	$120	$74,000	-	-	Incl.	$74,000	$74,000
	Sub-Base (Granular B)	1,845	m^3	$110	$203,000	-	-	Incl.	$203,000	$203,000
	Excavation	34,000	m^3	$25	$850,000	-	-	Incl.	$850,000	$647,000
	Backfill & Disposal	34,000	m^3	$50	$1,700,000	-	-	Incl.	$1,700,000	$1,700,000
	Yard Piping (Watermain, Sewerage, catch basins, etc.)	1	L.S.	$1,110,000	$1,110,000	-	-	Incl.	$1,110,000	$1,110,000
	Dewatering	1	L.S.	$800,000	$800,000	-	-	Incl.	$800,000	$800,000
	Site Preparation	1	L.S.	$200,000	$200,000	-	-	Incl.	$200,000	$200,000
	Bracing and Shoring	1	L.S.	$1,100,000	$1,100,000	-	-	Incl.	$1,100,000	$1,100,000
	Demolition (existing facilities)	1	L.S.	$5,000,000	$5,000,000	-	-	Incl.	$5,000,000	$5,000,000
	Finishing and Landscape	1	L.S.	$500,000	$500,000	-	-	Incl.	$500,000	$500,000
	Inlet Conduit	160	m	$2,500	$400,000	-	-	Incl.	$400,000	$400,000
	Outfall Pipe	90	m	$2,500	$225,000	-	-	Incl.	$225,000	$225,000
	RAS and WAS Pipes	250	m	$1,500	$375,000	-	-	Incl.	$375,000	$375,000
								TOTAL ESTIMATE FOR DIVISION 2 - SITE WORKS	**$12,907,000**	**$12,704,000**
								TOTAL ESTIMATE FOR DIVISION 2	**$13,000,000**	**$13,000,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PROJ. NO.: T001744A
PREPARED BY: Kang-Young Ko, Emily Snoei
DATE: June 19, 2024
SUBJECT: Sewage Pumping Station

Spec Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Formwork	1	L.S.	$60,000	$60,000	-	-	Incl.	$60,000	$60,000
	Reinforcement	1	L.S.	$50,000	$50,000	-	-	Incl.	$50,000	$50,000
	Footings	50	m^3	$2,000	$100,000	-	-	Incl.	$100,000	$100,000
	Mud Slab	77	m^3	$2,000	$153,600	-	-	Incl.	$153,600	$154,000
	Base Slab	72	m^3	$2,000	$144,000	-	-	Incl.	$144,000	$364,000
	Slabs and Walls	221	m^3	$2,500	$553,125	-	-	Incl.	$550,000	$550,000
	Misc. Structures	100	m^3	$2,500	$250,000	-	-	Incl.	$250,000	$250,000
	TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE								**$1,307,600**	**$1,600,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Masonry	1	L.S.	$100,000	$100,000	-	-	Incl.	$100,000	$100,000
	Structural steel and architectural finishes	45	m^2	$2,800	$126,000	-	-	Incl.	$126,000	$126,000
	Woods and plastics	1	L.S.	$50,000	$50,000	-	-	Incl.	$50,000	$50,000
	Thermal and moisture protection	1	L.S.	$40,000	$40,000	-	-	Incl.	$40,000	$40,000
	Doors and windows	1	L.S.	$25,000	$25,000	-	-	Incl.	$25,000	$25,000
	Access Hatches	1	L.S.	$20,000	$20,000	-	-	Incl.	$20,000	$20,000
	Ladders	2	ea.	$12,000	$24,000	-	-	Incl.	$24,000	$24,000
	Finishes	1	L.S.	$25,000	$25,000	-	-	Incl.	$25,000	$25,000
	TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL								**$410,000**	**$500,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$188,000	$188,000	-	-	Incl.	$188,000	$188,000
	Raw Sewage Pumps	1	L.S.	$150,000	$150,000	50%	-	$75,000	$225,000	$225,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$150,000	$150,000	-	-	Incl.	$150,000	$150,000
	TOTAL ESTIMATE FOR DIVISION 11 - PROCESS								**$563,000**	**$600,000**

