Baffinland Iron Mines Corporation

BIM-5200-PLA-0022 FRESH WATER SUPPLY, SEWAGE, AND WASTEWATER MANAGEMENT PLAN

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Document Revision Record

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Track Changes Table

Index of Major Changes/Modifications in Revision 12

Item No.	Description of Change	Relevant Section
1	The abbreviation BTE has been amended to reflect Xylenes and NR has been added	3.1
2	KM105 Surface Water Management Pond description change	7.2.5
3	Administrative wording edits with regard to PWSP operations	5.4.1-2
4	Added additional controls to ensure no exceedances occur of freshwater use	4.1.1.5
5	Added verbiage to outline the process established in Part E, Item 4 of BIM's Type A Water Licence 2AM-MRY2540	4.2
6	Updated wording for recycled water to reflect BIM's Type A Water Licence 2AM-MRY2540	5.2
7	Updated wording to reflect new dedicated effluent discharge pipe to Mary River	7.2.2
8	Added section for new FDP from Pit runoff (MS-12)	7.2.6
9	Updated Concordance Tables and associated sections	Full Document
10	Revised the wording in Appendix F to better align and more closely reflect BIM's Type A Water Licence 2AM-MRY2540	Appendix F

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1. Purpose

The purpose of this Plan is to describe the management the freshwater supply and wastewater for the various camp sites at the Mary River Project (the "Project") during the Project's construction and operation phases.

This Plan will continue to support the Membrane Biological Reactor (MBR) sewage treatment plants (STPs) installed in 2014 to service the Mine Site Complex (MSC) and Port Site Complex (PSC) camps, the MBR STP installed in 2018 to service the Sailiivik Camp, the MBR STP installed in 2019 to service the 380 Person Camp, and the potable water supply and oily water treatment activities under the Type A Water Licence 2AM-MRY2540 (the "Type A Water Licence"). This Plan will also support future upgrades and additions to the MBR STPs necessary to service future MSC, PSC, and Sailiivik camp expansions at the Mine Site and at Milne Port, as well as the camps required for the construction and operation of Steensby Port and Railway.

2. Application

The Plan applies to all departments and to all Baffinland Iron Mines Corporation (BIM) employees, contractors, and visitors when involved in controlled activities.

Specifically, this document focuses on freshwater supply and wastewater treatment and disposal at the Mine Site, Milne Port, Steensby Port, and various temporary camps.

2.1 Regulatory Requirements

This Plan has been developed under the requirements of BIM's Type A Water Licence (refer to the concordance table for the Type A Water Licence presented in Appendix B). Furthermore, all actions undertaken under this Plan will be compliant with the appropriate sections of Federal and Territorial legislation as indicated in Table 2.1.

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Table 2.1 Applicable Regulations, Standards, and Codes

Title	Number/Acronym
American Water Works Association	-
International Building Codes	-
National Sanitation Foundation	-
Health Canada Guidelines for Canadian Drinking Water Quality	-
Northwest Territories Water Supply System Regulations	NWT Regulation 108-2009
Nunavut Waters and Nunavut Surface Rights Tribunal Act, SC2 002, c. 10	--
Northwest Territories Water Act	NWTWA
Northwest Territories Water Regulations (SOR/93-303)	--
Ontario Drinking Water Quality Standards	--
Federal *Fisheries Act*	--
Canadian Environmental Protection Act (1999)	CEPA
CCME Water Quality Guidelines for the Protection of Aquatic Life	--
Ontario Guidelines for Sewage Works, 2008	--
Drinking Water System Components	NSF/ANSI Standard 61
Filtering Material	AWWA Standard B100
Granular Activated Carbon	AWWA Standard B604
Canada Occupational Health and Safety Regulations	-
Metal and Diamond Mining Effluent Regulations	-
End-of-pipe Fish Protection Screens for Small Water Intakes in Freshwater	DFO Canada Interim Code of Practice (2020)
Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada	Canadian Science Advisory Secretariat Science Advisory Report 2013/17

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Title	Number/Acronym
DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut	DFO (2010)

3. Definitions And Abbreviations

3.1 Abbreviations

Statement	Definition
AMF	Adaptive Management Framework
API	American Petroleum Institute
BIM	Baffinland Iron Mines Corporation
BOD_5	Biochemical Oxygen Demand (Five-Day)
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CF	Crusher Facility
CFU	Colony Forming Unit(s) Per 100 Millilitres
COD	Chemical Oxygen Demand
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
FDP	Final Discharge Point
GCDWQ	Guidelines for Canadian Drinking Water Quality
GEVP	Group Executive Vice President
m^3/day	Cubic Metre(s) Per Day
MBR	Membrane Biological Reactor
MDMER	Metal and Diamond Mine Effluent Regulation
mg/L	Milligram(s) Per Litre
MHR	Mine Haul Road
MSC	Mine Site Complex
MWH	Mine Site Weatherhaven

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Statement	Definition
NH_4	Ammonia
NO_2	Nitrite
NO_3	Nitrate
NR	Not Regulated
NWB	Nunavut Water Board
OHWM	Ordinary High Water Mark
OMS	Operation, Maintenance, and Surveillance
OWS	Oily Water Separator
PLC	Programmable Logic Controller
PSC	Port Site Complex
PWSP	Polishing Water Stabilization Pond
PWTP	Potable Water Treatment Plant
RBC	Rotating Biological Contactor
ROM	Run-of-Mine
SCP	Spill Contingency Plan
SO_4	Sulphate
STP	Sewage Treatment Plant
SWAEMP	Surface Water and Aquatic Ecosystem Management Plan
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TOG	Total Oil and Grease
TSS	Total Suspended Solids
WRF	Waste Rock Facility
WTP	Water Treatment Plant

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4. Fresh Water

4.1 General Mitigation Measures for Water Use

4.1.1 Water Intakes

4.1.1.1 Engineering Intake Structures

Engineered intake structures are designed to minimize erosion, avoid sediment issues, and provide protection from ice and peak water flows. Care is taken to ensure that disturbance to aquatic environments is minimized during installation and maintenance of infrastructure. Riprap used in construction is clean, free of fine sediment, non-acid leaching, and non-metal generating.

4.1.1.2 Screens on Intake Pipes

All water intake hoses will be equipped with a screen of an appropriate mesh size, in accordance with Fisheries and Oceans Canada's (DFO's) *Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater* (2020) to ensure no entrainment of fish. The guideline also requires a water withdraw rate such that fish do not become impinged on the screen.

4.1.1.3 Selection of New Water Take Locations

New water take locations may be required for a variety of needs, including concrete production, drilling, dust suppression, etc. A screening process will be used to confirm whether water sources are considered adequate as water take locations. Source selection begins by looking for the largest possible water body that is feasible for use. Lakes are considered first, followed by ponds and then large rivers. Streams and creeks will not be considered for short-term water withdrawal unless larger sources are not available. Baffinland will notify the Inspector and the Board at least ten (10) days in advance of using any new water sources not identified in the Type A Water Licence. If the required volume of water is likely to result in drawdown of the source water body, an assessment of the proposed water withdrawal will accompany the notification to the Inspector and the Board. For water taken from fish-bearing streams during open water, DFO (2013) recommends that water withdrawals not exceed 10% of the instantaneous flow without further study. During winter, water

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withdrawals from lakes should not exceed 10% of the under-ice volume without further study (DFO, 2010). During winter and under ice conditions, water must be drawn from below 2 metres of non-frozen water (as the top 2 metres of water provides higher oxygenation for resident fish).

4.1.1.4 Water Withdrawals

Water trucks will withdraw water from the Km 32 Lake to supply Milne Port with freshwater for domestic and industrial purposes. Potable water (domestic) is pumped from the water trucks into water storage tanks located at Milne Port's Potable Water Treatment Systems (Port Site Complex, Milne Port 380-Person Camp).

Water is withdrawn from Camp Lake using a wet well jetty structure to supply the Mine Site with freshwater for domestic and industrial (i.e. production drills, emulsion plant, maintenance facilities, etc.) water needs. Potable water (domestic) is transported from the jetty to water storage tanks located at the Mine Site's Potable Water Treatment Systems (Mine Site Complex, Sailiivik Camp) using heat-traced water pipelines and/or water trucks. Water required for industrial purposes at the Mine Site is withdrawn and transported from the Camp Lake jetty using water trucks or other equipment (i.e. fire trucks).

A number of water sources are authorized for use in dust control. Intakes on the extraction hoses are screened in accordance with DFO guidelines. Water withdrawals are short-term (approximately 20 to 40 minutes to fill a water truck). The approved water withdrawals are based on guidance established by Knight Piésold (2014).

4.1.1.5 Water Usage and Conservation Measures

Water meters are installed at strategic locations to monitor water consumption and enable the development of management strategies, including the installation of low flow water taps, to reduce water usage/consumption. If water meters are not available, water use will be estimated (calculated) using flow rates or other methods.

Water withdrawn from approved water take locations within the Project is recorded and reported to the Environment Department. All personnel involved with water use activities will follow the Type A Water Licence to ensure that daily withdrawal limits

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are not exceeded. Controls that may be implemented to ensure daily limits are not exceeded include:

- Totalizer flow meters
- Source location and limit signage
- Ongoing training of involved personnel in water taking
- Automation of water withdrawals through connection of flow meters to the site Programmable Logic Controller (PLC) and implementation of logic coded programming controls such as notifications when daily withdrawal limits are approached, and preventing water withdrawal once daily limits are reached. Detailed water truck logs that indicate when the maximum daily volume of water has been collected from each source based on the number of water truck loads filled
- Waterproof housing to store water truck logs in a singular location at the source, enabling the use of a common log sheet for all operators and improved tracking between different trucks using the same source on the same day
- Effective communication between day shift and night shift operators

4.2 Fresh Water Sources

Freshwater for domestic and industrial purposes, during Construction and Operation Phases of the Project will be obtained in an amount and from sources listed in Table 4.1. Domestic water use is for camp operations and industrial uses are primarily for firefighting and other industrial uses (e.g. concrete production, ice road construction, etc.).

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Table 4.1 Water Use Authorized for Domestic and Industrial Purposes during Project Construction and Operations Phases

Site	Source	Construction Phase	Operations Phase		
			Domestic	Industrial	Combined
		Volume (m^3/day)	Volume (m^3/day)		
Milne Port (Milne Inlet)	Phillips Creek (summer) / Km 32 Lake (Winter)	367.5	300	67.5	367.5
Mine Site (Mary River)	Camp Lake	657.5	203.8	151.6	355.4
Steensby Port (Steensby Inlet)	ST 347 Km Lake / 3 Km Lake	435.8	101	142.6	243.6
Ravn River	Camp Lake	145.2	N/A	N/A	N/A
Mid-Rail	Nivek Lake (Summer)	79.5	N/A	N/A	N/A
	Ravn Camp Lake (Winter)		N/A	N/A	N/A
Cockburn North (Tunnels Camp)	Cockburn Lake	101.4	N/A	N/A	N/A
Cockburn South Camp	Cockburn Lake	111.1	N/A	N/A	N/A
Total		**1,898**	**604.8**	**361.7**	**966.5**

m^3/day: Cubic Metre(s) Per Day
Source: Type A Water Licence (2AM-MRY2540)

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Table 4.1 outlines approved water sources under the Type A Water Licence for domestic and industrial purposes. Table 4.2 outlines approved water sources authorized for the purposes of dust suppression. Water can be extracted from some of these streams during June and July in any year, with the exception of dry years where water withdrawals are prohibited during the rest of the year. The Environment Department will be consulted before withdrawing water from the streams listed in Table 4.2 to verify if it is a wet or dry year and if water withdrawals are authorized.

Table 4.2 Water Use Authorized for Dust Suppression along the Tote Road

Source	Proposed Maximum Volume (m^3/day)	Restriction
Phillip's Creek	212	None
Km 32 Lake	364	None
CV128	579.5	None
CV099	110	June – July only during low flow (less than mean flow) years
CV087	90	June – July only during low flow (less than mean flow) years
CV078	75	June – July only during low flow (less than mean flow) years
Katiktok Lake	318	None
BG50	150	None
BG32	120	June – July only during low flow (less than mean flow) years
CV217	130	None
Muriel Lake	212	None
David Lake	132	June – July only during low flow (less than mean flow) years
BG17	75	June – July only during low flow (less than mean flow) years
CV233 (Tom River)	135	None

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Source	Proposed Maximum Volume (m^3/day)	Restriction
Camp Lake	86	None

Source: Type A Water Licence (2AM-MRY2540)

The above water sources have been approved by the Board as freshwater sources for domestic, industrial, and dust suppression purposes. BIM will give notice to the Board in advance of using freshwater for domestic and industrial purposes during the Operation Phase of the Project from the locations listed above, or as otherwise approved by the Board. Authorization by the Board in writing must be obtained prior to withdrawing water at the sources listed in Table 3 for any purpose other than dust suppression.

Waterproof storage systems are installed at each water source to house daily water use logs, which enables the use of a common log sheet for all operators and improved tracking between different trucks using the same source on the same day. The water truck operator log indicates when the maximum daily volume of water has been collected from each source based on the number of water truck loads filled.

Streams or other waterbodies will not be used as a water source unless the Board is notified (ten)10 days in advance, and authorization is granted by the Board in writing. Additionally, no material will be removed from below the ordinary high-water mark (OHWM) of any water body unless authorized. For remote freshwater requirements such as dust suppression, tunnelling, and geotechnical and exploration drilling, some water may be drawn by truck from nearby lakes and ponds and used directly for these purposes if the source is pre-approved by the Type A Water Licence or by application to the Board.

Sources that are restricted by low flow years will have a visual inspection completed by Environment Department personnel to determine if restrictions need to be put in place on a regular basis. Environment Department personnel may then perform instantaneous flow measurement by staff gauge monitoring, if deemed necessary. The instantaneous flow estimate measures the height of water on a staff gauge and applies it to rating curves of representative streams around the Project. This data can be compared to low flow indices from current monitoring locations for a

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representative stream in consultation with a hydrologist to determine if it is a low flow year. The Environment Department will inform operators of any restrictions.

Water used for the purposes of exploration drilling and domestic camp use at supporting satellite exploration camps will be withdrawn under the authorization of BIM's Exploration Type B Water Licence 2BE-MRY2131 (the "Type B Water Licence"). Water withdrawn for domestic camp use at satellite exploration camps will be withdrawn from sources proximal to each camp. Total water use for all satellite exploration camps will not exceed 49 m^3/day. Likewise, drill water will be withdrawn from water sources proximal to drilling targets and shall not exceed 250 m^3/day. Therefore, the volume of water withdrawn for all purposes under the Type B Water Licence will not exceed 299 m^3/day.

4.3 Fresh Water System Process Description

The following sections describe the freshwater systems at the Project sites. Each site includes a potable water treatment plant (PWTP) that produces drinking water for the personnel at the site during Construction and Operation Phases. These systems treat water to meet the *Guidelines for Canadian Drinking Water Quality* (Health Canada, 2017) as well as the *Ontario Drinking Water Quality Standards* (Government of Ontario, 2018a). Minimum process equipment requirements are based upon the *Northwest Territories Water Supply System Regulations*, *NWT Regulation 108-2009*, *Ontario Design Guidelines for Drinking Water Systems 2008*, *Ontario Regulation 170/03 – Drinking Water Systems*, the *Procedure for Disinfection of Drinking Water in Ontario*, as well as best management practices.

4.3.1 Milne Port

At Milne Port, two camps support operations and construction activities. These camps include the PSC Camp and the 380-Person Camp. Each camp contains a PWTP within or near the camp as well as freshwater tanks to store raw water delivered. The freshwater demand for the Construction and Operation Phases is shown on drawing 'Milne Inlet – Water Supply Balance Block Flow Diagram' in Appendix D of this Plan.

A raw water truck draws water from the Km 32 Lake (in winter/summer) or Phillips Creek (in summer) and delivers the water to a freshwater storage tank near the

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camp. Currently, the Phillips Creek intake location is not in use. Water from the freshwater storage tank is used to provide firefighting water as well as meet the freshwater requirements of the site. A standpipe within the tank ensures that firefighting water is always available in the tank. The Milne Port camp layout, including the locations of potable water related infrastructure, is presented in Appendix C. The potable water treatment scheme consists of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water then undergoes a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use.

4.3.2 Mine Site

At the Mine Site, two camps support construction, operations and site-wide exploration activities. These camps include the Sailiivik Camp, and the MSC Camp. Each camp contains a PWTP within or near the camp as well as freshwater tanks to store raw water being delivered. The freshwater demand for the Construction and Operation Phases are shown on the drawing 'Mine Site – Water Supply Balance Block Flow Diagram' in Appendix D of this Plan.

Freshwater supply for the Mine Site is obtained using an electric pump positioned inside a heated and insulated pump house on a raw water jetty on Camp Lake. Water is pumped directly from the lake source to water storage tanks located at camps. Storage tanks that are not connected to this water line are filled from water trucks that draft water directly from the pump house. Water from these tanks is used to provide firefighting water as well as meet the freshwater requirements of the site. A stand pipe within each tank ensures that firefighting water is always available in the tank. The Mine Site camp layout, including locations of potable water relate infrastructure, is presented in Appendix C of this Plan.

