



newterra[®]
clean water. modular solutions. *simple.*[™]

Port Glasgow MBR
PDA PROPOSAL 410064R5
315 Cubic Meters / Day

**Newterra MicroClear[®] MEMBRANE BIOREACTOR
WASTEWATER TREATMENT SYSTEM**

Submitted To:

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DRAFT

Submitted By:
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1 Introduction

1.1 Advantages of Newterra MBR System

The Newterra MBR system employs membrane biological reactor (MBR) technology with submerged ultrafiltration membranes. The system is designed to be the simplest, most operator-friendly membrane technology available in the market. The Newterra MBR system produces ultra-clean water (solids free effluent) which effectively meets any water standards for discharge and reuse.

The Newterra MBR system is a packaged wastewater treatment plant with modular design features. The system comes complete with containerized screen, biological treatment, and membrane filtration. The plant is housed inside modified high-cube shipping containers or prefabricated buildings - completely pre-assembled, pre-piped, pre-wired and pre-tested, ready for a quick site installation and start-up. The advantages that the Newterra MBR system offers include:

- Absolute Physical Barrier for Contaminants
- Short Delivery Period
- Factory Assembled & Tested
- Minimal Site Work Required
- Reliable & Low Maintenance System
- Compact Footprint
- Minimal Noise & Odourless Operation



2 Technical Proposal

2.1 Design Basis

Design Parameters

PARAMETER	PHASE 1 DESIGN VALUE	PHASE 2 DESIGN VALUE	UNIT
Average daily flow (ADF)	158.5	315	m ³ /d
Maximum Month Flow (MMF)	189	377	m ³ /d
Maximum Daily Flow (MDF)	315	629	m ³ /d
Site power ¹	Three-phase, 347/600VY, 60Hz Maximum Available Fault Current: 10,000 Symmetrical RMS Amps (Newterra's default design standard)		
System area classification	According to NFPA 820, 2016 Edition		
Ambient temperatures	-35 to 35		°C
Elevation	100		m

NOTES:

- The system will not be rated for service entrance but this can be provided. Please contact Newterra to discuss if this is desired.

Wastewater Characteristics

Parameter	UNIT	Design Value
Biochemical Oxygen Demand (BOD ₅) ¹	mg/L	350
Total Suspended Solids (TSS) ¹	mg/L	400
Total Kjeldahl Nitrogen (TKN) ¹	mg/L	55
Total Phosphorus (TP) ¹	mg/L	12.5
Fat, Oil and Grease (FOG) ¹	mg/L	< 30
Water Temperature ¹	°C	10 to 25
Prohibited Chemicals/Compounds ³	Not Present	
Grinder Pumps	Not Present Upstream of MBR	

NOTES:

- Noted values are assumed. Any variance to assumed parameter values may require system modification at the sole responsibility of the purchaser. A change order will be required to proceed with modifications and will delay delivery
- A complete list of prohibited chemicals is included in the membrane maintenance manual

Effluent Quality

Parameter	Units	Regulatory Limit	Design Value
pH		6.0 to 8.5	6.5 to 8.5
Biochemical Oxygen Demand (BOD ₅)	mg/L	< 5	< 5
Total Suspended Solids (TSS)	mg/L	< 5	< 1
Ammonia nitrogen (NH ₃ -N)	mg/L	< 2	< 0.5
Total Phosphorus (TP)	mg/L	< 0.15	< 0.1
Dissolved Oxygen (DO)	mg/L	> 2	> 2
E. coli	CFU/100mL	< 50	< 2.2

Chemical Consumption Full Build Out

CHEMICAL	CONCENTRATION	FUNCTION	DESIGN VALUE ¹	UNIT
Sodium Hypochlorite	12% Solution	Membrane cleaning	777	L/year
Citric Acid	30% Solution	Membrane cleaning	1632	L/year
Aluminum Sulphate	48% Solution	Phosphorous reduction	137.5	L/day
Sodium Hydroxide ²	50% Solution	pH Correction / Alkalinity addition	63	L/day

NOTES:

1. Chemical consumption values are estimated based on the system operating at ADF and average loading and will vary based on actual operational conditions.
2. It is assumed that there is sufficient alkalinity such that sodium hydroxide will not be required. However, a chemical dosing pump has been provided in the event that there is insufficient alkalinity.