Spec Section	Description	QTY	Unit	MATERIAL Unit Cost	MATERIAL Total Cost ($)	LABOUR % Of MAT'L	LABOUR or Unit Cost ($)	LABOUR Total Cost	Amount ($)	ROUNDED COST ($)
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Lump Sum	1	L.S.	$420,000	$420,000	-	-	Incl.	$420,000	$420,000
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$420,000**	**$500,000**
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$420,000	$420,000	-	-	Incl.	$420,000	$420,000
								TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL	**$420,000**	**$500,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$620,000	$620,000	-	-	Incl.	$620,000	$620,000
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$620,000**	**$620,000**
								TOTAL ESTIMATE FOR DIVISION 3-16	**$3,740,600**	**$5,000,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PROJ. NO.: T001744A
PREPARED BY: Kang-Young Ko
DATE: June 19, 2024
SUBJECT: Headworks

Spec Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud Slab	90	m^3	$1,000	$90,000	-	-	Incl.	$90,000	$90,000
	Base Slab	542	m^3	$1,200	$650,160	-	-	Incl.	$650,000	$650,000
	Slabs and Walls	711	m^3	$2,100	$1,493,835	-	-	Incl.	$1,490,000	$1,490,000
	Misc. Structures	100	m^3	$2,100	$210,000	-	-	Incl.	$210,000	$210,000
	TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE								**$2,440,000**	**$2,440,000**
						Reduced Footprint Like-for-Like				**$1,634,800**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Handrails	60	m2	$850	$50,000	-	-	Incl.	$50,000	$50,000
	Structural steel and architectural finishes	840	m^2	$2,800	$2,350,000	-	-	Incl.	$2,350,000	$2,350,000
	TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL								**$2,400,000**	**$2,400,000**
						Reduced Footprint Like-for-Like				**$1,608,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$194,000	$194,000	-	-	Incl.	$194,000	$194,000
	Channel Gates and Stop Gates	1	L.S.	$520,000	$520,000	50%	-	$260,000	$780,000	$780,000
	Grit Pumps	2	Each	$48,000	$96,000	50%	-	$48,000	$144,000	$144,000
	Grit Classifiers	2	Each	$144,000	$288,000	50%	-	$144,000	$432,000	$432,000
	Vortex Grit Removal System	2	Each	$96,000	$192,000	50%	-	$96,000	$288,000	$288,000
	Perforated Find Screens	2	Each	$300,000	$600,000	50%	-	$300,000	$900,000	$900,000
	Washer Compactors	3	Each	$96,000	$288,000	50%	-	$144,000	$432,000	$432,000
	Screw Conveyors	1	Each	$54,000	$54,000	50%	-	$27,000	$81,000	$81,000
	Manual Screen	1	Each	$36,000	$36,000	50%	-	$18,000	$54,000	$54,000
	~~Band Screens~~	~~2~~	~~Each~~	~~$312,000~~	~~$624,000~~	~~50%~~	-	~~$312,000~~	~~$936,000~~	
	Odour Control Facility c/w Fan	1	L.S.	$120,000	$120,000	50%	-	$60,000	$180,000	
	Channel Mixing Blowers	2	Each	$35,000	$70,000	50%	-	$35,000	$105,000	$105,000
	Retrievable Channel Mixing System	1	L.S.	$300,000	$300,000	50%	-	$150,000	$450,000	$450,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$200,000	$200,000	-	-	Incl.	$200,000	$200,000

TOTAL ESTIMATE FOR DIVISION 11 - PROCESS									**$5,176,000**	**$4,060,000**
Spec Section	**Description**	**QTY**	**Unit**	**MATERIAL**		**LABOUR**			**Amount ($)**	**ROUNDED COST ($)**
				Unit Cost	**Total Cost ($)**	**% Of MAT'L**	**or Unit Cost ($)**	**Total Cost**		
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	750mm	1	Each	$35,000	$35,000	50%	-	$18,000	$53,000	$53,000
	Lump Sum	1	L.S.	$780,000	$780,000	-	-	Incl.	$780,000	$780,000
TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS									**$833,000**	**$833,000**
	DIVISION 14 - HOISTING SYSTEMS									
	Lump Sum	1	L.S.	$50,000	$50,000	-	-	Incl.	$50,000	$50,000
TOTAL ESTIMATE FOR DIVISION 14 - HOISTING SYSTEMS									**$50,000**	**$50,000**
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$780,000	$780,000	-	-	Incl.	$780,000	$780,000
TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL									**$780,000**	**$780,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$1,550,000	$1,550,000	-	-	Incl.	$1,550,000	$1,550,000
TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL									**$1,550,000**	**$1,550,000**
TOTAL ESTIMATE FOR DIVISION 3-16									**$14,000,000**	**$11,000,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PREPARED BY: Kang-Young Ko
SUBJECT: Blower Building
PROJ. NO.: T001744A
DATE: June 19, 2024