The potable water treatment scheme consists of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water then undergoes a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use.

Some freshwater requirements such as road dust suppression, exploration drilling, quarry dust suppression, and concrete and explosives manufacturing will be provided directly from Camp Lake and other nearby lakes using water trucks.

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Exploration drilling will continue throughout the Construction and Operation Phases of the Project.

4.3.3 Steensby Port

The operation of Steensby Port and associated railway infrastructure has not commenced to date. As a result, freshwater systems are not yet in place at Steensby Port. This Plan will be updated prior to the commencement of operations at Steensby Port and the associated railway to reflect planned water management and monitoring.

5. Sewage Treatment

5.1 Sewage Generation Rate

The estimated generation of sewage is based on a per capita generation as shown in Table 5.1.

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Table 5.1 STP Average Sewage Flow Design Basis

Parameter	Design Value	Source
Sewage Generation	300 L/day/person	Design Basis – Sewage Treatment Plant, Doc. No. H337697-4000-10-109-0002 (FEIS, Appendix 3B).

5.2 Sewage Discharge Criteria

All sewage generated from relevant Project sites is directed to the STPs or as otherwise approved by the Board. As per the Type A Water Licence, BIM constructs and operates infrastructure and facilities designed to contain, withhold, divert, or retain Water and/or Waste in accordance with applicable legislation and industry standards. Effluent is discharged such that surface erosion is minimized and no additional impacts are created. Effluent discharge locations are regularly monitored for erosion, and control measures are implemented as required. The quality of the sewage treatment plant effluent discharging to freshwater shall be in accordance with the applicable site discharge limits and the approved Type A Water Licence as listed in Table 5.2.

Table 5.2 Effluent Quality Discharge Limits for Sewage Treatment Facilities to Freshwater Receiving Environment

Parameter	Unit	Maximum Concentration of Any Grab Sample discharging into Freshwater
BOD_5	mg/L	30
TSS	mg/L	30
Faecal Coliform	CFU/100 mL	1,000 CFU /100 ml
Oil and Grease	mg/L	No visible sheen
pH	--	Between 6.0 and 9.5
Ammonia (NH_3-N)	mg/L	4.0
Total Phosphorus (MS-01, MS-01B, MS-MRY-04A)	mg/L	4.0

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Parameter	Unit	Maximum Concentration of Any Grab Sample discharging into Freshwater
Total Phosphorus (MS-01A)	mg/L	1.0
Toxicity	--	Final effluent not acutely toxic

BOD5: Biochemical Oxygen Demand (Five-Day)
CFU/100 ml: Colony Forming Unit(s) Per 100 Millilitres
mg/L: Milligram(s) Per Litre
TSS: Total Suspended Solids
Source: Type A Water Licence (2AM-MRY2540) Table 5

Recycled water and use of reclaimed water from the various treatment facilities (STPs, Oily Water Separators (OWSs), etc.), surface water management ponds, and embankment dams and approved discharge locations may be used if the water meets appropriate discharge criteria for those facilities, with the exception of TSS if the water is being used for dust suppression in areas of the Project where water reports to a Metal and Diamond Mine Effluent Regulation (MDMER) regulated facility, containment pond, sump or does not have the potential to directly flow to a receiving water body. Sludge generated from STPs or any other facilities will be incinerated using the Milne Port, Steensby Port, and Mine Site on-site incinerators, disposed of in the landfill with the appropriate approvals from authorities, or backhauled for disposal off-site in Southern Canada.

5.3 Treated Wastewater Generation and Discharge/Outfall Locations

Treated sewage and wastewater from the Project are discharged to the locations listed in Table 6. Refer to Site Block Flow Diagrams in Appendix D for Milne Port and Mine Site anticipated annual effluent discharge. The Project-specific operation and maintenance manual for STPs is provided in Appendix E.

BIM will notify the Board and the Inspector at least ten (10) days prior to the commencement of discharge from any STP associated with the Project. The notice will include estimated volume proposed for discharge and the location and description of the receiving environment.

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Table 5.3 Treated Effluent Generation and Discharge/Outfall Locations

Camp/ Site	Discharge/Outfall Location	Coordinates (UTM)	
	Summer	Easting	Northing
Milne Port	Ocean at Milne Inlet	503636	7976338
Mine Site	Storage Ponds (PWSPs)	559733	7913630
Mine Site	Effluent Line to Mary River	562321	7911946
Tote Road Work Sites	Conveyed to Mine Site or Milne Port Sewage Treatment Facilities	N/A	N/A
Steensby (Port)	Ocean at Steensby Inlet	593378	7801412

Treated wastewater effluent will be discharged at a distance of at least 31 meters above the OHWM of any water body or watercourse or, where direct flow into the adjacent water body or watercourse is possible, so that surface erosion is minimized and additional impacts are avoided.

The sewage treatment facilities are sampled at the locations listed in Table 7.

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Table 5.4 Sewage Treatment Facility Monitoring Locations

Camp/Site	Treatment Facility	Description	Coordinates (UTM)	
			Easting	Northing
Mine Site	MS-01	MSC Wastewater Treatment Plant	561322	7913257
Mine Site	MS-01A	Polishing Waste Stabilizing Ponds	Not Constructed	Not Constructed
Mine Site	MS-01B	Sailiivik Camp Wastewater Treatment Plant	560798	7913291
Mine Site	MS-MRY-04	Exploration Camp Wastewater Treatment Plant	558141	7914427
Mine Site	MS-MRY-04A	Polishing Waste Stabilizing Ponds	558528	7914112
Mine Site	MS-MRY-04B	Polishing Waste Stabilizing Ponds	558447	7914275
Mine Site	MS-MRY-04C	Polishing Waste Stabilizing Ponds	558496	7914244
Milne Port	MP-01	PSC Wastewater Treatment Plant	503209	7976485
Milne Port	MP-01A	Polishing Waste Stabilizing Ponds	503625	7976015
Milne Port	MP-01B	380 Man Camp Wastewater Treatment Plant	503808	7975985
Steensby Port	SP-01	N/A	Not Constructed	Not Constructed
Steensby Port	SP-01A	N/A	Not Constructed	Not Constructed

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5.4 Sewage Treatment Process Description

The process description for the sewage treatment systems at each site are described in the sections that follow. Note that for design purposes, a per capita sewage generation rate of 344 L/person/day had been considered originally, which is higher than the per capita potable water consumption rate of 300 L/person/day. This was to ensure that the sewage treatment systems would have a higher design allowance. For consistency, 300 L/person/day is used for both potable water consumption and sewage generation. On average, sewage generated per person ranges from approximately 100 to 300 L/day. In addition, camp occupancy can be optimized based on potable water conservation measures that can be implemented to reduce per capita water consumption and reduce overall sewage generation rates.

5.4.1 Milne Port

The STP for the PSC Camp is an MBR facility that was installed in 2014. Raw sewage generated at the PSC Camp is pumped via lift stations and sewage lines to the MBR STP. A second MBR STP is adjacent to the 380-Person Camp.

Treated effluent from the MBR STP servicing the PSC Camp accommodations is stored in a series of treated effluent tanks. It is designed such that the effluent tank will be at a low-level during operation. This design allows for delay of discharge should sampling indicate that the effluent quality does not meet the applicable criteria. Such delay allows the effluent to be mixed, re-treated, and re-tested before discharge. Once sampling indicates that effluent meets discharge criteria, the treated effluent stream is directed to discharge via truck or pipeline to the ocean outfall discharge location (see Table 7 for coordinates). The discharge location at Milne Inlet is shown on the Milne Port Site Layout (Appendix C).

Should discharge of off-spec effluent be necessary from the treated effluent tanks due to volume, the off-spec effluent will be stored in the Milne Port Polishing Water Stabilization Pond (PWSP). The off-spec effluent will be removed by vacuum truck and fed into the sewage plant feed tank for re-processing or treated by means of a pond treatment system (i.e. Dissolved Air Flotation system). Should there be high volumes of off-spec effluent greater than the capacity of the existing PWSP, the Type A Water Licence allows for the construction of a second PWSP to be built at Milne

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Port. This second PWSP would work in parallel with the existing PWSP and be treated in the same manner.

In the event that there is an electrical power outage that causes the STP(s) to be completely inoperable, raw sewage may be diverted temporarily and trucked to the PWSP, until the STP(s) is operational. Partially or untreated sewage from the PWSP(s) from this event can either be trucked back to the STP(s) for treatment or treated in-situ at the pond location and discharged to the ocean outfall (refer to Appendix G - PWSP Effluent Discharge Plan). Discharges from PWSPs are monitored and treated as outlined in the PWSP Effluent Discharge Plan, which serves as a guideline for discharge decisions to ensure effluent discharged meets the applicable water quality criteria outlined in the Type A Water Licence. In the event that water treatment methods differ significantly from the PWSP Effluent Discharge Plan, BIM will seek third-party consultation to confirm the appropriate water treatment methods.

Sludge generated by the STP MBRs is de-watered using a mechanical de-watering device and a filter press and then incinerated or backhauled for disposal off site. Sludge generated from the STPs that is confirmed to be non-hazardous may be disposed in the Landfill Facility if approved by the Board in writing. Non-hazardous MBR sludge may also be used in biotreatment at the Landfarm Facility if confirmed through a bench-scale study that press cake material is suitable for use as an organic bulking and nutrient source for landfarming onsite. Prior to disposal, sludge is stored in an animal-proof secure area. Odour generation is limited as a result of the sludge being aerobically digested, de-watered, and double-bagged. Sewage sludge also accumulates in the bottom of the lift stations that service the accommodations camps. Regular maintenance of the lift stations includes periodic removal of the accumulated sewage sludge.

The sewage treatment system basis as described above is applicable for current construction and operational requirements. The site layout showing the location of camp, sewage treatment and ancillary facilities is presented in Appendix C.

5.4.2 Mine Site

The Mine Site has two MBR STP facilities to service the MSC and the Sailiivik Camp Complex. Effluent is discharged via a direct effluent discharge line from the STP

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servicing the Sailiivik Camp Complex and MSC to the approved discharge location near the Mary River. The Rotating Biological Contactor (RBC) STP (Seprotech manufactured), previously used to treat sewage from the Mine Site Weatherhaven (MWH), is currently being used as a potential temporary holding facility/surge tank for the MWH. Raw sewage is transported from the RBC by vacuum truck to the MBR STPs for treatment.

Treated effluent from the MBR STPs is stored in a series of treated effluent tanks. It is designed such that the effluent tanks will be at a low-level during operation. This design allows for delay of discharge should sampling indicate that effluent quality does not meet the applicable criteria. Such delay allows the effluent to be mixed, re-treated, and re-tested before discharge. Once sampling indicates that effluent meets discharge criteria, the treated effluent stream is directed to discharge via pipelines to the Mary River discharge locations; one pipeline from the MSC Camp MBR STP and one pipeline from the Sailiivik Camp MBR STP (refer to Table 7 for discharge co-ordinates). The discharge locations at the Mine Site are shown on the Mine Site Layout presented in Appendix C.

To reduce potential sedimentation and/or erosion, riprap (i.e., coarse aggregate) has been used at the approved Mary River discharge locations.

In the event that there is an electrical power outage that causes the STP(s) to become inoperable, raw sewage may be temporarily trucked to local existing PWSPs until the STP(s) come on line again. Partially or untreated sewage from the PWSPs from this event can either be trucked back to the treatment plant(s) for treatment/reprocessing or treated in situ at the pond location and discharged to the outfall (refer to Appendix G - PWSP Effluent Discharge Plan). Water quality parameters are monitored in the spring and a discharge plan is developed if needed based on the determined water quality conditions. Discharges from Project PWSPs are monitored and treated as outlined in the PWSP Effluent Discharge Plan, which serves as a guideline for discharge decisions, to ensure effluent discharged meets the applicable water quality criteria outlined in the Type A Water Licence. In the event that water treatment methods differ significantly from the PWSP Effluent Discharge Plan, BIM will seek third-party consultation to confirm the appropriate water treatment methods.

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Sludge generated at the STP MBR is dewatered using a mechanical dewatering device and filter press, and then incinerated or backhauled for disposal off site., Sludge generated from the STPs that is confirmed to be non-hazardous may be disposed in the Landfill Facility if approved by the Board in writing. Non-hazardous MBR sludge may also be used in biotreatment at the Landfarm Facility if confirmed through a bench-scale study that press cake material is suitable for use as an organic bulking and nutrient source for landfarming onsite. Prior to disposal, sludge cake is stored in an animal-proof secure area. Odour generation is limited as a result of the sludge being aerobically digested, de-watered and double-bagged. Sewage sludge also accumulates in the bottom of the lift stations that service the accommodations camps. Regular maintenance of the lift stations includes periodic removal of the accumulated sewage sludge.

The MBR STPs are also designed to process raw or partially treated sewage from the Ravn and Mid-Rail camps in the event these facilities are operational.

The sewage treatment system as described above is adequate for current construction and operations requirements. The modular nature of the plants makes it simple to add containerized plants for increased sewage treatment capacity. The site layout showing the location of camps, sewage treatment plants and ancillary facilities is presented in Appendix C.

5.4.3 Steensby Port

The operation of Steensby Port and associated railway infrastructure has not commenced to date. As a result, sewage treatment has not been initiated at the Steensby Port location. This Plan will be updated prior to the commencement of operations at Steensby Port and the associated railway to reflect planned water management and monitoring.

6. Wastewater Management – Oily Water and Operational Wastewater

Both the Mine Site and the Milne Port site generate oily water and operational wastewater. Oily water or operational wastewater generated from these locations is predominately collected from floor drains and collection sumps located within the vehicle maintenance facilities, waste management buildings, emergency response

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garages, and the vehicle wash bay facility, as well as surface water (i.e. precipitation) that accumulates within the bulk fuel storage berms, hazardous waste storage berms, and soil landfarm facilities.

Recycled water and use of reclaimed water from the various treatment facilities (STPs, OWSs, etc.), surface water management ponds, and embankment dams and approved discharge locations may be used if the water meets appropriate discharge criteria for those facilities, with the exception of TSS if the water is being used for dust suppression in areas of the Project where water reports to an MDMER regulated facility, containment pond, sump or does not have the potential to directly flow to a receiving water body.

BIM will notify the Board and the inspector at least ten (10) days prior to the commencement of discharge from any Oily Water/Wastewater facility associated with the Project. The notice will include estimated volume proposed for discharge and the location and description of the receiving environment.

Treated Oily Water/Wastewater effluent will be discharged at a distance of at least 31 m above the OHWM of any water body or watercourse or, where direct flow into a water body or watercourse is possible, so that surface erosion is minimized and additional impacts are avoided.

6.1 Oily Water and Operational Wastewater Treatment Discharge Criteria

Discharge from the OWS for monitoring stations MP-02, MS-02, and SP-02 must not exceed the following effluent quality limits provided in Table 8.

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Table 6.1 Effluent Quality Discharge Limits for Oily Water Treatment Facilities

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
pH	Between 6.0 and 9.5
TSS	30
Ammonia (NH3-N)	4.0
Total Phosphorous	4.0
Benzene	0.59
Ethylbenzene	0.07
Toluene	0.003
Xylene	0.07
Oil and Grease	15 and no visible sheen
Total Arsenic	0.60
Total Copper	0.60
Total Lead	0.20
Total Nickel	1.0
Total Zinc	1.0

Source: Type A Water Licence (2AM-MRY2540) Table 6.

All discharge from Bulk Fuel Storage Facilities must not exceed the following effluent quality limits outlined in Table 9. Associated discharge and environmental monitoring stations include MP-03, MP-MRY-7, MS-03, MS-03B, MS-04, MS-MRY-6, SP-04 and SP-05.

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Table 6.2 Effluent Quality Discharge Limits for Bulk Fuel Storage Facilities

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
Benzene	0.59
Ethylbenzene	0.07
Toluene	0.03
Xylene	0.07
Oil and Grease	15 and no visible sheen
Total Lead	0.20

Source: Type A Water Licence (2AM-MRY2540) Table 8.

All discharge from the soil Landfarm Facilities, including the Contaminated Snow Containment Berm, must not exceed the following effluent quality limits outlined in Table 10. Applicable discharge and monitoring stations include MS-05 and SP-06.

Table 6.3 Effluent Quality Discharge Limits for Landfarm Facilities

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
pH range	Between 6.0 and 9.5
TSS	30
Oil and Grease	15 and no sheen
Total Lead	0.20
Benzene	0.59
Toluene	0.03
Ethylbenzene	0.07
Xylene	0.07

Source: Type A Water Licence (2AM-MRY2540) Table 9.

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6.2 Oily Water and Operational Wastewater Potential Source Locations

Oily water and operational wastewater effluent discharge locations and environmental monitoring stations associated with the OWSs on the Project are listed in Table 11.