Waste Activated Sludge (WAS) Production Full Build Out

LOCATION/HANDLING STAGE	VOLUME ²	UNIT	SOLIDS CONTENT ¹	UNIT
WAS Volume with Thickening	6.8	m ³ /d	2%	w/w dry solids

NOTES:

1. WAS Production values are estimated based on the system operating at ADF and average loading and will vary based on actual operational conditions.

2.2 Process Description

Membrane bioreactor (MBR) treatment technology is a simple, yet effective combination of an activated sludge biological treatment process with membrane filtration. The ultrafiltration (UF) membranes act as a physical barrier against the passage of all particulate solids, unlike the gravity settling of mixed liquor in the conventional activated sludge process, where separation is not complete. As a result, the MBR can operate at a much higher mixed liquor suspended solids (MLSS) concentration (typically 8,000 to 12,000 mg/L vs. 2,000 to 4,000 mg/L in conventional activated sludge system). This results in a robust, versatile, and ultra-compact wastewater treatment system. In addition, the high concentration of biomass inventory in the MBR system provides resilience to changes in influent quality.

Flow-Equalization

Throughout the day the flow and strength of the wastewater will vary. To accommodate this, an equalization tank will buffer the flow and homogenize the loading. The equalization tank is aerated to maintain an aerobic environment to reduce odors and to maintain suspension of solids and pumps transfer wastewater to biological treatment.

Fine Screening

Raw wastewater entering the MBR system contains particulates and solids that could damage the equipment and membranes down-stream. Fine screening protects the down-stream equipment by removing large solids and fibrous material

Biological Treatment

In the aerobic zone, the influent wastewater is combined with return activated sludge from the membrane tank. Fine bubble diffusers create an aerobic environment where the organics contributing to biological oxygen demand (BOD) and ammonia (TAN) are oxidized by the biology. Dissolved oxygen is continuously measured and aeration blowers controlled to maintain it in the range of 2 to 3 mg/L for process optimization and energy savings.

pH Correction and Alkalinity Addition

As organics and ammonia are oxidized alkalinity is consumed lowering the pH of the mixed liquor. To maintain the pH in the proper range and replenish alkalinity a sodium hydroxide or “caustic soda” solution is dosed into the mixed liquor, as required.

Phosphorous Reduction

Chemical precipitation is used to remove inorganic phosphate. An aluminum sulphate or “Alum” solution is dosed into the mixed liquor causing dissolved phosphorus to precipitate and coagulate. The precipitated phosphorus cannot pass through the UF membrane, and the phosphorus is eventually removed from the system as a solid with the waste activated sludge (WAS).

Membrane Filtration

After being treated biologically, the treated effluent is separated from the mixed liquor and solids by our membrane modules and the permeate extraction system. The membrane modules are continually air scoured to induce flow of mixed liquor over the membrane surface and prevent fouling and buildup of solids on the membrane surface without the use of chemicals.

The mixed liquor is then transferred to the inlet of the biological treatment to maintain even distribution of solids throughout the system and to introduce activated biology to the raw wastewater.

Effluent Disinfection

The UF membrane removes 99.9999% of bacteria and 99.99% of viruses. For additional disinfection and/or redundancy the effluent will pass through a UV reactor.

Waste Activated Sludge (WAS) Handling

As solids-laden wastewater enters the system, suspended bacteria grow and solids-free effluent is discharged, the suspended solids concentration in the mixed liquor (MLSS) will increase. To maintain the proper level of MLSS, solids must be removed from the system as Waste Activated Sludge (WAS) which is mixed liquor discharged from the aerobic tank at approximately 0.8% dry solids by weight.

WAS is discharged to a tank for holding and thickening. The holding tank is aerated to maintain an aerobic environment to reduce odors. In the thickening process, the WAS is allowed to settle and supernatant is pumped off, and returned to the MBR, thickening the sludge in the holding tank. By thickening the sludge to approximately 2% dry solids by weight, the total volume that must be disposed of is decreased, extending holding time and reducing operational costs. Level control in the tank indicates when the tank should be decanted or a vacuum truck should be scheduled to dispose of the WAS.