Spec Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud Slab	50	m^3	$1,000	$50,000	-	-	Incl.	$50,000	$50,000
	Base Slab	217	m^3	$1,200	$260,304	-	-	Incl.	$260,000	$260,000
	Slabs and Walls	177	m^3	$2,100	$372,645	-	-	Incl.	$370,000	$370,000
	Misc. Structures	20	m^3	$2,100	$42,000	-	-	Incl.	$42,000	$42,000
								TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE	**$722,000**	**$722,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Structural steel and architectural finishes	434	m^2	$3,000	$1,300,000	-	-	Incl.	$1,300,000	$1,300,000
								TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL	**$1,300,000**	**$1,300,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$118,000	$118,000	-	-	Incl.	$118,000	$118,000
	Turbo Blowers	4	Each	$247,500	$990,000	50%	-	$495,000	$1,485,000	$1,485,000
	Chemical Dosing Pumps	1	Set	$40,000	$40,000	50%	-	$20,000	$60,000	$60,000
	Chemical Storage Tanks	2	Each	$100,000	$200,000	50%	-	$100,000	$300,000	$300,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$500,000	$500,000	-	-	Incl.	$500,000	$500,000
								TOTAL ESTIMATE FOR DIVISION 11 - PROCESS	**$2,463,000**	**$2,463,000**
	DIVISION 13 - INSTRUMENTATION AND CONTROLS								$5,000,000	$5,000,000
	Blower Master Control Panel	1	L.S.	$150,000	$150,000	-	-	Incl.	$150,000	$150,000
	Lump Sum	1	L.S.	$370,000	$100,000	-	-	Incl.	$100,000	$100,000
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$100,000**	**$250,000**

Spec Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$620,000	$620,000	-	-	Incl.	$620,000	$620,000
								TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL	**$620,000**	**$620,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$740,000	$740,000	-	-	Incl.	$740,000	$740,000
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$740,000**	**$740,000**
								TOTAL ESTIMATE FOR DIVISION 3-15	**$5,945,000**	**$6,500,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PROJ. NO.: T001744A
PREPARED BY: Kang-Young Ko
DATE: June 19, 2024
SUBJECT: Aeration Tanks

Spec Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud mat	207	m^3	$1,000	$206,515	-	-	Incl.	$206,515	$207,000
	Base Slab	1584	m^3	$1,200	$1,900,416	-	-	Incl.	$1,900,000	$1,900,000
	Slabs and Walls	1703	m^3	$2,100	$3,575,321	-	-	Incl.	$3,580,000	$3,580,000
	Misc. Structures	150	m^3	$2,100	$315,000	-	-	Incl.	$315,000	$315,000
								TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE	**$6,001,515**	**$6,002,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	FRP Grating Covers	85	m^2	$1,500	$127,500	50%	-	$64,000	$191,500	$192,000
	Handrails	380	m2	$850	$320,000	-	-	Incl.	$320,000	$320,000
	Misc. Lump sum	1	L.S.	$100,000	$100,000	-	-	Incl.	$100,000	$100,000
								TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL	**$611,500**	**$612,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$167,000	$167,000	-	-	Incl.	$167,000	$167,000
	Fine Bubble Diffusers	1	L.S.	$327,000	$327,000	50%	-	$164,000	$491,000	$491,000
	Mixers with Lifting Davits	3	Each	$65,000	$195,000	50%	-	$98,000	$293,000	$293,000
	Inlet Gates	6	Each	$30,000	$180,000	50%	-	$90,000	$270,000	$270,000
	Retrievable Channel Mixing System	1	L.S.	$450,000	$450,000	50%	-	$225,000	$675,000	$675,000
	Piping, Valves and Supports	1	L.S.	$1,500,000	$1,500,000	-	-	Incl.	$1,500,000	$1,500,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$100,000	$100,000	-	-	Incl.	$100,000	$100,000
	Insulation and Heat Tracing	1	LS	$20,000	$20,000	-	-	Incl.	$20,000	$20,000
								TOTAL ESTIMATE FOR DIVISION 11 - PROCESS	**$3,496,000**	**$3,496,000**