The discharge and associated environmental monitoring locations identified in Table 11 represent the location where the effluent verification sample is collected from a sampling port prior to discharge and release into the environment.

Note: OWS effluent is only released into the environment following confirmation that the laboratory analysis demonstrates the effluent meets the established discharge criteria as part of the commissioning process for the Mobile OWS.

Table 6.4 Oily Water/ Wastewater Potential Source Locations

Camp/ Site	Discharge/ Monitoring Locations	Facility	Coordinates (UTM)	
			Easting	Northing
Mine Site	MS-02	Mobile Maintenance Shop Sump	561638	7913222
Mine Site	MS-03	Bulk Fuel Storage Facility	561258	7913304
Mine Site	MS-03B	Bulk Fuel Storage Facility	561070	7913449
Mine Site	MS-04	Fuel Unloading Station	Not Constructed	Not Constructed
Mine Site	MS-05	Landfarm Facility	560800	7912700
Mine Site	MS-MRY-6	Exploration Camp Bulk Fuel Storage Facility	558309	7914487
Milne Port	MP-02	Mobile Maintenance Shop Sump	503785	7976209
Milne Port	MP-03	Bulk Fuel Storage Facility	503638	7976272
Milne Port	MP-04	Landfarm Facility	503710	7975574

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Camp/ Site	Discharge/ Monitoring Locations	Facility	Coordinates (UTM)	
			Easting	Northing
Milne Port	MP-04A	Contaminated Snow Facility	503862	7975482

6.3 Oily Water/Operational Wastewater Treatment Process Description

Oily water and operational wastewater generated by the Project sites shall be treated using the Oily Water/Wastewater Treatment Facilities as per conditions in Part F of the Type A Water Licence. The process description for the oily water/wastewater treatment systems located at each site is described in the sections that follow.

6.3.1 System Overview

The mobile OWS is a prefabricated system (Newterra Ltd., model OWS-24) housed in a 40’ seacan and is designed to remove oil, grease, and dissolved volatile compounds such as Benzene, Toluene, Ethylbenzene and Xylenes (BTEX), as well as Petroleum Hydrocarbon ispounds from hydrocarbon-contaminated water. The unit includes an American Petroleum Institute (API) type separator to remove free product, a bag filter for solids and sediment removal and three adsorption units (one clay, two granular activated carbon) for oil/grease and BTEX removal. Additional treatment using media filter drums is added to the end of the mobile OWS unit to remove any metals that may be associated with the contaminated water.

Figure 1 shows the Process Flow Diagram for the OWS when it is set-up for treating from surface water containment berms throughout the Project site. Figure 2 shows the Process Flow Diagram for the OWS when it is set up as a stationary treatment system. The OWS is sized for a water temperature of 7°C, specific gravity of 0.88 diesel/furnace oil, total oil and grease (TOG) concentration of 50 mg/L and flow rate of 50 gallons per minute (gpm). For the operation and maintenance procedures and schedule relating to the mobile OWS unit, refer to the BIM Mobile OWS Manual provided in Appendix H.

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The mobile OWS systems at both Milne Port and the Mine Site can be reconfigured for temporary stationary operations as shown in Figure 2, using storage tanks to contain the raw oily/operational waste water (i.e., influent) and the treated water within a heated facility, if required, to permit the year-round treatment of oily and operational wastewater. The treated water is tested prior to discharge to ensure the water quality meets the applicable discharge criteria prior to release to the environment.

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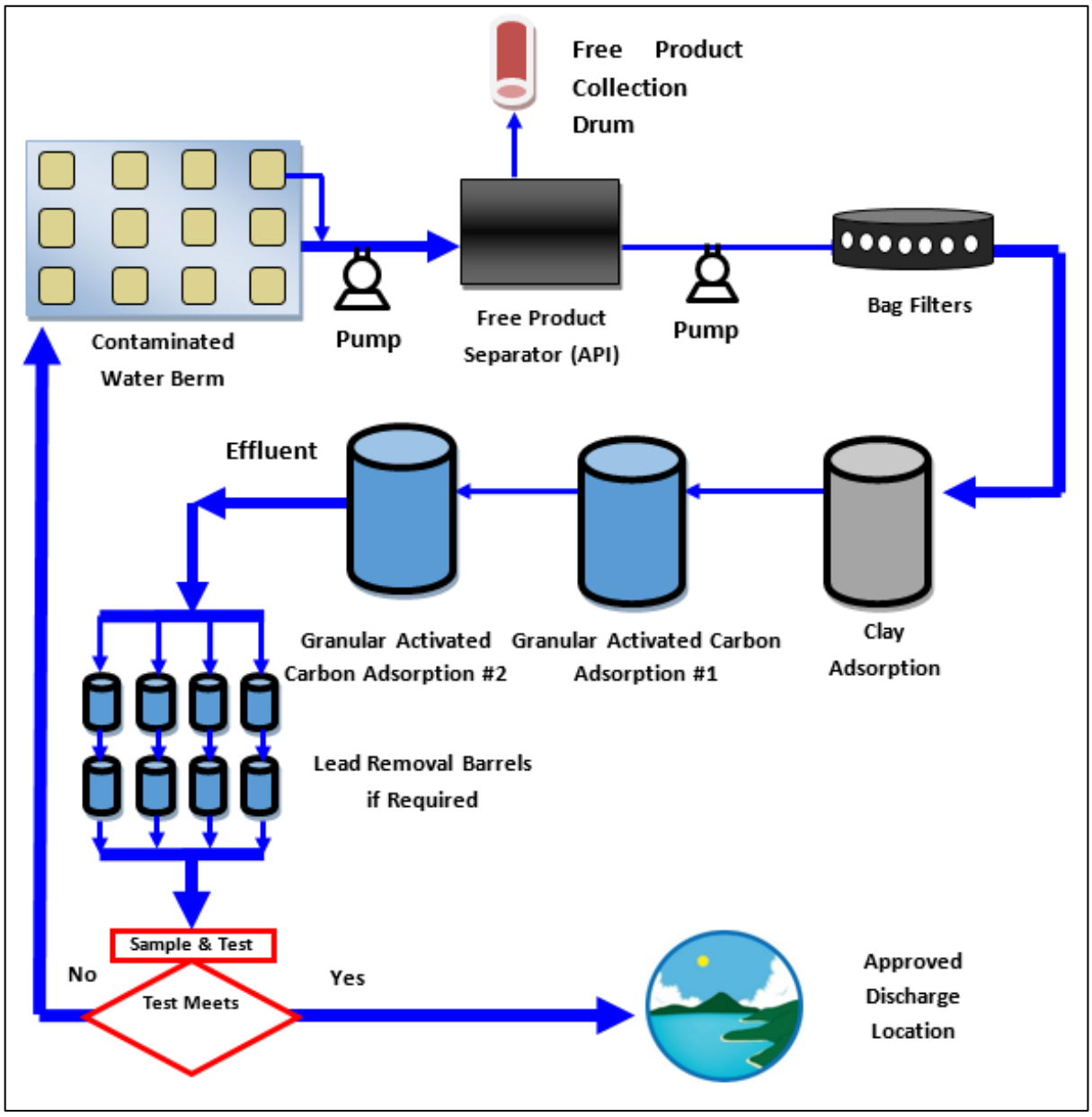

Figure 1 Mobile OWS Flow Process Diagram

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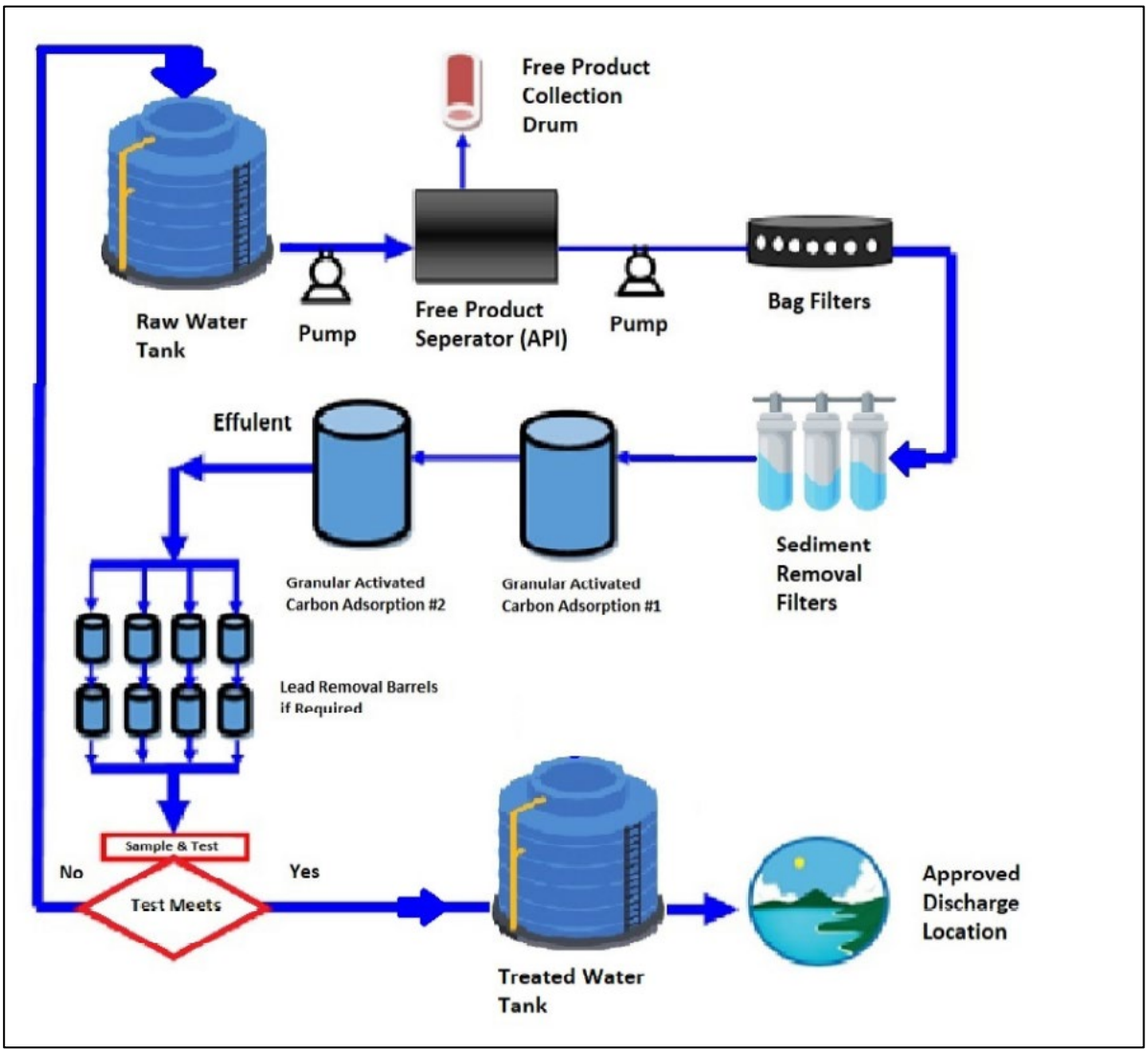

Figure 2 Mobile OWS Flow Process Diagram for Stationary Set-Up

6.3.2 Milne Port

Sources of oily water and operational wastewater that may be generated at the Milne Port site are:

- Vehicle maintenance and wash facilities (i.e., floor drains and concrete sumps in the Mobile Maintenance Shops (North/South), Toromont Shop and Contractor Maintenance Shop);

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- Bulk Fuel Facility (i.e., precipitation that accumulates in the sump of the lined containment berms);
- Concrete sumps in buildings such as the Waste Management Building, Emergency Response Building, etc.;
- Lined containment facilities (i.e., hazardous waste and bulk fuel storage facilities); and
- Landfarm Facility including the Contaminated Snow Containment Facility.

Collected oily storm water run-off from the Mine Site Bulk Fuel Storage Facility and/or other lined containment facilities will be treated using the mobile OWS system, if required, and discharged directly to the adjacent land surface.

Oily water generated at Milne Port is collected in surface water sump(s) within each facility. The water is then pumped from the sumps and treated directly by the prefabricated mobile OWS contained within a 40’ seacan. The prefabricated mobile OWS uses a series of skimmers, sediment filters, activated carbon media, and media filters to capture and remove hydrocarbons from oily water and/or wastewater generated from these containment areas. Effluent from the mobile OWS is sampled from a sampling port on the OWS system prior to being released to the environment. Laboratory results are compared to the applicable discharge criteria prior to effluent being released to the environment.

Oily water is removed from each facility as needed and is then transferred to an engineered lined containment facility or to the mobile OWS Raw Water tank. The Milne Port Mobile OWS stationary configuration is shown in Figure 2 in Section 6.3.1 of the Plan.

During winter, the mobile OWS system may be temporarily installed and operated at one of the Waste Management buildings to permit year-round treatment capacity.

Following treatment by the mobile OWS, the effluent is sampled to ensure the water quality meets the applicable discharge criteria before being discharged to the receiving environment.

Water that does not meet discharge criteria will be reprocessed to ensure it meets discharge criteria prior to discharge.

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All effluent discharges of treated oily water/wastewater from the mobile OWS to the receiving environment will be discharged to meet effluent discharge criteria outlined in Section 7.1.

6.3.3 Mine Site

Sources of oily water and operational wastewater that may be generated at the Mine Site are:

- Vehicle maintenance and wash facilities (i.e., floor drain and concrete sumps located in the Heavy-Duty Shop, Heavy Truck Maintenance Shop and Washbay, and Toromont Shop);
- Mine Site Bulk fuel storage facilities (i.e., precipitation collected in the lined tank farm containment areas);
- Waste Management Building, Emergency Response Building (i.e., floor drains and concrete sumps);
- Lined containment facilities (i.e., precipitation collected in the various hazardous waste and product storage berms); and
- Landfarm Facility (i.e., precipitation collected in surface water sumps).

Collected oily storm water run-off from the Mine Site Bulk Fuel Storage Facility and/or from other lined containment facilities or sumps will be treated via multi-stage settling, ammonia removal, filtering and hydrocarbon residual removal using the mobile OWS system, if required, and discharged directly to the adjacent land surface.

Oily water generated at the Mine Site is collected and then transferred to one of the designated lined hazardous waste containment facilities or to the MS OWS system (raw water tank). The Mine Site OWS configuration is shown in Figure 2 in Section 6.3.1 of the Plan.

During winter, the mobile OWS system may be temporarily installed and operated at one of the Waste Management buildings to permit year-round treatment capacity.

Following treatment by the mobile OWS, the effluent is sampled to ensure the effluent water quality meets the applicable discharge criteria before being discharged to the receiving environment.

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Water that does not meet discharge criteria will be reprocessed, transferred to the Mine Site PWSP for further treatment via the MBR, or treated in-situ prior to discharge. Wastewater generated that cannot feasibly be treated by the previously described means may be shipped off site for disposal at an accredited treatment facility in southern Canada.

6.3.3.1 Truck Wash Bays

The Truck Wash Facility (OHT Wash Bay) is equipped with a sediment treatment plant that removes sediment and solids and recycles the wash water within the system. The system also has trays and a sump to capture all wash wastewater generated at the facility, allowing it to recycle and thereby reduce the amount of freshwater used. Waste wash water produced in the truck wash facility (i.e. vehicle washing, equipment and floor wash down) will flow by gravity and be collected in the trays and a local sump. Suspended material in the wastewater is removed using a series of sumps, settling tanks (de-muck tank) and filters. The water is then reused by the facility to wash down equipment and vehicles.

Most water is recycled and reused within the facility. Accumulated suspended solids will be periodically removed by bucket loader vehicle and sent to the Landfarm Facility for treatment if contaminated with hydrocarbons or the landfill if demonstrated to be non-hazardous.

The Heavy Duty shop is equipped with an oily water treatment plant. The system also has trays and a sump to capture all wash water generated at the facility, allowing it to recycle and thereby reduce the amount of freshwater used. Wash water produced in the truck wash facility (truck washing, equipment and floor wash down) will flow by gravity and be collected in the trays and a local sump. Suspended material in the wastewater is removed using a series of sumps, settling tanks (de-muck tank) and filters. Free and emulsified oil in the wastewater is removed by the facility's oily water treatment plant, which utilizes a series of skimmers, activated carbon, and filters to substantially reduce oil levels in the recycled wastewater. The water is then reused by the facility to wash down equipment and vehicles. Should there need to be a discharge from the facility to the receiving environment, the wastewater is further treated as described in Section 6.3.3, to ensure the final effluent meets discharge criteria outlined in the Type A Water Licence.

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Treated compliant effluent from the truck wash bays/oily water treatment plant will be sampled and flow recorded as per the water license. The separated waste oil will be stored in a local tank. Periodically, the oil from the tank will be drained and shipped off site. Accumulated suspended solids will be periodically removed and sent to the Landfarm Facility for treatment if contaminated with hydrocarbons or the landfill if demonstrated to be non-hazardous.