Modular Building

With 15 years of experience containerizing equipment Newterra has developed a modular building system that includes insulation, HVAC, interior and exterior lighting, spill containment and sumps, access doors, and other features facilitating operations.

All equipment installation, wiring, and piping internal to a container is done in the ideal conditions of our climate-controlled, manufacturing facility with full access to proper tools, equipment and engineering support.

The full system will be assembled and undergo comprehensive Factory Acceptance Testing (FAT) before it leaves our facility. This rigorous testing prior to shipping to helps eliminate downtime when the system arrives on site.



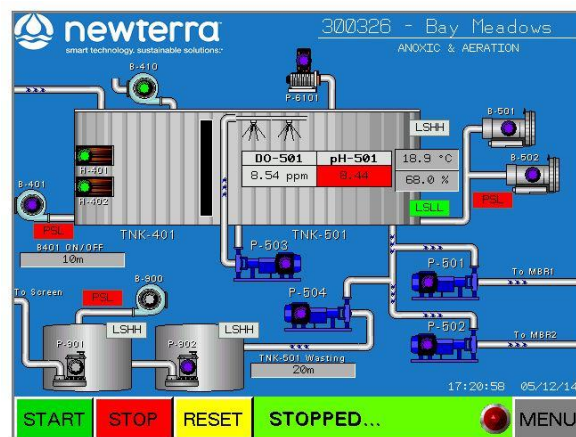
Control & Automation System

Newterra's control and automation system combines a high level of instrumentation, an advanced PLC, and in-house custom programming to deliver a system that offers tremendous optimization capabilities yet requires no operator intervention for day to day operation.

The user interface can be accessed on-site from control panel mounted touchscreen HMIs or remotely from a computer over the internet with purchase of a telemetry package and annual subscription service.

Also with the telemetry package, alarm messages can be transmitted by email or text message to alert operators to issues, even when the operators are not on site.

All important information is logged so trends can be monitored to ensure the long term successful operation of the Newterra system.



2.3 Scope of Supply

2.3.1 Phase One Equipment Scope of Supply

Flow Equalization

- In-ground FRP Equalization Tank (*Supplied loose for installation onsite by others*)
- In-tank equipment for Equalization Tank (*Equipment pre-installed inside the tank*)
 - Low level alarm switch
 - High level alarm switch
 - Level transmitter
 - Coarse bubble air diffuser grid
- Two (2) air mixing blowers (*Installed inside Newterra enclosure*)
 - One (1) blower duty, one (1) blower standby
 - Regenerative
 - Inlet filter silencers
 - Check valves
 - Isolation valves
 - Temperature gauges
 - Pressure gauges
 - Low pressure alarm switch
 - Pressure relief valves
- Two (2) Fine Screen feed pumps
 - One (1) pump duty, one (1) pump standby
 - Submersible
 - Isolation valves
 - Check valves
 - Rail system for pumps removal

Fine Screening

- Two (2) fine screens (both duty)
 - Rotary brush
 - Automatic cleaning 2 mm perforated plate
 - Screenings bagger
- Combined Discharge tank
 - High level alarm switch
 - Pump control switches
- Three (3) discharge pumps
 - Two (2) pumps duty, one (1) pump common standby
 - Centrifugal
 - Isolation valves
 - Check valves
 - Pressure gauge
 - Sample port

Biological Treatment

- In-ground FRP Aerobic Tank (*Supplied loose for installation onsite by others*)
- In-tank equipment for Aerobic Tank (*Equipment pre-installed inside the tank*)
 - Low level alarm switch
 - High level alarm switch