Spec Section	Description	QTY	Unit	MATERIAL Unit Cost	MATERIAL Total Cost ($)	LABOUR % Of MAT'L	LABOUR or Unit Cost ($)	LABOUR Total Cost	Amount ($)	ROUNDED COST ($)
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Air flow meter	3	Each	$10,000	$30,000	50%	-	$15,000	$45,000	$45,000
	DO meter	3	Each	$15,000	$45,000	50%	-	$23,000	$68,000	$68,000
	Integration and Misc.	1	L.S.	$100,000	$100,000	-	-	Incl.	$100,000	$100,000
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$213,000**	**$213,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$170,000	$170,000	-	-	Incl.	$170,000	$170,000
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$170,000**	**$170,000**
								TOTAL ESTIMATE FOR DIVISION 3-15	**$10,492,015**	**$11,000,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PREPARED BY: Kang-Young Ko
SUBJECT: MBR & UV Building
PROJ. NO.: T001744A
DATE: June 19, 2024

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud Slab	97	m^3	$1,000	$97,000	-	-	Incl.	$97,000	$97,000
	Base Slab	551	m^3	$1,200	$660,960	-	-	Incl.	$660,000	$660,000
	Slabs and Walls	1275	m^3	$2,100	$2,676,734	-	-	Incl.	$2,680,000	$2,680,000
	Misc. Structures	300	m^3	$2,100	$630,000	-	-	Incl.	$630,000	$630,000
								TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE	**$4,067,000**	**$4,067,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Checkered Plate Covers	265	m^2	$500	$132,687	50%	-	$66,000	$198,687	$199,000
	Structural steel and architectural finishes	918	m^2	$3,000	$2,754,000	-	-	Incl.	$2,754,000	$2,754,000
								TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL	**$2,952,687**	**$2,953,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$739,000	$739,000	-	-	Incl.	$739,000	$739,000
	Tertiary Membrane Filtration	1	L.S.	$12,150,000	$12,150,000	-	-	Incl.	$12,150,000	$12,150,000
	Inlet Gates of MBR and UV Systems	7	Each	$40,000	$280,000	50%	-	$140,000	$420,000	$420,000
	Channel Mixing	1	L.S.	$100,000	$100,000	50%	-	$50,000	$150,000	$150,000
	UV Disinfection System	1	L.S.	$700,000	$700,000	50%	-	$350,000	$1,050,000	$1,050,000
	Chemical Storage Tanks	2	Each	$100,000	$200,000	50%	-	$100,000	$300,000	$300,000
	Parshall Flume	1	Each	$50,000	$50,000	50%	-	$25,000	$75,000	$75,000
	Odour Control Facility c/w Fan	1	L.S.	$150,000	$150,000	50%	-	$75,000	$225,000	$225,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$400,000	$400,000	-	-	Incl.	$400,000	$400,000
								TOTAL ESTIMATE FOR DIVISION 11 - PROCESS	**$16,000,000**	**$16,000,000**

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Lump Sum	1	L.S.	$480,000	$480,000	-	-	Incl.	$480,000	$480,000
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$480,000**	**$480,000**
	DIVISION 14 - HOISTING SYSTEMS									
	Hoist	1	L.S.	$200,000	$200,000	-	-	Incl.	$200,000	$200,000
								TOTAL ESTIMATE FOR DIVISION 14 - HOISTING SYSTEMS	**$200,000**	**$200,000**
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$1,600,000	$1,600,000	-	-	Incl.	$1,600,000	$1,600,000
								TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL	**$1,600,000**	**$1,600,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$4,800,000	$4,800,000	-	-	Incl.	$4,800,000	$4,800,000
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$4,800,000**	**$4,800,000**
								TOTAL ESTIMATE FOR DIVISION 3-16	**$30,099,687**	**$30,000,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PREPARED BY: Kang-Young Ko
SUBJECT: Onsite Sludge Storage
PROJ. NO.: T001744A
DATE: June 19, 2024