6.3.4 Steensby Port

The operation of Steensby Port and associated railway infrastructure has not commenced to date. As a result, oily water treatment has not been initiated at the Steensby Port location. This Plan will be updated prior to the commencement of operations at Steensby Port and the associated railway to reflect planned water management and monitoring.

7. Wastewater Management – Contact Water

Contact water for the purposes of this Plan is defined as water that has come in contact with ore or waste rock; it is considered equivalent to mine effluent as defined under the MDMER. The water management ponds described in the sections below retain runoff water from the Milne Port ore stockpile pad and the Mine Site crushing pad, KM 106 Ore (KM106) Stockpile, Mine Haul Road (MHR) and the waste rock Facility (WRF). In the event of abnormal conditions at an existing surface water management pond, BIM may consult an engineer for recommendations on required improvements or upgrades.

7.1 Discharge Criteria

All discharge from the surface water management ponds and infrastructure (MS-06, MS-07, MS-08, MS-09, MS-10, MS-11, and MS-12) associated with the Project's mining operations (crushing, ore, and waste rock stockpiles) must not exceed the effluent quality limits outlined in the Type A Water Licence and provided in Table 12.

In addition, effluent discharged from surface water management ponds at the Mine Site (MS-06, MS-07, MS-08, MS-09, MS-10, MS-11 and MS-12) must not exceed the effluent quality limits within the MDMER provided in Table 13.

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Table 7.1 Effluent Quality Discharge Limits for Open Pit, Stockpiles, and Surface Water Management Ponds

Parameter	Maximum Monthly Mean Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
Total Arsenic	0.30	0.60
Total Copper	0.30	0.60
Total Lead	0.10	0.20
Total Nickel	0.50	1.0
Total Zinc	0.50	1.0
Total Suspended Solids	15	30
Oil and Grease	No visible sheen	
Toxicity	Not acutely toxic	
pH	6.0 – 9.5	

Source: Type A Water Licence (2AM-MRY2540) Table 10.

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Table 7.2 Effluent Quality Discharge Limits for Open Pit, Stockpiles, and Surface Water Management Ponds

Parameter	Maximum Authorized Monthly Mean Concentration (mg/L)[1]	Maximum Concentration of Any Grab Sample (mg/L)
Total Arsenic	0.30	0.60
Total Copper	0.30	0.60
Total Lead	0.10	0.20
Total Nickel	0.50	1.00
Total Zinc	0.50	1.00
Total Suspended Solids	15	30
Radium-226	0.37 Bq/L	1.11
pH	6 – 9.5	
Toxicity	Not acutely toxic	
Un-ionized Ammonia	0.50	1.00

Source: Metal and Diamond Mining Effluent Regulations, Schedule 4

Additional parameters are also required under MDMER, however these parameters do not have a maximum water quality discharge limit but instead are used to provide additional information to assist in interpreting toxicity results and identifying potential effects on the receiving environment. For additional information on the MDMER requirements pertaining to the Project refer to Appendix K.

7.2 Contact Water Facility and Discharge Locations

BIM will notify the Board and the Inspector at least ten (10) days prior to the commencement of discharge from any contact water treatment facility associated with the Project. The notice will include estimated volume proposed for discharge and the location and description of the receiving environment.

Recycled water and use of reclaimed water from the various treatment facilities (STPs, OWS, etc.), surface water management ponds, and embankment dams and approved discharge locations may be used if the water meets appropriate discharge criteria for those facilities, with the exception of TSS if the water is being used for

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dust suppression in areas of the Project where water reports to a MDMER regulated facility, containment pond, sump or does not have the potential to directly flow to a receiving water body.

Treated contact water effluent will be discharged at a distance of at least 31 m from the OHWM of any water body or watercourse or, where direct flow into a water body or watercourse is possible, so that surface erosion is minimized and additional impacts are avoided.

The locations of the contact water management facilities and their respective discharge points are listed in Table 14.

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Table 7.3 Location of Water Management Facilities

Site	Facility	Description	Facility Coordinates (UTM)		FDP Coordinates (UTM)	
			Easting	Northing	Easting	Northing
Mine Site	MS-06	Crusher Pad Stormwater Facility	561475	7913000	561474	7913000
Mine Site	MS-07	Run Of Mine Stockpile Stormwater Facility	563475	7913058	563583	7913074
Mine Site	MS-08	Waste Rock Stormwater Facility	562901	7916776	563217	7916789
Mine Site	MS-09	Waste Rock Stormwater Facility	Not Constructed	Not Constructed	N/A	N/A
Mine Site	MS-11	KM105 Facility Stormwater	562250	7913150	TBD	TBD
Mine Site	MS-12	570 Dewatering Sump	TBD	TBD	TBD	TBD
Milne Port	MP-05	Ore Stockpile Stormwater Facility	503469	7976383	N/A	N/A
Milne Port	MP-06	Ore Stockpile Stormwater Facility	503097	7976363	N/A	N/A
Steensby Port	SP-07	Steenby Ore Stockpile Stormwater	N/A	N/A	N/A	N/A

FDP: Final Discharge Point

7.2.1 Milne Port Stockpile Surface Water Management Ponds

The three Milne Port stockpile surface water management ponds were constructed to retain the runoff water from the Milne Port ore stockpile area and to contain the sediment load.

During normal operation, runoff from the stockpile area drains to the stockpile surface water management ponds. The ponds were designed with sufficient retention time to

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ensure the sediment will gravity-settle to the bottom of the pond and allow the runoff to be tested before the water reaches the overflow weirs. The ponds are equipped with an overflow spillway designed to allow the unloaded surface water to drain through a controlled discharge to Milne Inlet. Alternatively, the pond can be pumped out using a portable pump arrangement.

In the case that the surface water management pond effluent quality does not meet the discharge criteria outlined in the Type A Water Licence by means of sediment gravity settling alone, additional treatment methods will be employed to ensure effluent compliance.

7.2.2 Mine Site Ore Crusher Pad Surface Water Management Pond

The Mine Site ore crusher pad surface water management pond is designed to retain the runoff water from the Mine Site Crusher Facility (CF) and contain the sediment load, particularly during seasonal freshet activities. During normal operation, runoff from the crusher area drains to the surface water management pond (west of the crusher pad). The pond is equipped with an overflow weir designed for extreme weather periods (e.g. greater than a 1 in 10 year, 24-hour design storm), allowing the unloaded surface water to drain through a controlled discharge to Sheardown Lake. The pond was designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond before the water reaches the overflow spill way.

The pond is also equipped with a pump pad on the northwest side. The normal operation of the pond is to test the water quality for MDMER and applicable Type A Water Licence requirements and, when on spec, control discharge using a portable pump arrangement. The pump arrangement connects into a dedicated effluent discharge pipeline for discharge to Mary River.

In the case that the surface water management pond effluent quality does not meet the applicable discharge criteria by means of sediment gravity settling alone, additional treatment methods will be employed to ensure effluent compliance. Chemical addition to control pH as required prior to discharge may be required. Additional contingency exists to transfer non-compliant water from this facility to the KM105 Surface Water Management Pond and/or the Mine Site ROM Stockpile Surface Water Management Pond for additional settling/treatment.

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7.2.3 Mine Site KM106 Ore Stockpile Surface Water Management Pond

The Mine Site KM106 stockpile infrastructure supports Deposit No. 1 mining operations and is located off the MHR at approximately kilometer 106. Stormwater runoff originating in the KM106 stockpile is intercepted by the Facility's perimeter collection ditches and directed to the KM106 pond. The KM106 pond is designed to retain the runoff and contain the sediment load, particularly during freshet activities. During normal operation, runoff from the KM106 stockpile drains to the surface water management pond. The pond is equipped with an overflow weir designed for extreme weather periods (e.g. greater than a 1 in 200 year, 24-hour design storm), allowing the unloaded surface water to drain through a controlled discharge to Mary River.

In the case that the surface water management pond effluent quality does not meet the applicable discharge criteria by means of sediment gravity settling alone, additional treatment methods will be employed to ensure effluent compliance.

7.2.4 Mine Site Waste Rock Facility Surface Water Management Pond

The Waste Rock Facility (WRF) Surface Water Management Pond (WRF Pond) was constructed to support Deposit No. 1 mining operations and is located northeast of the Deposit No. 1 open pit. Seepage and stormwater runoff originating from the Waste Rock Stockpile is intercepted by the Facility's perimeter collection ditches and directed to the WRF Pond. The WRF Pond for the Mine Site was constructed in 2016 and is designed to retain surface water runoff. The capacity of the pond was upgraded in 2019 to account for an expansion of the Waste Rock Facility. Controlled transfers of in-pit mine water to the WRF Pond for treatment through the Water Treatment Plant (WTP) may also occur in accordance with BIM's Surface Water and Aquatic Ecosystem Management Plan (SWAEMP).

Water from the WRF Pond is pumped into the WTP for pH adjustment and subsequently discharged into a geotube adjacent to the WTP for solids removal via filtering and settling. The WTP has a design treatment rate of 280 m3/hr capacity, consisting of two 140 m3/hr treatment trains. For each train, the water flow rate and pH in Reactor Tanks 1 and 2 are continuously monitored. Ferric sulphate and polymer are added based on flow rate, while the lime dosage is based on the pH in Reactor Tank 1. The chemical dose rate is adjusted by the plant operator using the PLC to achieve water quality requirements. Monitoring of the treated effluent at various stages of the treatment

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system is conducted to monitor the treatment system's performance. The Waste Pond Water Treatment Plant Operations SOP, which includes plant operating procedures as well as an overview of the treatment process, and General Arrangement Drawings is provided in Appendix J. Additional contingency water treatment measures are described in Section 9.2 of the Phase 1 Waste Rock Management Plan.

The effluent from the geotube is tested to ensure it meets MDMER and applicable Type A Water Licence criteria and then controlled discharged intermittently using a portable pump arrangement. Sludge generated from the operation of the WRF WTP is assessed for suitability of disposal within the WRF or disposed of off-site at an appropriate waste receiving facility. Following the FDP, effluent is discharged to the tundra of the approved receiving environment, the Mary River watershed.

In high rainfall periods (e.g. greater than a 1 in 10 year, 24 hour design storm), the WRF Pond is also equipped with an overflow weir on the north side designed to allow the unloaded surface water to drain through a controlled discharge diversion channel. The WRF Pond was designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond before the water reaches the overflow weir. However, controlled discharges from the pond via active pumping are implemented.

7.2.5 KM105 Surface Water Management Facility

The KM105 Surface Water Management Facility (KM105 Facility) is located north of the KM104 laydown and treats storm water and snow melt runoff originating from the MHR. Storm water and snowmelt runoff originating from the MHR is collected in a ditch that runs along the MHR and is directed to the KM105 surface water management pond during the open-water season.

The facility currently employs a number of treatment processes to ensure effluent quality meets the prescribed Water Licence and MDMER criteria. The current treatment system consists of a chemical dosing system at the inlet of the facility for the addition of flocculent, coagulant, as well as lime for pH control, as required. The flocs this system generates are then captured in a series of rock filter berms which have been constructed with the KM105 facility containment; allowing for filtration through the berm. The treated water then flows into an existing pond downstream

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which serves to further enhance the settling of any remaining fine sediments. This is achieved through the addition and maintenance of silt curtains, if required. An engineered structure will be the final control point where effluent quality and flow are monitored and recorded.

The effluent from this facility then travels overland into Sheardown Lake Tributary-1 (SDLT-1) and into Sheardown Lake. The estimated length of the flow path from MS-11 to Sheardown Lake is 1.5 km via SDLT-1.

Monitoring of water quality from the KM105 Facility is conducted as required to ensure it meets the requirements prescribed in the Water Licence. Regular inspections will occur along with the inspections of waste and water retention structures on site. Regular geotechnical inspections are also conducted annually by a geotechnical engineer, annually.

7.2.6 Deposit 1 Pit Runoff Water Management

A new proposed FDP to monitor discharge of clean snowmelt and stormwater collected within the Mine pit footprint at the Mary River Mine Site will be submitted to the Water Board and ECCC prior to freshet in 2026. Water collected from large sumps within the mine pit is normally pumped via pipeline to the WRF Storage Pond (MS-08) for settling and treatment. In anticipation of higher than usual snowfall in 2026 and associated increases in snowmelt volumes reporting to MS-08, BIM will segregate mine pit sump water suitable for direct discharge and convey it via a dedicated pipeline to the receiving environment, thereby reducing hydraulic loading on MS-08. The new FDP, which will be referred to as Monitoring Station-12 (MS-12), will represent the Project's fifth federal compliance monitoring station.

Water will be collected in large sumps within the mine pit. The main discharge sump within the pit (570 Sump) has been designed and meets the requirements of Technical Guidance 7 – Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining (British Columbia Ministry of Environment, 2015).

Runoff collected in the 570 Sump will be treated for solids removal via sump-based settling prior to discharge at the MS-12 FDP. Effluent will be pumped from the sump through the FDP using centrifugal pumps(s) and conveyed through an 8-inch HDPE pipeline. Discharge from MS-12 will report to the Mary River Tributary F system

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(similar to, but downstream of where MS-08 discharges). During the 2026 freshet, a rockfill splash pad will be installed at the discharge location for erosion and sediment control (ESC) and discharge flow will be adjusted based on field observations. For the 2027 freshet, the 8-inch HDPE pipeline will be extended to discharge closer to or directly into the channel to further reduce potential for erosion. During the summer season, water retained in the 570 Sump will either be used for dust suppression within the Mine footprint or pumped to the 110 Pond for additional management, as required.

7.2.7 Steensby Port Contact Water Management

The operation of Steensby Port and associated railway has not commenced to date. As a result, contact water management has not been initiated. This plan will be updated prior to the commencement of operations at Steensby Port and the associated railway to reflect planned water management and monitoring.

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8. Landfill

8.1 Discharge Criteria

Runoff and seepage from the Landfill Facilities at monitoring stations MS-MRY-13A and MS-MRY-13B must not exceed the effluent quality limits presented in the table below:

Table 8.1 Effluent Quality Discharge Limits for Landfill Facilities

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
pH range	Between 6.0 and 9.5
Total Arsenic	0.6
Total Copper	0.6
Total Lead	0.2
Total Nickel	1.0
Total Zinc	1.0
TSS	30
Oil and Grease	No visible sheen

Source: Type A Water Licence (2AM-MRY2540) Table 7.

8.2 Mine Site Landfill

The Mine Site Landfill Facility is located just south of the NE Basin of Sheardown Lake. Both monitoring stations, MS-MRY-13A and MS-MRY-13B, are sampled monthly during the open water season and are situated on a small stream downgradient of the Landfill Facility. The small stream drains into the NE Basin of Sheardown Lake on its southern shoreline. Refer to the Mine Site Layout presented in Appendix C for the exact location of the monitoring stations and Landfill Facility.

9. Potable Water

The Sample plans for operation and maintenance of the potable water systems are outlined below.

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9.1 Regular Maintenance Schedule

The potable water system is fully automatic and only requires limited supervision and regular maintenance. The following maintenance schedule provided in Table 16 is subject to regulations from local government, and instructions from original equipment manufacturers. The following maintenance schedule is common for all potable treatment plants.

Table 9.1 Recommended Maintenance Schedule – Potable Treatment Plants

Items	Description
Daily	• Alarm check. • Chemical storage level check. • Controller time check. • Pressure gauge check. • Total and free chlorine testing. • Turbidity check.
Monthly	• Turbidity analyzer check/calibration. • Residual chlorine/pH analyzer check/calibration.
Annual	• Filter media level check, and refill if required. • UV lamp replacement.

9.2 Monitoring Plan

Untreated freshwater will be sampled at active intake locations and/or from the raw water tank at the potable treatment plants. Treated potable water will be sampled as well as several locations throughout the distribution system.

The monitoring plan is subject to local regulations of drinking water and other related codes. The following instruments are used to monitor the operation and performance of the potable water system.

- Inlet flow meter: to monitor feed flow, backwash flow, rinse flow and filtered flow;
- Effluent turbidity analyzer: to monitor turbidity in produced water; and,

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- Effluent pH/residual chlorine analyzer: to monitor pH and residual chlorine of produced water.

The PLC system in the control panel will totalize raw water, produced water, backwash water, chemical injection, pump-running time etc.

Periodic sampling and lab tests for raw water and treated water will be applied to ensure the treated water meets drinking water standards. The frequency of the sampling and testing will be determined by the ministry and outlined in the certificate of approval.

Currently samples are collected at active water take locations for select analyses at frequencies specified in applicable regulations/guidelines. A typical list of parameters which are tested includes the following:

Calcium, Magnesium, Sodium, Potassium, Aluminum, Arsenic, Boron, Barium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Vanadium, Zinc, Tin, pH, Conductivity, Alkalinity as $CaCO_3$, total dissolved solids (TDS), TSS, Turbidity, Phenols, NH_3, sulfate (SO_4), Cl, Br, nitrite (NO_2), nitrate (NO_3), Mercury, Hardness as $CaCO_3$, chemical oxygen demand (COD), BOD5, and Oil and Grease.