- Level transmitter
- DO probe
- pH probe
- Fine bubble air diffuser grid
- Two (2) aeration blowers (*Installed inside Newterra enclosure*)
 - One (1) blower duty, one (1) blower standby
 - Positive displacement
 - VFD controlled
 - Inlet filter silencers
 - Check valves
 - Isolation valves
 - Temperature gauges
 - Pressure gauges
 - Low pressure alarm switch
 - Pressure relief valves
- Two (2) membrane feed pumps duty
 - Submersible
 - Isolation valves
 - Check valves
 - Rail system for pumps removal
- One (1) waste activated sludge (WAS) pump
 - Submersible
 - Isolation valve
 - Check valve
 - Rail system for pump removal

Membrane Filtration

Two (2) trains total, each train includes:

- Membrane tank
 - All wetted components are stainless steel
 - Sample port for MLSS testing
 - Viewing window
 - Ground level access hatch
 - High level alarm switch
 - Level control switch
- Nine (9) ZeeWeed 500S submerged membrane modules with
 - Stainless steel housing
- Air scouring diffusers
- Two (2) permeate extraction pump
 - One (1) pump duty, one (1) common standby
 - Centrifugal
 - VFD controlled
 - Vacuum transmitter
 - Vacuum gauge
 - Isolation valves
 - Check valve
 - Pressure gauge
 - Sample port
 - Flow transmitter

- Membrane Backwash System (Common between trains)
 - Holding tank
 - Automated fill valve
 - Automated backwash valves
- Two (2) air scouring blowers
 - One (1) blower duty, One (1) common standby
 - Regenerative
 - Inlet filter silencer
 - Check valve
 - Isolation valve
 - Temperature gauge
 - Pressure gauge
 - Low pressure alarm switch
 - Pressure relief valves

Chemical Dosing

- One (1) chemical dosing pump, Aluminum Sulphate
 - Spill containment for chemical drum
- One (1) chemical dosing pump, Sodium Hydroxide
 - Spill containment for chemical drum

Effluent Disinfection

- Three (3) UV reactors
 - Piped in parallel
 - Bypass valves

Sludge Holding & Thickening

- In-ground FRP Sludge Holding Tank (*Supplied loose for installation onsite by others*)
- In-tank equipment for Sludge Holding Tank (*Equipment pre-installed inside the tank*)
 - High level alarm switch
 - Low level alarm switch
 - Level control switches
 - Coarse bubble air diffuser grid
- Two (2) aeration blowers
 - One (1) blower duty, one (1) blower standby
 - Regenerative
 - Inlet filter silencers
 - Check valves
 - Isolation valves
 - Temperature gauges
 - Pressure gauges
 - Low pressure alarm switch
- Two (2) decanting pumps duty
 - Submersible
 - Isolation valve
 - Check valve
 - Pressure gauge
 - Sample port

- Rail system for pump removal

Odour Control

- Two (2) activated carbon vessels
 - Pressure gauges
 - Inlet moisture separator
 - Ventilation blowers

System Enclosures

Two (2) 40' Modified High-Cube Shipping Containers

cMET certified, built to CEC standards with all wiring complete and all equipment pre-piped factory tested and mounted in enclosure.

New high-cube modified shipping containers with the following features:

- Exterior paint
- Lifting eyes on upper corners
- Coated plywood floor
- Welded steel man door(s) with safety window and push/crash bar lever
- Barn-style double doors
- Lighting
- Insulation
- Heating
- Ventilation fans
- Passive vent louvers with hoods
- Low temperature alarm switch
- Emergency stop switch
- Duplex 15 Amp GFI receptacle for heat trace inlet and discharge

Please note:

- a) Newterra has included base option pricing for the weather proofing of the roof between containers. This option is guaranteed under Newterra's standard warranty, terms and conditions and has an estimated 2 to 3 year life span when adhering to the conditions stipulated in the system manual. An option for an extended lifespan is available and can be added at any time, please contact Newterra to discuss if required.