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud Slab	41	m^3	$1,000	$41,000	-	-	Incl.	$41,000	$41,000
	Base Slab	211	m^3	$1,200	$253,515	-	-	Incl.	$250,000	$250,000
	Slabs and Walls	342	m^3	$2,100	$718,657	-	-	Incl.	$720,000	$720,000
	Misc. Structures	30	m^3	$2,100	$63,000	-	-	Incl.	$63,000	$63,000
	TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE								**$1,074,000**	**$1,074,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Structural steel and architectural finishes	160	m^2	$2,800	$448,000	-	-	Incl.	$448,000	$448,000
	TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL								**$448,000**	**$448,000**
	DIVISION 11 - PROCESS									
	Equipment General Requirement	1	L.S.	$342,000	$342,000	-	-	Incl.	$342,000	$342,000
	Storage Tank Aluminum Dome Covers	2	Each	$1,950,000	$3,900,000	50%	-	$1,950,000	$5,850,000	$5,850,000
	Hydraulic Mixing Systems c/w Pumps	2	Each	$280,000	$560,000	50%	-	$280,000	$840,000	$840,000
	Sludge Transfer Pump	1	Each	$30,000	$30,000	50%	-	$15,000	$45,000	$45,000
	Miscellaneous (Piping, Valves and Testing)	1	L.S.	$100,000	$100,000	-	-	Incl.	$100,000	$100,000
	TOTAL ESTIMATE FOR DIVISION 11 - PROCESS								**$7,177,000**	**$7,177,000**
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Lump Sum	1	L.S.	$150,000	$150,000	-	-	Incl.	$150,000	$150,000
	TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS								**$150,000**	**$150,000**
									$15,000,000	$15,000,000
	DIVISION 15 - MECHANICAL									
	Lump Sum	1	L.S.	$150,000	$150,000	-	-	Incl.	$150,000	$150,000
	TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL								**$150,000**	**$150,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$300,000	$300,000	-	-	Incl.	$300,000	$300,000
	TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL								**$300,000**	**$300,000**
	TOTAL ESTIMATE FOR DIVISION 3-16								**$9,299,000**	**$9,300,000**

Conceptual Cost Estimate

PROJECT: Facility Upgrade Plan for Dundas WWTP
PROJ. NO.: T001744A
PREPARED BY: Kang-Young Ko
DATE: June 19, 2024
SUBJECT: Administration/Control Building

Section	Description	QTY	Unit	MATERIAL		LABOUR			Amount ($)	ROUNDED COST ($)
				Unit Cost	Total Cost ($)	% Of MAT'L	or Unit Cost ($)	Total Cost		
	DIVISION 3 CONCRETE									
	Mud Slab	75	m^3	$1,000	$75,000	-	-	Incl.	$75,000	$75,000
	Base Slab	375	m^3	$1,200	$450,000	-	-	Incl.	$450,000	$450,000
	Slabs and Walls	788	m^3	$2,100	$1,654,800	-	-	Incl.	$1,654,800	$1,655,000
	Misc. Structures	30	m^3	$2,100	$63,000	-	-	Incl.	$63,000	$63,000
								TOTAL ESTIMATE FOR DIVISION 3 - CONCRETE	**$2,242,800**	**$2,243,000**
	DIVISION 4 TO 10 - STRUCTURAL AND ARCHITECTURAL									
	Structural steel and architectural finishes	1500	m2	$3,000	$4,500,000	-	-	Incl.	$4,500,000	$4,500,000
	Misc. Structures	1	L.S.	$500,000	$500,000	-	-	Incl.	$500,000	$500,000
								TOTAL ESTIMATE FOR DIVISION 5 to 10 - STRUCTURAL AND ARCHITECTURAL	**$5,000,000**	**$5,000,000**
	DIVISION 13 - INSTRUMENTATION AND CONTROLS									
	Lump Sum	1	L.S.	$500,000	$500,000	-	-	Incl.	$500,000	$500,000
								TOTAL ESTIMATE FOR DIVISION 13 - INSTRUMENTATION AND CONTROLS	**$500,000**	**$500,000**
	DIVISION 15 - MECHANICAL									
	HVAC	1	L.S.	$600,000	$600,000	-	-	Incl.	$600,000	$600,000
	Plumbing	1	L.S.	$250,000	$250,000	-	-	Incl.	$250,000	$250,000
								TOTAL ESTIMATE FOR DIVISION 15 - MECHANICAL	**$850,000**	**$850,000**
	DIVISION 16 - ELECTRICAL									
	Lump Sum	1	L.S.	$300,000	$300,000	-	-	Incl.	$300,000	$300,000
								TOTAL ESTIMATE FOR DIVISION 16 - ELECTRICAL	**$300,000**	**$300,000**
								TOTAL ESTIMATE FOR DIVISION 3-15	**$8,892,800**	**$10,000,000**

Engineering
for **people**