Sampling results are compared to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

10. Contingency Measures

Design criteria for the sewage and oily water treatment systems and discharge criteria for surface water management ponds have been reviewed and revised to provide additional safety factors.

To effectively manage emergency responses, BIM has adopted a tiered emergency classification scheme (Figure 2). Each level of emergency, based on its severity, requires varying degrees of response, effort, and support. Each level has distinct effects on normal business operations, as well as requirements for investigation and reporting. Levels of classification specific to spill response are as follows:

Level 1 (Low) – Minor accidental release of a deleterious substance with:

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- No threat to public safety; and/or
- Negligible environmental impact to receiving environment.

Level 2 (Medium) – Major accidental release of a deleterious substance with:

- Some threat to public safety; and/or
- Potential Moderate environmental impact to receiving environment

Level 3 (High) – Uncontrolled hazard which:

- Jeopardizes project personnel safety: and/or
- Potential significant environmental impacts to receiving environment.

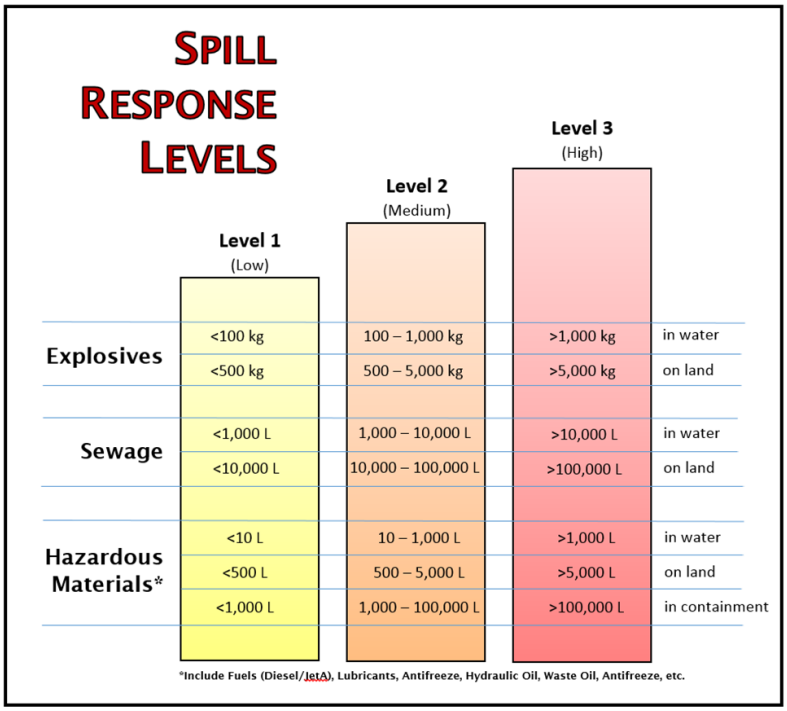

Figure 3 Emergency Spill Response Levels

The sewage treatment systems are set back sufficiently from surface water bodies and are fully enclosed units. In the event of a spill of untreated or partially treated sewage from these facilities, BIM will follow the procedures in its Spill Contingency Plan (SCP) and Emergency Response Plans. In the event that sewage discharge

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does not meet applicable discharge criteria, raw sewage will be temporarily trucked to the existing PWSPs or to another on-site STP for treatment. Partially or untreated sewage from the PWSPs from this event can either be trucked back to the STP(s) for treatment or treated in-situ at the pond location (refer to Appendix G - PWSP Effluent Discharge Plan). The PWSP Effluent Discharge Plan is used as a reference guideline by the on-site environmental team. Water quality parameters are monitored in the spring, and a discharge plan is developed if needed based on the determined water quality conditions. Discharges from Project PWSPs are monitored and treated as outlined in the PWSP Effluent Discharge Plan to ensure effluent discharged meets the applicable water quality criteria outlined in the Type A Water Licence. In the event that water treatment methods differ significantly from the PWSP Effluent Discharge Plan, BIM will seek third-party consultation to confirm the appropriate water treatment methods.

Effluent from the mobile OWS is sampled regularly to ensure effluent quality meets the applicable discharge criteria outlined in the Type A Water Licence. In the case of an accidental spill of oily water, Baffinland will follow the procedures in its SCP and Emergency Response Plans. In the event of a release of oily water in exceedance of applicable discharge criteria, discharge will be ceased immediately, and treatment options will be evaluated. Prior to resuming discharge, resampling will occur to ensure effluent water quality meets the applicable discharge criteria before the effluent is finally discharged to the receiving environment.

Surface water management ponds are discharged in adherence to the MDMER and Type A Water Licence discharge criteria. Workers involved in the pumping operations exercise caution when setting up and operating pumps on the pond liners. While installing the pump’s intake hose on an inner tube in a pond, workers will be in particularly close proximity to the water. The workers should ensure they have dry, secure footing while performing this task. When compliant results are received from pre-discharge water samples, surface water management ponds can be discharged.

Discharge is discontinued if internal or external results are approaching or exceed applicable water quality criteria. In the event of a spill of non-compliant water, Baffinland will follow the procedures in its SCP and Emergency Response Plans. In cases where water retained in water management infrastructure is determined to be non-compliant with applicable discharge limits, retained water (effluent) will be

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treated as per this Plan, the Phase 1 Waste Rock Management Plan, Waste Pond Water Treatment Plant Operations and MDMER ERP (BIM-5200-PLA-003) to ensure compliance with the applicable discharge limits. Potential treatment options include use of temporary treatment systems to alter water chemistry with various mixing and dosing components, arranging equipment on the discharge end of the pump/discharge to provide final polishing before the water enters the receiving environment, or incorporation of additional treatment steps to ensure effluent water quality is compliant.

In the event that a containment facility is at risk of over-topping, pond to pond transfer will occur in order to safely lower the levels of a facility. Only containment facilities under MDMER regulations will be used to accept other MDMER regulated facilities. As a result, all effluent under MDMER regulations will still report to regulated FDPs for monitoring and treatment.

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11. Monitoring

Generally, monitoring of the potable and wastewater treatment systems include the following:

- Regular sampling of sewage and wastewater discharge in accordance with the Type A Water Licence requirements;
- More frequent internal process sampling and monitoring to identify potential upset conditions early that could potentially lead to non-compliance;
- Recording of volumes of sewage and wastewater effluent discharged and sludge generated in accordance with the Type A Water Licence requirements;
- Completion of daily checklists related to O&M requirements for the facilities and reporting of any upset conditions that require action; and,
- Implementation of the AEMP to confirm/validate environmental predictions.
- Weekly inspections of the waste and water retention structures

12. Adaptive Management

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes (Canadian Environmental Assessment Agency, 2016). Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project.

BIM has developed a draft Adaptive Management Framework (AMF) that provides the framework by which adaptive management is to be incorporated into Project operations (BIM, 2020). The Project-wide adaptive management process begins with a planning phase, followed by iterative phases of implementing and monitoring the actions included in the plan(s), evaluating the effectiveness of actions included in the plans based on results of monitoring and other feedback mechanisms, and adjusting management strategies and actions and responses based on monitoring. The cycle begins anew with implementation and monitoring of a revised plan, which integrates the outcomes of the previous cycle. This cycle can occur in real-time or over an extended period according to the nature of the situation or area of focus. In this way, a properly designed and well-implemented adaptive management process

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progressively diminishes uncertainty, as management strategies and processes are refined throughout a project's operational lifecycle.

Monitoring and responding to effects in the short-term is addressed in a Trigger Action Response Plan (TARP) described in Table 17. The TARP identifies the pre-defined actions to be taken should threshold levels be exceeded. Longer term review of and response to monitoring data is addressed in an annual review of plan effectiveness in Section 13.

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Table 12.1 Fresh Water Supply, Sewage, and Wastewater Trigger Action Response Plan

Project Activity	Objectives	Performance Indicators	Monitoring Program / Plan	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Domestic and industrial water withdrawals	Protect fish and fish habitat during water withdrawal activities	Volume of water withdrawn (m^3/day)	SNP; monitoring requirements of Public Water Supply Regulations	Water withdrawals below the withdrawal limits prescribed in the Type A Water Licence (Table 3.7).	Water withdrawals exceed the limits prescribed in the Type A Water Licence (Table 3.7). The weekly average remains within the authorized limit.	Water withdrawals exceed the thresholds presented in Table 3.1 (>10% of the lake outflow and/or the winter withdrawal is >10% of the under-ice lake volume.	No action required.	Env't Dept: Notify Site Services and determine reason for exceedance. Notify the NWB in the monthly report. Work with Site Services to determine the need for a WL amendment. Site Services Dept: Report the exceedance to the Env't Dept. Determine root cause of exceedance and adjust activities to reduce water use to be within approved limits.	Env't Dept: Direct stoppage of all non-essential water use. Assess if the exceedance may have resulted in impacts to fish and fish habitat. Report exceedance of threshold in the following NWB monthly report, and the assessment of impacts in the annual report. Site Services Dept: Cease all non-essential water use to reduce water consumption to below thresholds. Determine root cause and take corrective action to avoid future overuse.
Dust suppression water		Volume of water withdrawn (m^3/day) from lakes. Rate of water withdrawal (m^3/s) from rivers.	SNP; Detailed Water Withdrawal Plan; Type A Water Licence	Below water withdrawal limits prescribed in the Type A Water Licence (Table 3.8).	Exceed water withdrawal limits prescribed in the Type A Water Licence (Table 3.8). The weekly average remains within the authorized limit.	Water withdrawals exceed the thresholds presented in Table 3.1 (>10% of the instantaneous flow).	No action required.	Env't Dept: Notify the Roads and/or Projects Depts of the exceedance. Review the pumping rates used by the water trucks and determine if a lower pumping rate is required. Include the exceedance in the monthly report to the NWB. Roads/Projects Dept: Report the exceedance to the Env't Dept (if the Env't Dept is not already aware). Cease water withdrawal from sites which have exceeded the authorized limits. Determine route cause of exceedance and adjust activities to reduce water use to within approved limits.	Env't Dept: Direct Roads/Projects Dept(s) to adjust daily withdrawals to within authorized limits, and/or flow rates to below 10% threshold. Notify the QIA, and report exceedance of threshold in the following monthly report. Roads/Projects Dept: Cease water withdrawal until a plan is developed to ensure water take is within authorized volumes and/or rates.
Geotechnical drilling and exploration		Volume of water withdrawn (m^3/day) from lakes. Rate of water withdrawal (m^3/sec) from rivers.	SNP (Type B Water Licence)	Below water withdrawal limits prescribed in the Type B Water Licence (Section 3.4).	Exceed water withdrawal limits prescribed in the Type B Water Licence (Section 3.4). The weekly average remains within the authorized limit.	Water withdrawals exceed the thresholds presented in Table 3.1 (>10% of the instantaneous flow).	No action required.	Env't Dept: Notify the Geology Dept of the exceedance. Include the exceedance in the monthly report to the NWB. Geology Dept: Report the exceedance to the Env't Dept (if the Env't Dept is not already aware). Cease water withdrawal from sites which have exceeded the authorized limits. Determine route cause of exceedance and adjust activities to reduce water use to within approved limits.	Env't Dept: Direct Geology Dept to adjust flow rates to below 10% threshold. Notify the QIA, and report exceedance of threshold in the following monthly report. Geology Dept: Cease water withdrawal (drilling) where exceedance occurred until a plan is developed to ensure water take is within authorized volumes.

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Project Activity	Objectives	Performance Indicators	Monitoring Program / Plan	Condition Status / Threshold			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Treated sewage effluent	Maintain receiving environment water quality	BOD_5, COD, TSS, faecal coliform, oil and grease, pH, ammonia (NH3-N), total phosphorus and acute toxicity	SNP	Treated sewage effluent exceeds Baffinland's Internal Discharge Limits for any of the performance indicators (Table 3.2).	Treated sewage effluent exceeds the Water Licence Discharge Limits for any of the performance indicators (Table 3.2).	Sustained[2] non-compliance (exceedance of Water Licence Discharge Limits).	Env't Dept: Continue to monitor. Site Services Dept: Delay discharge (if possible) and divert off-spec sewage to the PWSP for additional management. Refer to the PWSP (Appendix E) for possible treatment methods.	Env't Dept: Conduct a risk evaluation as to proceed with discharge. Site Services Dept: Delay discharge (if possible) and divert off-spec sewage to the PWSP for additional management. Refer to the PWSP (Appendix E) for possible treatment methods.	Env't Dept: Implement the Spill Contingency Plan and notify the NWB and QIA. The Emergency Response Plan (ERP) will be implemented if the spill is Level 2 or 3 (Section 3.8). Notify the NWB and the QIA. Site Services Dept: Investigate the cause and identify additional contingencies and assess the need for modifications to the treatment system.
Contact water management		As, Cu, Pb, Ni, Zn, TSS, oil and grease, pH, radium-266, un-ionized ammonia aquatic toxicity.	SNP and MDMER	Contact water exceeds Baffinland Internal Discharge Limits for any of the performance indicators (Table 3.3).	Contact water exceeds Water Licence Discharge Limits and/or MDMER Schedule 4 and 5 limits for any of the performance indicators (Table 3.3).	Sustained[2] non-compliance (exceedance of Water Licence and/or MDMER Discharge Limits).	Env't Dept: Conduct risk evaluation on whether to proceed with discharge. Mine Operations Dept: Cease discharge unless directed otherwise by the Env't Dept.	Env't Dept: Determine if discharge can be delayed. Mine Operations Dept: Cease discharge unless directed otherwise by the Env't Dept.	Env't Dept: Implement the Spill Contingency Plan and notify the NWB and QIA. The Emergency Response Plan (ERP) will be implemented if the spill is Level 2 or 3 (Section 3.8). Notify the NWB and the QIA. Site Services Dept: Investigate the cause and identify additional contingencies and assess the need for an amendment to the Type A Water Licence.
Oily water management from oily water separators, bulk fuel storage facilities, and landfarms		pH, TSS, ammonia, phosphorous, benzene, ethylbenzene, toluene, oil and grease, As, Cu, Pb, Ni, and Zn	SNP	Oily water is below discharge limits for all performance indicators (Tables 3.4, 3.5 or 3.6).	Oily water exceeds discharge limits for one or more performance indicator (Tables 3.4, 3.5 or 3.6).	Oily water is discharged to the environment despite exceeding discharge limits for one or more performance indicator (Tables 3.4, 3.5 or 3.6).	Env't Dept: Communicate acceptable effluent quality for discharge to Site Services Dept. Site Services Dept: Discharge effluent.	Env't Dept: Communicate unacceptable effluent quality for discharge to Site Services Dept. Operations Dept: Delay discharge and treat effluent. Transfer to a PWSP as a temporary measure if required.	Env't Dept: Implement the Spill Contingency Plan and notify the NWB and QIA. The Emergency Response Plan (ERP) will be implemented if the spill is Level 2 or 3 (Section 3.8). Notify the NWB and the QIA. Site Services Dept: Investigate the cause and take corrective action to prevent another unauthorized discharge from occurring.

NOTES:

1. Immediately means without delay, understanding that there could be competing urgent work or emergencies that may affect this response time.
2. Sustained refers to exceedances that continue to occur despite application of mitigation measures and pre-defined response

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13. Review Of Plan Effectiveness

An important element of Baffinland's management system is reviewing the continued suitability, adequacy and effectiveness of each management plan. This will occur through an annual review process as well as scheduled updates.

14. Responsibilities

Role	Responsibility
Executive Vice President / Vice President, General Manager Operations	• Reports to the Chief Executive Officer • Responsible for providing oversight for all Project operations and allocating the necessary resources for the operation, maintenance and management of Project infrastructure.
Mine Operations Superintendent/ Manager	• Reports to the General Manager • Provides oversight for all Deposit No. 1 mining operations, including the operation, construction and maintenance of water and waste management infrastructure at Deposit No. 1 mining areas, ROM stockpile, KM105 Pond, Waste Rock Facility and along the Mine Haul Road, including culverts, ditches, surface water management ponds and associated water treatment systems.
Crusher Superintendent/ Manager	• Reports to the General Manager • Provides oversight for all ore crushing operations, including the operation, construction and maintenance of surface water management infrastructure at the Mine Site Crusher Facility, including culverts, ditches, surface water management ponds and any associated water treatment systems.
Site Services Superintendent/ Manager	• Reports to the General Manager • Provides oversight for all Site Services operations, including the operation, construction and

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Role	Responsibility
	maintenance of water and waste management infrastructure and treatment systems at the Mine Site and Milne Port. • Responsible for managing water retained in containment areas associated with Project bulk fuel facilities and hazardous materials/waste storage areas, including landfarm facilities.
Road Maintenance Superintendent/ Manager	• Reports to the General Manager • Provides oversight for all Road Maintenance operations, including the operation, construction and maintenance of surface water management infrastructure for the Tote Road that runs between Milne Port and the Mine Site, including culverts, bridges, ditches and swales.
Environment Department	• Support the management of the Project's surface water management infrastructure by advising operational departments and obtaining the appropriate regulatory approvals for necessary changes and modifications. • Advise operational departments on the implementation of the appropriate controls to manage surface water flows and effluents at the Project, including the implementation of sedimentation and erosion controls. • Report incidents to senior management and the appropriate regulatory agencies and stakeholders. • Conduct inspections and monitoring to ensure compliance with applicable regulations and commitments. • Provide training sessions to operational departments on the appropriate mitigation measures and strategies for managing surface water flows and effluents at the Project.
All Departmental Supervisors	• Reports to the Departmental Manager/Superintendent

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Role	Responsibility
	• Responsible for reading and understanding applicable sections of this Plan and directing departmental personnel on the appropriate mitigation measures and strategies for managing surface water flows and effluents in their Project area.
All Project Personnel	• All personnel Project personnel are responsible for complying with the requirements of this Plan in the management of surface water flows and effluents at the Project.