Control System Module

Main Power distribution

PLC based control panels with the following standard features:

- cMET certification
- AIC rating of 10000
- NEMA 12 panel enclosure
- Primary circuit protection
- Main power block
- Branch circuit protection with circuit breakers for motors
- Motor starters with overload protection
- Variable frequency drives where required
- Branch circuit protection with circuit breakers for powered devices
- PLC control system
- 24 VDC IS power supply
- Intrinsically safe barriers for switches in classified areas
- Alarm notification in the event of a main power failure

- Dry contacts to allow interlock with system inlet pumps
- Wired and installed
- Factory tested prior to shipping

Outside cover of panel to contain the following:

- System ready light
- Red alarm indicator light
- Programmable touch screen with:
 - Colour P&ID display
 - Display of measurements recorded from any transmitters present in system
 - System on/off control
 - Safety control over all valves and motors with timed delay when in Hand position
 - Timers for solenoid valves and motors present in system
 - Alarm indicators with reset function
 - Run indicators for system components
 - USB port for datalogging download (USB key included)
 - Alarm reset button
- Emergency stop button

Operation and Maintenance Manual

- Operating instructions for all treatment system components
- Copy of operating manual for each piece of equipment (*Digital copy only*)
- Summary of system components
- Summary of system operation principles
- Summary of operation controls and failsafes
- Summary of maintenance requirements for each piece of equipment
- One digital copy provided
- All documentation provided in English

Factory Acceptance Testing (FAT)

- Material receipt inspection
- Assembly verification
- Leak test/set up verification
- Functional challenge
- FAT summary & deviation report

2.3.2 Phase Two Equipment Scope of Supply

Biological Treatment

- In-ground FRP Aerobic Tank (*Supplied loose for installation onsite by others*)
- In-tank equipment for Aerobic Tank (*Equipment pre-installed inside the tank*)
 - Low level alarm switch
 - High level alarm switch
 - Level transmitter
 - DO probe
 - pH probe
 - Fine bubble air diffuser grid
- Two (2) aeration blowers (*Installed inside Newterra enclosure*)
 - One (1) blower duty, one (1) blower standby
 - Positive displacement
 - VFD controlled
 - Inlet filter silencers
 - Check valves
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- Two (2) membrane feed pumps duty
 - Submersible
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 - Check valves
 - Rail system for pumps removal
- One (1) waste activated sludge (WAS) pump
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- Emergency stop switch
- Duplex 15 Amp GFI receptacle for heat trace inlet and discharge

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- Summary of maintenance requirements for each piece of equipment
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Factory Acceptance Testing (FAT)

- Material receipt inspection
- Assembly verification
- Leak test/set up verification
- Functional challenge
- FAT summary & deviation report

2.3.3 Services Scope of Supply Phase 1

Pre-commissioning System Walkthrough

Typical system walkthrough includes the following:

- System walk through by project engineer
 - Inspect all shipped loose equipment to verify correct installation
 - Confirm all mechanical equipment installed as per Newterra drawings
 - Confirm all electrical equipment installed as per Newterra drawings
- Summary & deviation report/list of corrective actions to be performed before commissioning

Site Acceptance Testing (SAT)

Typical SAT includes the following:

- Assembly/Installation verification
 - Includes electrical & mechanical check
- SAT summary & deviation report/list of corrective actions

NOTES:

1. Newterra SAT does not relieve another party from warranty issues arising from their scope of work
2. Newterra will not begin formal start-up until SAT is complete and signed off by all parties

System Startup/Commissioning

Typical System Startup/Commissioning includes the following:

- Equipment check
 - Electrical, mechanical, and controls
- Functional test
 - Equipment and control system
- Hydraulic test
- Operation during plant seeding

Training

On-site operator training including the following topics:

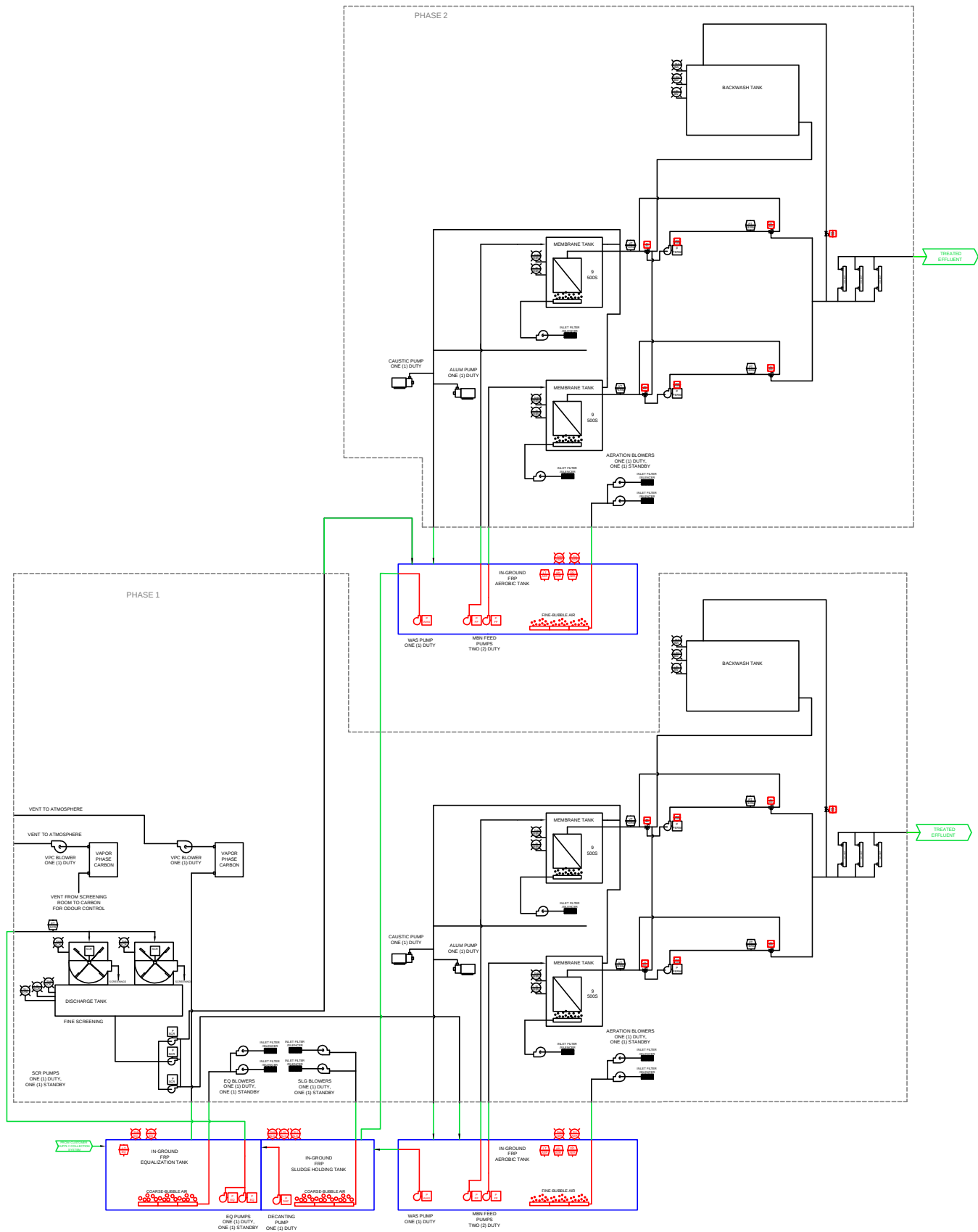
- General MBR theory & process
- Specific system instruction
 - Components
 - Controls and operating philosophy
 - Alarms and alarm troubleshooting
 - Maintenance
 - Troubleshooting
 - MBR fouling control (Biology, physical, and chemical)

2.4 Customer's Scope of Supply

Newterra does not include the following unless expressly detailed in this proposal:

- Installation of loose shipped equipment supplied by Newterra
- Placement and anchoring (if required) of equipment
- Interconnecting piping supply and installation
- Interconnecting electrical and controls supply and installation including connection inside Newterra's control panel
- Electrical power supply to our electrical panel, lightning, grounding, etc.
- Permitting
- Potable water supply to the plant site for plant hydraulic test during startup
- Seed sludge
- Wastewater testing
- Chemicals supply and storage
 - NOTE: Based on local regulations, additional safety equipment may be required to store and handle chemicals on the site which have not been included as part of this proposal. This may include but be limited to: eye wash stations, safety showers, spill containment, secondary containment, isolation curtains, isolated ventilated bulk storage buildings, personal protective equipment, constant ventilation systems, vapor suppression equipment, and spill containment equipment. Newterra can provide pricing for these options upon request.
- Treated effluent and waste sludge disposal
- All civil work including design
 - Tank sizing as per Newterra supplied PFD, to be confirmed during detailed design
- Anything not mentioned in "Scope of Supply" above