15. Pre-Requisite Competency Skills

Baffinland staff and contractors working on site receive environmental training as part of the site orientation to achieve a basic understanding of their obligations regarding environmental compliance with regulatory requirements, commitments and best practices.

Operations superintendents and contractor supervisors are provided this Plan, and receive additional training on the requirements outlined in this Plan. In addition, supervising level staff and sub-contractors are provided the Operational Environmental Standards (found in the Project's Environmental Protection Plan) as written guidance for their work.

Targeted environmental awareness training will be provided to both individuals and groups of workers assuming a specific authority or responsibility for environmental management or those undertaking an activity with an elevated high risk of environmental impact. These will be delivered in the form of toolbox meetings or other means as appropriate.

The content of the environmental component of the site orientation will include at a minimum:

- Location of environmental sensitivities;
- Location of additional information on environmental matters;
- Due diligence responsibilities;

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- Responsibilities related to waste management, minimizing noise as necessary, road traffic rules, etc.; and,
- Principles and necessary steps to avoid encounters with bears or other wildlife and what to do if one such encounter occurs.

16. Related Documents

This Plan should be used in conjunction with the Surface Water and Aquatic Ecosystem Management Plan (SWAEMP) (BIM-5200-PLA-0009), Aquatic Effects Monitoring Plan (AEMP) (BIM-5200-PLA-0023), Metal and Diamond Mining Effluent Regulations Emergency Response Plan (BIM-5200-PLA-003) and the Sampling Program – Quality Assurance and Quality Control (QA/QC) Plan (BIM-5200-PLA-0004).

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Appendix A Sustainable Development Policy & Health, Safety and Environment Policy

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Baffinland Iron Mines Corporation

BIM-5000-POL-0005 SUSTAINABLE DEVELOPMENT POLICY

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DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Rev #	Prepared By	Reviewed By	Approved By	Description of change and purpose of issue
05/07/15	0	EM		TP	For use
03/07/16	1	JS		BP	Minor edits
05/09/25	2	R. Chakravorty	C. Oliver	M. Lord-Hoyle	Updated the entire Policy, and moved to new template.

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PURPOSE

Baffinland Iron Mines LP (Baffinland or the Company) conducts its business in accordance with the principles of our Sustainable Development Policy ("Policy"), which is underpinned by the Universal Declaration of Human Rights, United Nations (UN) Sustainable Development Goals, and Canada's commitments to the Paris Agreement.

The sustainability of our operations is strengthened by our commitment and responsibility to protect the environment, to operate safely, in a fiscally responsible manner and with utmost respect for the cultural values, Inuit Qaujimajatuqangitiq (IQ) and legal rights of Inuit.

SCOPE

We expect each and every employee, contractor, and visitor to value, honour and commit to this Policy through their actions.

The six pillars of our Sustainable Development Policy are:

1) Health and Safety
2) Environment
3) People, Rights Holders and Cultural Integrity
4) Supply Management and Economic Development
5) Climate Action
6) Transparent Governance

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OUR PILLARS

1. HEALTH AND SAFETY

- Our motto is “Safety First, Always.” We consider people as our greatest assets and Health and Safety of our workforce and affected communities is a foundational value. This value is further bolstered by our Health, Safety and Environment Policy.
- We strive to achieve the safest workplace for our people and remain free from occupational injuries and illnesses.
- We lead with a culture of collective responsibility and promote courageous leadership through active participation, responsible behaviour, and risk awareness.

2. ENVIRONMENT

- We integrate western science and IQ knowledge through community engagements and consultations, environmental and socio-economic working groups and monitoring programs to assess project related effects, minimize impacts and preserve marine, terrestrial and freshwater life, conserve biodiversity and support community well-being.
- We continuously seek to undertake initiatives to use energy, raw materials and natural resources more efficiently, and implement technologies to enhance our environmental conservation practices and reduce our footprint.
- We evolve our Interim Closure and Reclamation Plan to meet reclamation objectives effectively through all stages of project operations and development.

3. PEOPLE, RIGHTS HOLDERS AND CULTURAL INTEGRITY

- We uphold human rights and dignity of all individuals with utmost respect, guided by UN Guiding Principles on Business and Human Rights and acting in accordance to Nunavut Land Claims Agreement.
- We strive to build strong and lasting relationships with the affected Inuit communities. We honour and respect the unique values and traditions of Inuit and work in partnership to incorporate IQ across our business practises, and our Mission, Vision and Values were developed to directly align with Inuit Societal Values.
- We are committed to the well-being of affected communities and aim to create positive and lasting impact. We actively engage, develop and provide support systems dedicated to physical, mental and emotional well-being, as well as foster inclusion and preservation of cultural practices.
- We do not tolerate discrimination or harassment of any form against individuals, including employees and contractors on the basis of race, colour, sexual orientation, gender identity, religion, political opinion, nationality or social origin and are committed to advance equity, diversity and inclusion of historically under-represented groups within our workforce and culture.
- We expect our employees and contractors, community members, and workers in our value chain to bring human rights concerns to our attention through our established channels. We are committed to engaging with our communities of interest on our human rights impacts and to report and improve on our performance.

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4. SUPPLY MANAGEMENT AND ECONOMIC DEVELOPMENT

- We are focused on advancing social, cultural and economic development of our communities of interests.
- We work with affected Inuit communities to develop socio-economic self-reliance through our support for local enterprises, skills development programs and job creation initiatives contributing to long term success and well-being of the community.
- We are committed to building resilient and transparent supply chains to uphold responsible business practices that enhances our economic impact on our communities and lowers business risks.
- We expect our suppliers to conform to our Code of Business Conduct and uphold internationally recognised human rihgts standards. While we operate in Canada, we actively engage with our value chain to minimize the risk of any violations.

5. CLIMATE ACTION

- As a Canadian critical mineral producer of high grade iron ore, we contribute to the manufacting of low carbon steel in support of global net zero transition.
- We are committed to adopt viable technologies for improving energy efficiency, reducing greenhouse gas emissions, reducing our carbon footprint and adapt to climate change.
- We work to ensure that our operations support the needs and vision of future generations of Nunavummiut.

6. TRANSPARENT GOVERNANCE

- We implement steps within our operations to understand, evaluate and manage risks on a continuing basis, including those that may impact the environment, employees, contractors, local communities, consumers and shareholders.
- We endeavour to ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and objectives for continuous improvement.
- We monitor, review and report our performance with respect to our safety, health, environmental, socio-economic commitments and set annual targets and objectives.
- We are dedicated to effectively and efficiently utilizing our shareholder's capital while demonstrating honesty and integrity by applying the highest standards of ethical conduct. Our Code of Business Conduct reinforces our commitment to uphold and exceed legal and regulatory requirements in all aspects of our business practices.
- We are committed to transparency in our operations, underscored by robust monitoring programs and disclosure practices. Our monitoring programs lead the body of research for this region of the Arctic and are evaluated by technical working groups comprised of government bodies, regulators and local authorities.

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FURTHER INFORMATION

Please refer to the following policies and documents for more information on Baffinland's commitment to operating in an environmentally and socially responsible manner:

Health, Safety and Environment Policy
Equity, Diversity and Inclusion in the Workplace Policy
Code of Business Conduct

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Baffinland Iron Mines Corporation

BIM-5000-POL-0001 HEALTH SAFETY AND ENVIRONMENT POLICY

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05/07/15	0	EM		TP	For Use
03/07/15	1	JS		Brian Penney	Minor Edits
04/20/18	2	TS		Brian Penney	Minor Edits
04/20/22	3	TS		Brian Penney	Minor Edits
01/16/25	4	Tim Sewell		Tayfun Eldem	Move to new template

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This Baffinland Iron Mines Corporation Policy on Health, Safety and Environment is a statement of our commitment to achieving a safe, healthy and environmentally responsible workplace. We will not compromise this policy for the achievement of any other organizational goals**.**

We implement this Policy through the following commitments:

- Continual improvement of safety, occupational health and environmental performance.
- Meeting or exceeding the requirements of regulations and company policies.
- Integrating sustainable development principles into our decision-making processes.
- Maintaining an effective Health, Safety and Environmental Management System.
- Sharing and adopting improved technologies and best practices to prevent injuries, occupational illnesses and environmental impacts.
- Engaging stakeholders through open and transparent communication.
- Efficiently using resources, and practicing responsible minimization, reuse, recycling and disposal of waste.
- Reclamation of lands to a condition acceptable to stakeholders.

Our commitment to provide the leadership and action necessary to accomplish this policy is exemplified by the following principles:

- As evidenced by our motto “Safety First, Always” and our actions, Health and Safety of personnel and protection of the environment are values, not priorities.
- All injuries, occupational illnesses and environmental impacts can be prevented.
- Employee involvement and active contribution through courageous leadership is essential for preventing injuries, occupational illnesses and environmental impacts.
- Working in a manner that is healthy, safe and environmentally sound is a condition of employment.
- All operating exposures can be safeguarded.
- Training employees to work in a manner that is healthy, safe and environmentally sound is essential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good business.
- Respect for the communities in which we operate is the basis for productive relationships.

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We have a responsibility to provide a safe workplace and utilize systems of work to meet this goal. All employees must be clear in understanding the personal responsibilities and accountabilities in relation to the tasks we undertake.

The health and safety of all people working at our operation and responsible management of the environment are core values to Baffinland. In ensuring our overall profitability and business success every Baffinland and business partner employee working at our work sites is required to adhere to this Policy.

Tayfun Eldem

Chief Operating Operator

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Appendix B Concordance Tables

Tables 18, 19 and 20 show the terms and conditions of the Project's Type A Water Licence (2AM MRY2540), Type B Water Licence (2BE-MRY2131), and the Project Certificate (No. 005 – Amend. No 1) and the location within this Plan.

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Table 16.1 Concordance Table with Type A Water Licence Terms and Conditions

Part	Number	Condition	Section
B	10	The Licensee shall post signs in the appropriate areas to inform the public of the location of infrastructure and/or facilities designed to contain, withhold, divert or retain Water and/or Waste. All signs must be in English, Inuktitut, and French.	Signage, written in English, Inuktitut, and French, will be posted inform the public of the location of infrastructure and/or facilities designed to contain, withhold, divert or retain Water and/or Waste.
D	1	The Licensee shall, at least sixty (60) days prior to Construction (unless otherwise approved by the Board), submit to the Board for review final design and for-Construction drawings accompanied with a detailed report described in Part D, Item 2 and stamped and signed by an Engineer, for all infrastructure and/or facilities designed to contain, withhold, divert or retain Water and/or Waste, as authorized under the Licence.	6.3, Appendix F4 If more immediate timeline required, Baffinland will issue letter to NWB with early drawings.
D	3	The Licensee shall, within ninety (90) days of completion of each facility designed to contain, withhold, divert or retain Waters or Wastes, submit to the Board for review a Construction Summary Report prepared by a qualified Engineer that includes as-built plans and drawings, documentation of field decisions that deviate from original plans and any data used to support these decisions in accordance with Schedule D, Item 1.	6.3, Appendix F
D	21	The Licensee shall construct and operate all infrastructure and Facilities authorized by the Board that are designed to contain,	Demonstrated and outlined by this Plan.

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Part	Number	Condition	Section
		withhold, divert or retain Water and/or Waste, in accordance with all applicable legislation and industry standards.	
E	3	The Licensee shall obtain all freshwater for domestic camp use and industrial purposes, during the Construction Phase of the Project, in amounts and from the sources described in Table 2, or in the volumes and from sources otherwise approved by the Board in writing. In addition to the source-specific limits prescribed in Table 2, the Licensee is authorized to use up to one thousand eight hundred and eighty-eight (1,888) cubic metres of Water per day, to a maximum of six hundred and eighty-nine thousand (689,000) cubic metres of Water annually, during the	Table 2

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Part	Number	Condition	Section
		Construction Phase of the Project.	

Table 2: Water Use Authorized for Domestic and Industrial Purposes during Project Construction Phase

Site	Source	Volume (m^3/day)	Combined Volume (m^3/year)
Milne Port (Milne Inlet)	Phillips Creek	367.5	~ 134,000
	Km 32 Lake		
Mine Site (Mary River)	Camp Lake	657.5	240,000
Steensby Port (Steensby Inlet)	ST 347 Km Lake	435.8	155,400
	3 km Lake		
Ravn River	Camp Lake	145.2	
Mid-Rail	Nivek Lake	79.5	
	Ravn Camp Lake		
Cockburn North (Tunnels Camp)	Cockburn Lake	101.4	
Cockburn South Camp	Cockburn Lake	111.1	
Annual Total		**~ 689,000 m^3/Annually**	

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Part	Number	Condition	Section
E	4	The Licensee shall provide notice to the Board, as required under Part B, Item 9, in advance of using freshwater for domestic camp use and industrial purposes during the Operations Phase of the Project in amounts and from the sources described in Table 3, or in volumes and from sources otherwise approved by the Board in writing. In addition to the source-specific limits prescribed in the Table 3, the Licensee is authorized to withdraw up to nine hundred and sixty-seven (967) cubic metres of water per day, to a maximum of three hundred and fifty-three thousand (353,000) cubic metres of Water annually, during the Operations Phase of the Project.	4.2
E	5	The Licensee may recycle water and use reclaimed water from the various treatment facilities, surface water management ponds and embankment dams, other facilities and approved discharge locations under the Licence, if such waters meet appropriate discharge criteria for those facilities, with the exception of TSS, if the water is being used for dust suppression in areas of the Project where the waters report to an MDMER regulated facility, containment pond or sumps or does not have the potential to directly flow to receiving water bodies upon application.	5.2, 6, and 7.2
E	6	The Licensee shall equip all Water intake hoses with screens of an appropriate mesh size, consistent with the requirements of Fisheries and Ocean Canada's (DFO) Freshwater Intake End-of-Pipe Fish Screen Guidelines (1995), to prevent the entrainment of fish are and shall withdraw Water at a rate such that fish do not become impinged on the screen.	4.1.1.2

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Part	Number	Condition	Section
E	8	Streams cannot be used as a water source unless authorized and approved by the Board in writing.	4.2
E	9	The Licensee shall notify the Inspector and the Board at least ten (10) days in advance of using Water from any sources not identified in the Application or requiring approval.	4.1.1.3
E	10	The Licensee shall update or revise annually following the commencement of the Operations Phase and/or the Early Revenue Phase, the Project Blockflow Diagram Water Supply Balance information for the various Project sites, provided with the revisions, for review by the Board, with the Annual Report under Part B, Item 4.	Appendix D
E	11	The Licensee shall carry out weekly inspections of all structures designed to contain, withhold, divert or retain Waters or Wastes during periods of flow and maintain records of the inspections and findings, for review upon the request by the Board or an Inspector.	11
E	12	The Licensee shall not remove any material from below the ordinary High Water Mark of any water body unless authorized.	4.2
E	25	The Licensee is authorized to withdraw up to 1,500 cubic metres of Water per day to a maximum of 547,500 cubic metres of Water annually specifically for use in dust suppression or control along the Tote Road, unless otherwise approved by the Board in writing. Water for dust suppression or control shall be obtained	Table 3