4 Process Flow Diagram



NOTES

- SUPPLY BY NEWTERRA
- INSTALL BY NEWTERRA (INSIDE MODULAR BUILDING)
- ISO CONTAINER BASED MODULAR BUILDING
- SUPPLY BY NEWTERRA, INSTALL BY CONTRACTOR
- SUPPLY BY NEWTERRA, PRE-INSTALL BY NEWTERRA
- SUPPLY BY CONTRACTOR, INSTALL BY CONTRACTOR
- INTERCONNECTING PIPING BETWEEN BUILDING AND TANKS, AND BETWEEN TANKS, IS TO BE REQUIRED BY CONTRACTOR.



PHONE:
(800) 420-4056

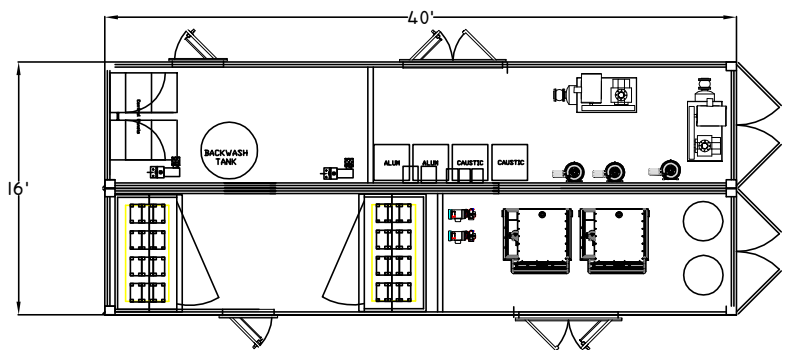
www.newterra.com

PROJECT NUMBER
410064
TITLE AND LOCATION
PROCESS FLOW DIAGRAM
PORT GLASGOW

CUSTOMER
SEASIDE
WATERFRONTS INC.