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<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td></td><td></td><td>from the sources in accordance with limits prescribed in Table 4.
Table 4: Water use Authorized for Dust Suppression
<table>
<tr><th>Site</th><th>Source</th><th>Maximum Volume (m³/day)</th><th>Restriction</th></tr>
<tr><td rowspan="15">Tote Road</td><td>Phillip's Creek</td><td>212</td><td rowspan="3">None</td></tr>
<tr><td>Km 32 Lake</td><td>364</td></tr>
<tr><td>CV128</td><td>579.5</td></tr>
<tr><td>CV099</td><td>110</td><td rowspan="3">June –July only during low flow (less than mean flow) years</td></tr>
<tr><td>CV087</td><td>90</td></tr>
<tr><td>CV078</td><td>75</td></tr>
<tr><td>Katiktok Lake</td><td>318</td><td rowspan="2">None</td></tr>
<tr><td>BG50</td><td>150</td></tr>
<tr><td>BG32</td><td>120</td><td>June –July only during low flow (less than mean flow) years</td></tr>
<tr><td>CV217</td><td>130</td><td rowspan="2">None</td></tr>
<tr><td>Muriel Lake</td><td>212</td></tr>
<tr><td>David Lake</td><td>132</td><td rowspan="2">June –July only during low flow (less than mean flow) years</td></tr>
<tr><td>BG17</td><td>75</td></tr>
<tr><td>CV233 (Tom River)</td><td>135</td><td rowspan="2">None</td></tr>
<tr><td>Camp Lake</td><td>86</td></tr>
</table></td><td></td></tr>
<tr><td>E</td><td>26</td><td>The Licensee shall obtain authorization from the Board in writing prior to using Water authorized under Part E, Item 25, for purposes other than that authorized in Part E, Item 25.</td><td>4.2</td></tr>
<tr><td>F</td><td>9</td><td>The Licensee shall treat oily water and wastewater generated by the Project at the Oily Water/Wastewater Treatment Facilities authorized under the scope of the Licence.</td><td>6.3</td></tr>
<tr><td>F</td><td>11</td><td>The Licensee shall provide at least ten (10) days' notice to the Inspector prior to planned discharges from any Waste Management Facilities, Oily Water/Wastewater Treatment Facilities, and any other relevant facilities associated with the Project. The notice shall include the estimated volume proposed</td><td>5.3, 6, 7.2</td></tr>
</table>

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Part	Number	Condition	Section
		for discharge and the location and description of the receiving environment.	
F	12	The Licensee shall, unless otherwise approved by the Board in writing, discharge effluent at a distance of least thirty-one (31) metres above the Ordinary High Water Mark of any Water body, where direct flow into the Water body is not possible, such that surface erosion is minimized and no additional impacts are created.	5.3, 6, 7.2
F	14	The Licensee shall direct all Sewage generated from the relevant Project sites to the Sewage Treatment Facilities or as otherwise approved by the Board in writing.	5.2
F	15	The Licensee shall treat all Sewage waste generated at the Ravn River and Mid-Rail camps and Sewage generated at the Cockburn North and Cockburn South camps at either the Mine Site Sewage Treatment Facility or the Steensby Port Sewage Treatment Facility, unless otherwise approved by the Board in writing.	Appendix E
F	16	The Licensee shall, at least sixty (60) days prior to installation, provide to the Board for review, detailed specifications and operational requirements for the Sewage storage tanks proposed for the Railway camps.	Appendix F
F	17	All discharge from the Sewage Treatment Facilities including the Polishing Waste Stabilization Ponds directly into water bodies at Monitoring Stations MS-01, MS-01A, MS-01B MS-MRY-04, MS-MRY-04A, and/or from monitoring stations as otherwise approved	Table 5

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<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td></td><td></td><td>by the Board in writing, must not exceed the following Effluent quality limits:
Table 5: Effluent Quality Discharge Limits for Sewage Treatment Facilities to Freshwater Receiving Environment
<table><tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr><tr><td>BOD_5</td><td>30</td></tr><tr><td>Total Suspended Solids</td><td>30</td></tr><tr><td>Faecal Coliform</td><td>1000 CFU/100 mL</td></tr><tr><td>Oil and Grease</td><td>No visible sheen</td></tr><tr><td>pH</td><td>Between 6.0 and 9.5</td></tr><tr><td>Ammonia (NH3-N)</td><td>4.0</td></tr><tr><td>Total Phosphorous (MS-01)</td><td>4.0</td></tr><tr><td>Total Phosphorous (MS-01a)</td><td>1.0</td></tr><tr><td>Toxicity</td><td>Not acutely toxic</td></tr></table></td><td></td></tr>
<tr><td>F</td><td>18</td><td>Sludge generated from the Sewage Treatment Facilities or any other facilities shall be confirmed to be non-hazardous and the results provided to the Board for review prior to disposal at any Landfill Facility or as otherwise approved by the Board in writing.</td><td>5.2</td></tr>
<tr><td>F</td><td>19</td><td>All discharge from the Oily Water/Wastewater Treatment Facilities at Monitoring Stations MP-02, MS-02, SP-02, MP-04A, and/or from monitoring stations as otherwise approved by the Board in writing, must not exceed the following Effluent quality limits:</td><td>Table 8</td></tr>
</table>

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<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td></td><td></td><td>Table 6: Effluent Quality Discharge Limits for Oily Water/Wastewater Treatment Facilities
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td></tr>
<tr><td>TSS</td><td>30</td></tr>
<tr><td>Ammonia (NH3-N)</td><td>4.0</td></tr>
<tr><td>Total Phosphorous</td><td>4.0</td></tr>
<tr><td>Benzene</td><td>0.59</td></tr>
<tr><td>Toluene</td><td>0.03</td></tr>
<tr><td>Ethylbenzene</td><td>0.07</td></tr>
<tr><td>Xylene</td><td>0.07</td></tr>
<tr><td>Oil and Grease</td><td>15 and no visible sheen</td></tr>
<tr><td>Total Arsenic</td><td>0.60</td></tr>
<tr><td>Total Copper</td><td>0.60</td></tr>
<tr><td>Total Lead</td><td>0.20</td></tr>
<tr><td>Total Nickel</td><td>1.0</td></tr>
<tr><td>Total Zinc</td><td>1.0</td></tr>
</table></td><td></td></tr>
<tr><td>F</td><td>20</td><td>All discharge from the Landfill Facilities at Monitoring Stations MS-MRY-13a, MS- MRY- 13b and SP-08, and/or from monitoring stations as otherwise approved by the Board in writing must not exceed the following Effluent quality limits:
Table 7: Effluent Quality Discharge Limits for the Landfill Facilities
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td></tr>
<tr><td>Total Arsenic</td><td>0.6</td></tr>
<tr><td>Total Copper</td><td>0.6</td></tr>
<tr><td>Total Lead</td><td>0.2</td></tr>
<tr><td>Total Nickel</td><td>1.0</td></tr>
<tr><td>Total Zinc</td><td>1.0</td></tr>
<tr><td>Total Suspended Solids</td><td>30</td></tr>
<tr><td>Oil and Grease</td><td>No visible sheen</td></tr>
</table></td><td>Table 15</td></tr>
<tr><td>F</td><td>21</td><td>All discharge from the Bulk Fuel Storage Facilities at Monitoring Stations MP-03, MP- MRY-7, MS-03, MS-04, MS-MRY-6, SP-04 and SP-05 and/or from monitoring stations as otherwise approved by the Board in writing, must not exceed the following</td><td>Table 9</td></tr>
</table>

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<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td></td><td></td><td>Effluent quality limits:
Table 8: Effluent Quality Discharge Limits for the Bulk Fuel Storage Facilities
<table><tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr><tr><td>Benzene</td><td>0.59</td></tr><tr><td>Toluene</td><td>0.03</td></tr><tr><td>Ethylbenzene</td><td>0.07</td></tr><tr><td>Xylene</td><td>0.07</td></tr><tr><td>Total Lead</td><td>0.20</td></tr><tr><td>Oil and Grease</td><td>15,000 and no visible sheen</td></tr></table></td><td></td></tr>
<tr><td>F</td><td>22</td><td>All discharge from the Landfarm Facilities at Monitoring Stations MS-05 and SP-06, and/or from monitoring stations as otherwise approved by the Board in writing, must not exceed the following Effluent quality limits:
Table 9: Effluent Quality Discharge Limits for the Landfarm Facilities
<table><tr><th>Parameters</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr><tr><td>pH</td><td>Between 6.0 and 9.5</td></tr><tr><td>Total Suspended Solids</td><td>30</td></tr><tr><td>Oil and Grease</td><td>15 and no sheen</td></tr><tr><td>Total Lead</td><td>0.20</td></tr><tr><td>Benzene</td><td>0.59</td></tr><tr><td>Toluene</td><td>0.03</td></tr><tr><td>Ethylbenzene</td><td>0.07</td></tr><tr><td>Xylene</td><td>0.07</td></tr></table></td><td>Table 10</td></tr>
<tr><td>F</td><td>23</td><td>All Discharge associated with the Run of Mine Ore Stockpile, Ore Stockpile, West and East Sedimentation Ponds at Monitoring Stations MS-06, MS-07, MS-08, MS-09, MS-10, MS-11 and SP-07 and/or monitoring stations as otherwise approved by the Board in writing shall not exceed the following Effluent quality limits:</td><td>Table 12</td></tr>
</table>

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Part	Number	Condition	Section
		Table 10: Effluent Quality Discharge Limits for Open Pit, Stockpiles, and Sedimentation Ponds	

Parameter	Maximum Monthly Mean Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
Total Arsenic	0.30	0.60
Total Copper	0.30	0.60
Total Lead	0.10	0.20
Total Nickel	0.50	1.0
Total Zinc	0.50	1.0
Total Suspended Solids	15	30
Oil and Grease	No visible sheen	
Toxicity	Not acutely toxic	
pH	Between 6.0 and 9.5	

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Table 16.2 Concordance Table with Type B Water Licence Terms and Conditions

Part	Number	Condition	Section
C	1	The Licensee shall obtain all Water for domestic camp use from sources proximal to each camp. Total camp Water use shall not exceed forty-nine (49) cubic metres per day. Drill Water shall be obtained from local Water source(s), proximal to the drilling targets as outlined in the Application and shall not exceed two hundred and fifty (250) cubic metres per day. The volume of Water for all purposes under this Licence shall not exceed two hundred and ninety-nine (299) cubic metres per day.	4.2
C	4	The Licensee shall equip all water intake hoses with a screen of an appropriate mesh size to ensure that fish are not entrained and shall withdraw Water at a rate such that fish do not become impinged on the screen.	4.1.1.2
C	6	The Licensee shall not cause erosion to the banks of any body of Water and shall provide necessary controls to prevent such erosion.	4.1.1, 5.2, 5.3, 5.4.2, 7.2.5
C	7	Sediment and erosion control measures shall be implemented prior to and maintained during the undertaking to prevent entry of sediment into Water.	4.1.1, 5.2, 5.3, 5.4.2, 7.2.5
E	10	Sediment and erosion control measures shall be implemented prior to and maintained during the undertaking to prevent entry of sediment into Water.	4.1.1, 5.2, 5.3, 5.4.2, 7.2.5

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Table 16.3 Concordance Table with Project Certificate Terms and Conditions

Number	Condition	Section
17	The Proponent shall develop and implement effectives measures to ensure that effluent from project-related facilities and/or activities, including sewage treatment plants, ore stockpiles, and mine pit, satisfies all discharge criteria requirement established by the relevant regulatory agencies prior to being discharged into the receiving environment.	7.1
24	The Proponent shall monitor as required the relevant parameters of the effluent generated from Project activities and facilities and shall carry out treatment if necessary to ensure that discharge conditions are met at all times.	11
46	The Proponent shall ensure that runoff from fuel storage and maintenance facility areas, sewage and wastewater other facilities responsible for generating liquid effluent and runoff meet discharge requirements.	7.1

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Appendix C Site Layout – Milne Port, Mine Site and Steensby Port

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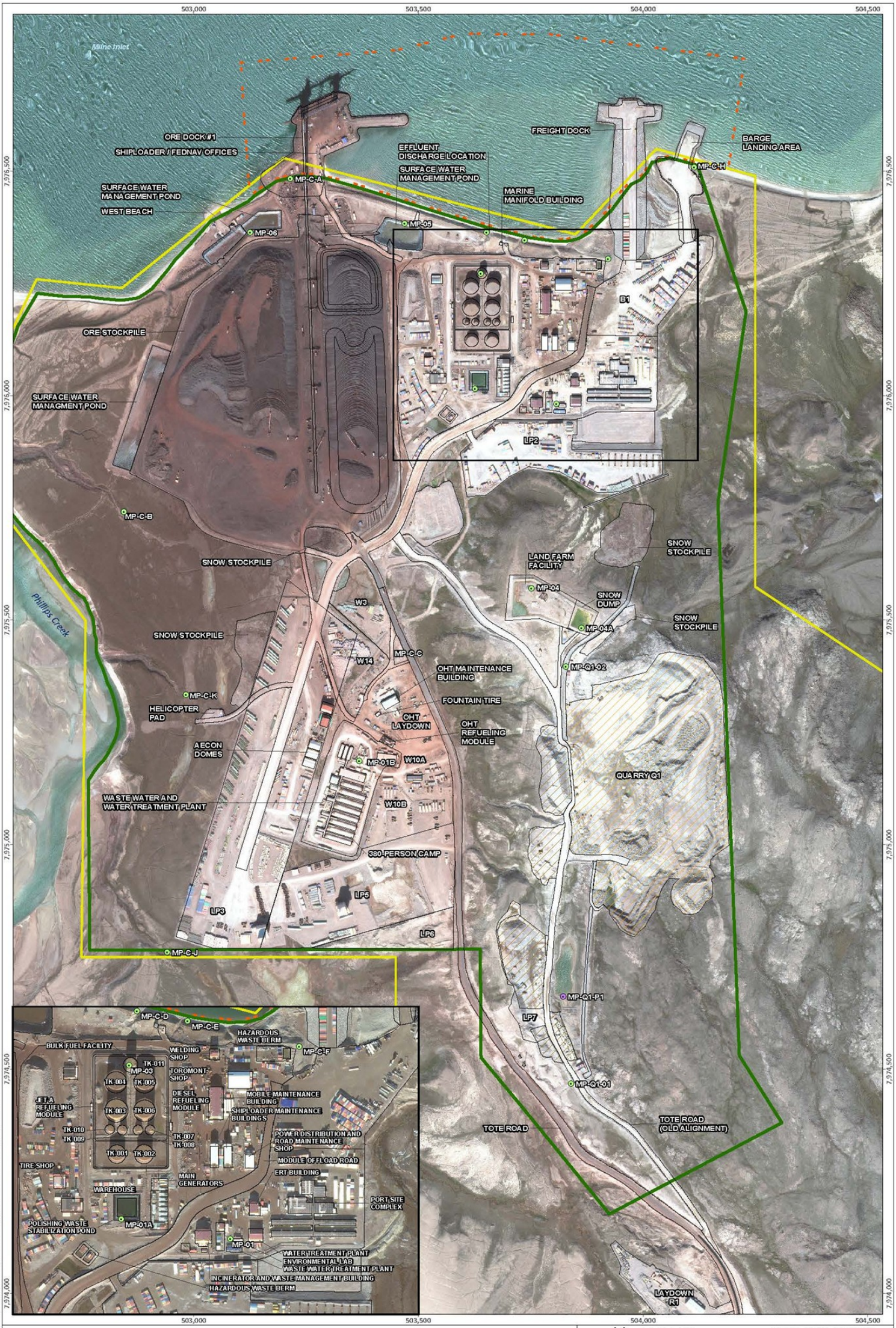

LEGEND

- Foreshore Lease Boundary
- Project Development Area
- Commercial Lease Boundary
- Borrow Area
- Quarry Area
- Infrastructure
- Domestic and Industrial Water Sources

SNP Monitoring Location

- Active
- Inactive

Monitoring Location

- Recycled Water Monitoring
- Snow Stockpile Monitoring
- Tote Road Monitoring

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Milne Port Site Layout

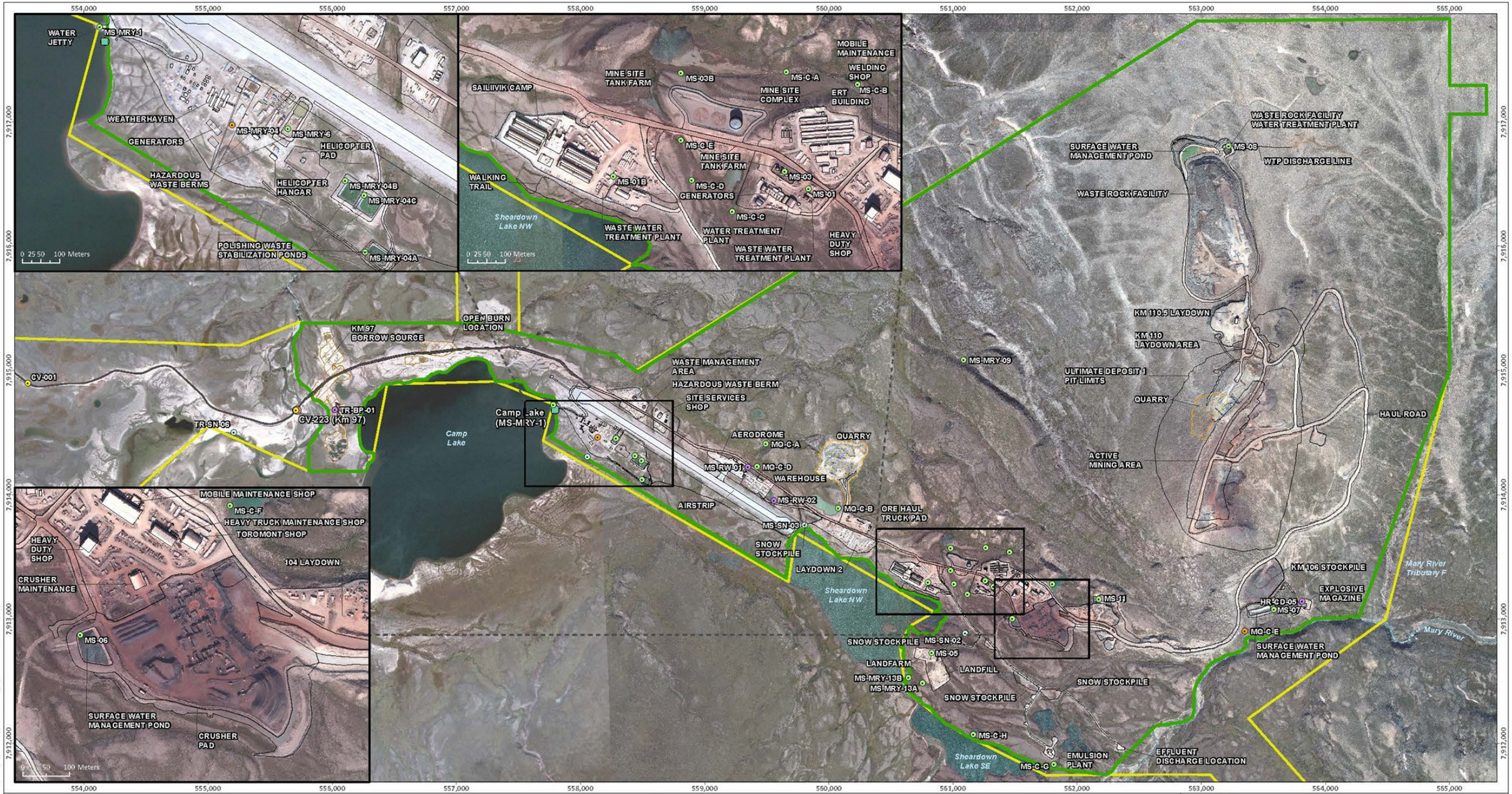
Projection: NAD 1983 UTM ZONE 17N.
Base Map: © 2023 Digital Globe, Inc.
Imagery and Infrastructure are representative as of July 2022.