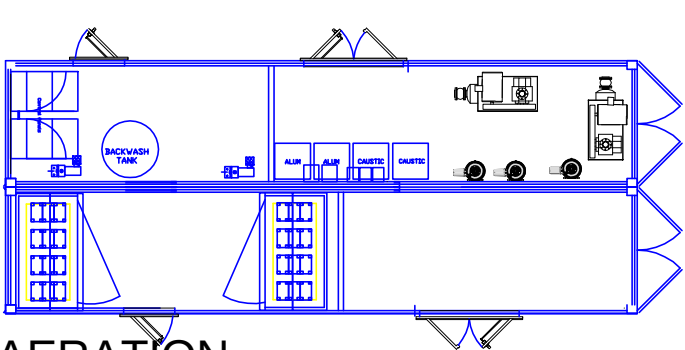
DRAWN BY DATE SHEET SHEETS
1 1

5 Preliminary Layout

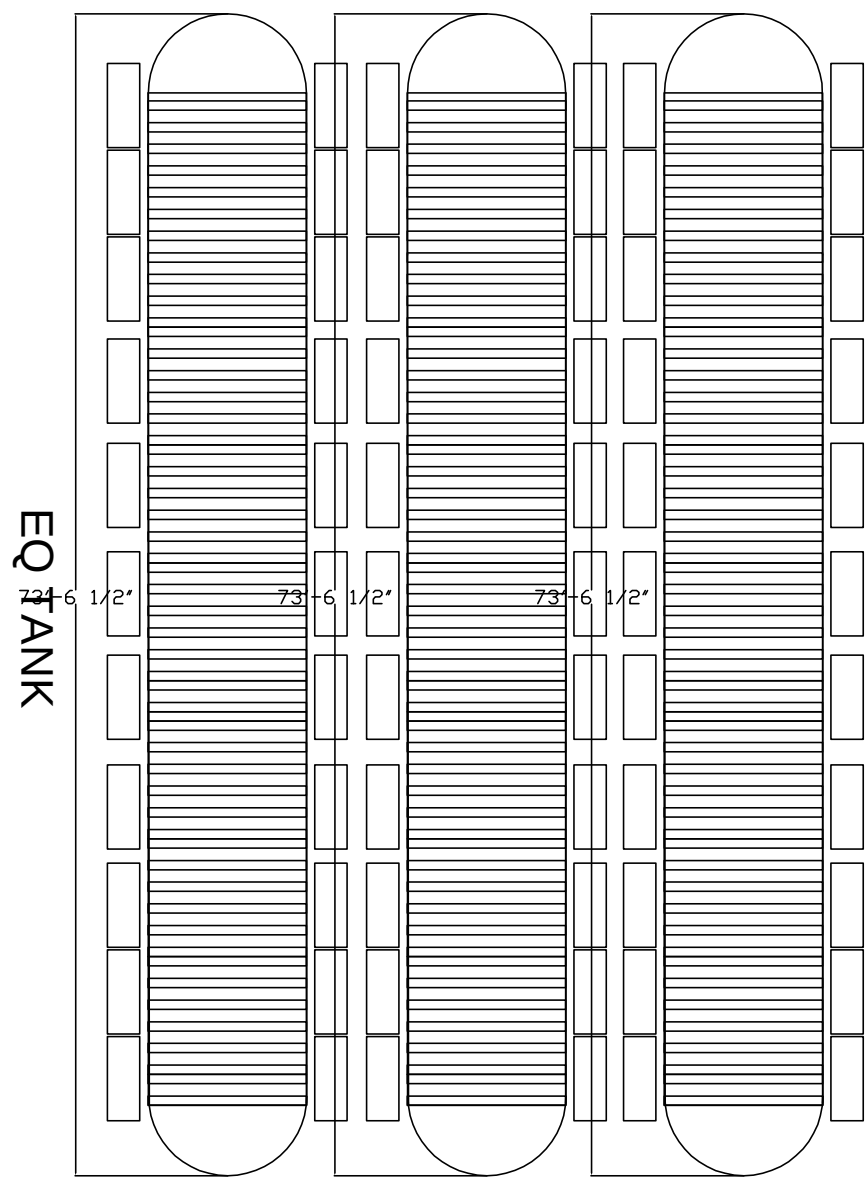


SLUDGE
HOLDING
TANK

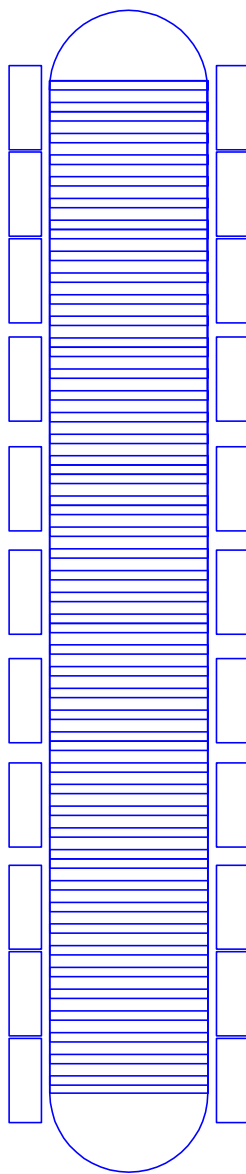
AERATION
TANK
PHASE 1



AERATION
TANK
PHASE 2



EQ TANK



NOTES

INTERCONNECTING PIPING BETWEEN BUILDING AND TANKS, AND BETWEEN TANKS, IS TO BE REQUIRED BY CONTRACTOR.

PHASE 1

PHASE 2

PHONE:
(800) 420-4056

www.newterra.com

				PROJECT NUMBER	410064	CUSTOMER		SEASIDE WATERFRONTS	
				TITLE AND LOCATION		PRELIMINARY LAYOUT PORT GLASGOW			
R0	PRELIMINARY FOR QUOTE			DATE (mm/dd/yy)	BY	DRAWN BY	DATE	SHEET	SHEETS
LEVEL	REVISION								

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