0 25 50 100 150 200 Meters
Scale 1:8,000

N

Baffinland

ᑎᑎᕋᐅᓯᖏᓐᓄᑦ FIGURE 3



LEGEND

- Borrow Area
- Quarry Area
- Project Development Area
- Commercial Lease Boundary
- Infrastructure
- Domestic and Industrial Water Sources

SNP Monitoring Station

- Active
- Inactive

Monitoring Location

- Recycled Water Monitoring
- Snow Stockpile Monitoring
- Tote Road Monitoring

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Mine Site Layout

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © 2023 Digital Globe, Inc.
Imagery and Infrastructure are representative as of July 2022.

0 100 200 400 600 800 Meters
Scale 1:30,000

N

Baffinland

ᑎᑎᕋᐅᓯᒪᔪᑦ FIGURE 5

SAVED: C:\Users\katie.mcguire\Documents\04 - Maps\Reporting\1_Annual\Type A\2022\BIM_Fig 5 Mine Site 2022 Monitoring.mxd; 25-Mar-23

592,000 594,000 596,000 598,000 600,000

7,808,000 7,806,000 7,804,000 7,802,000 7,800,000 7,798,000

Ikpikitturjuaq Bay

Steensby Inlet

Camp Limits (approx.)
Fuel Drum Storage
Laydown Area

LEGEND

- Contour (2.5 km Interval)
- Current Infrastructure
- Project Development Area

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Steensby Port Layout

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © King's Printer for Ontario, 2024.

0 200 400 800 Meters
Scale 1:35,000

N

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ᑎᑎᕋᐅᓯᖏᑦ FIGURE 7

Appendix D Block Flow Diagrams – Milne Port and Mine Site

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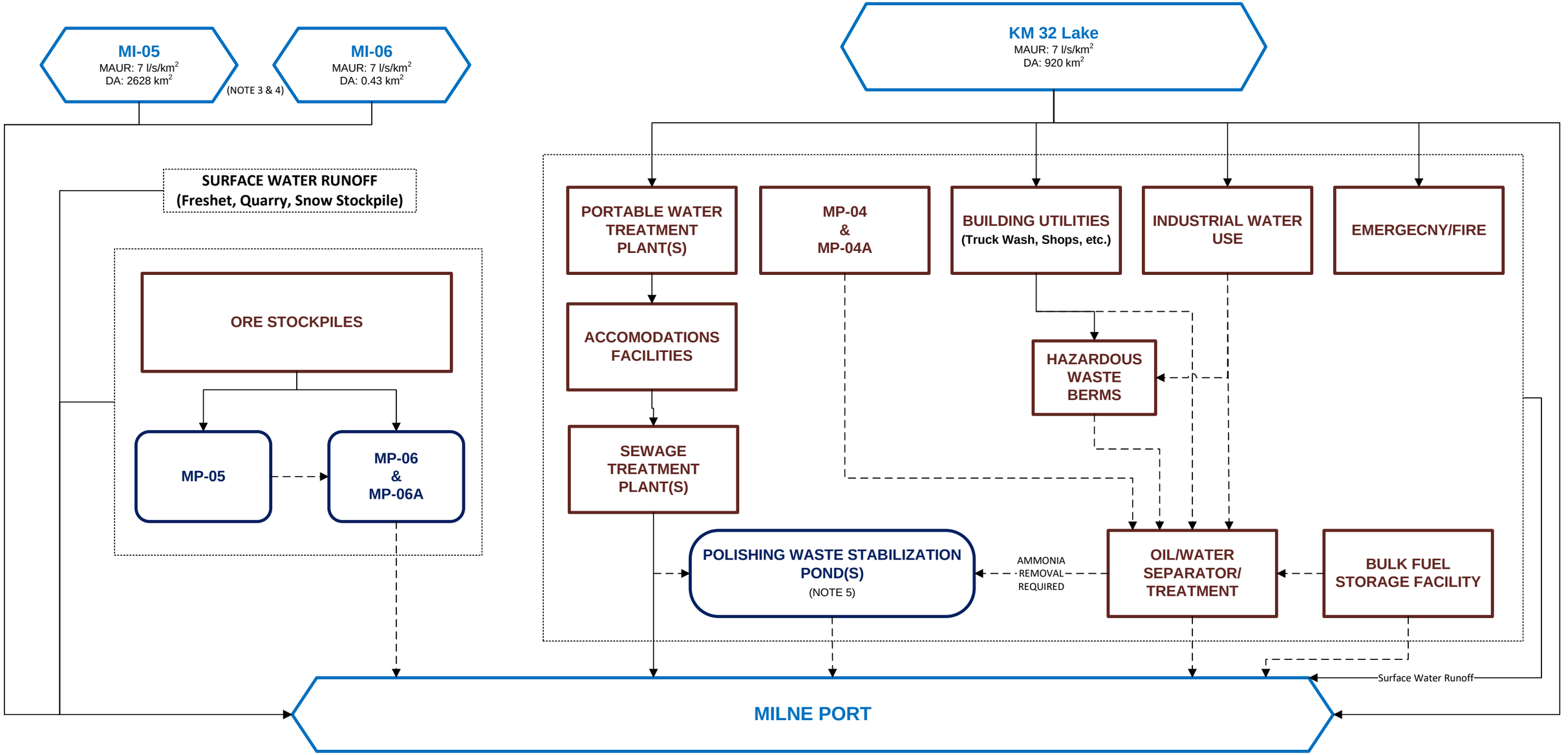


LEGEND

- Catchment or Water Body
- Development Areas
- Surface Water Management Pond
- Surface Water Runoff
- Continuous or Watershed Flow
- Intermittent Flow

NOTES:

1 - Raw water supply flow rate from KM32 Lake (Winter/Summer) are currently equal to or less than Type A water licence 2AM-MRY2540 flow rate limit of 367.5 m3/day (~134,000 m3/year).
2 - If compliant, any water from ponds or development areas can discharge directly to Milne Inlet.
3 - Mean Annual Unit Runoff (MAUR) in watersheds MI-05 and MI-06 likely range between 5 and 7.1/s/lm2. Part of the MI-06 natural catchment will be used for proposed infrastructure construction.
4 - DA = Drainage Area (km^2)
5 - Use of Polishing Waste Stabilization Pond(s) will occur on a contingency basis only, should off-spec treated effluent be produced.

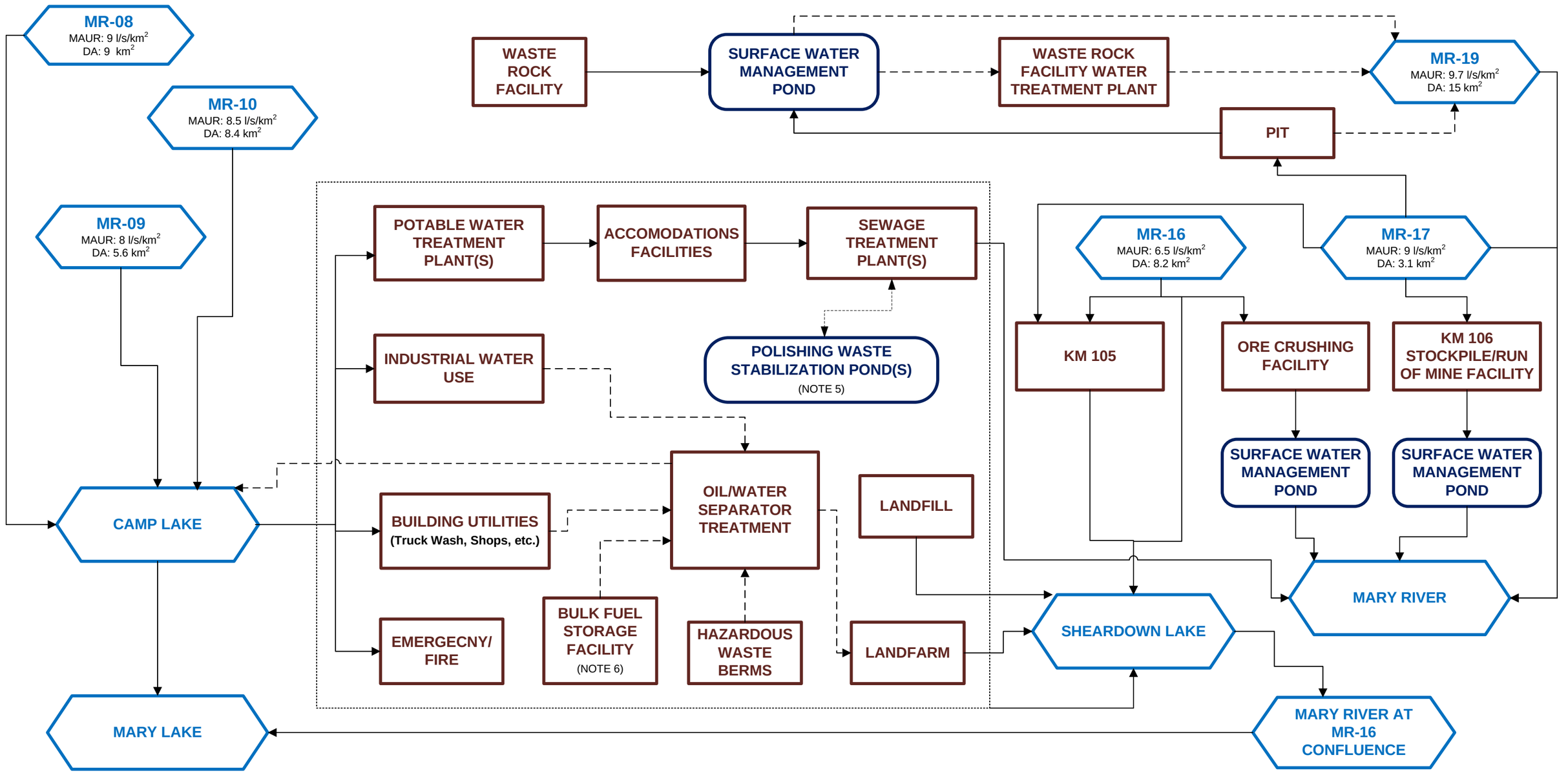
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MILNE PORT
SITE WATER BALANCE – BLOCK FLOW DIAGRAM

Baffinland

FIGURE D.1



LEGEND

- Catchment or Water Body
- Development Areas
- Surface Water Management Pond
- Surface Water Runoff
- Continuous or Watershed Flow
- Intermittent Flow

NOTES:

1 - Raw water supply flow rate from KM32 Lake (Winter/Summer) are currently equal to or less than Type A water licence 2AM-MRY2540 flow rate limit of 657.5 m^3/day (~240,000 m^3/year).
2 - If compliant, any water can bypass treatment.
3 - MAUR = Mean Annual Unit Runoff
4 - DA = Drainage Area (km^2)
5 - Use of Polishing Waste Stabilization Pond(s) and Sheardown Lake discharge will occur on a contingency basis only, should capacity be exceeded through the sewage treatment system discharging to Sheardown Lake.
6 - Bulk fuel storage area runoff drained to environment if quality satisfies discharge requirements; otherwise is conveyed to oil/water separator for treatment prior to discharge.

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE
SITE WATER BALANCE – BLOCK FLOW DIAGRAM

Baffinland

FIGURE D.2

Appendix E Sewage Treatment Plant O&M Manual

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Review Grade	Next Submittal Status
☐ C1 – Proceed to next submission & status	☐ Internal Review ☐ Certified Final ☐ Final ☐ As-Built
☐ C2 – Proceed with exceptions as noted to next submission & status	Next Submittal Date:
☐ C3 – Do not proceed, revise as noted & resubmit	
No further submission required - Complete ☐	
☐ C4 – No further submission required - Cancelled ☐	
No further submission required - Superseded ☐	

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Sewage Treatment Plant

Operations & Maintenance Manual

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newterra MicroClear™ Membrane Bioreactor (MBR) Wastewater Treatment Plant

OPERATION AND MAINTENANCE MANUAL

System:	**Milne Port & Mine Site Wastewater Treatment Plants**
Location:	**Baffin Island, Nunavut**
Client:	**Baffinland Iron Mines Corporation (via Hatch)**
Project:	**300106**
Rev.:	**0**
Date:	**June, 2013**

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MANUAL OVERVEW

Section	Section Title	Section Description
1	**Introduction**	Introduction to **newterra** MBR WWTP O&M Manual
2	**Safety**	General personal and environmental safety information for operators serving newterra MBR WWTP.
3	**Wastewater Treatment Plant Design Basis**	**newterra** MBR WWTP Specification, Influent / Effluent Characteristics, and Prohibited Items.
4	**Plant Installation, Inspection, and Testing**	Overview of general procedures and actions followed during the plant installation, inspection and initial testing.
5	**Process Control Narrative**	Description of wastewater treatment process and equipment functionality. Control narrative & Control system touchscreen operation.
6	**System Start-Up, Operating Guidelines and Monitoring**	Overview of the plant start-up procedure & operational conditions; monitoring and testing requirements.
7	**System Maintenance**	Schedule for Routine Operation and Maintenance Checkups; membrane cleaning.
8	**Membrane Filtration Unit Shut Down**	Overview of the procedure followed during membrane filtration unit temporary and permanent shut downs; winterization procedure.
9	**Service & Support**	Information regarding the support services offered by **newterra** ltd. including start-up and emergency services; training sessions during plant commissioning.
10	**Warranty and Performance Guarantee**	General warranty statements and conditions for the membrane warranty.

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APPPENDICES:

Appendix A Drawings and Bill of Materials
Appendix B Packing Slip
Appendix C Testing Checklists / Pre-commissioning Test Checklist
Appendix D Spare Parts List
Appendix E Technical Specs and Brochures for Parts and Equipment
Appendix F Material Safety Data Sheets
Appendix G Glossary & Terms
Appendix H Biological Treatment & Monitoring Parameters
Appendix I Process and Chemicals Dosage Calculations
Appendix J Membrane Fouling
Appendix K newterra MicroClear™ Membrane Cleaning Log Sheet
Appendix L Alarms Troubleshooting Guide
Appendix M Process Troubleshooting Guide

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1.0 INTRODUCTION

The purpose of this manual is to provide necessary information for the Installation, Operation and Maintenance of the Waste Water Treatment Plant equipment.

	The newterra MicroClear™ MBR wastewater treatment plant (WWTP) functions optimally if the operating procedures described in this manual are followed. If you have any questions after reading through this manual, please contact newterra ltd.

- This O&M Manual must be kept on-site and available to employees at all time.
- It is IMPERATIVE that employees read the manual BEFORE working in the plant.
- Employees' must read ***Section 2*** – Health and Safety.
- Technical Support Department contacts are provided in ***Section 9***.

CAUTION: ***Once wetted, the membrane should remain wet, and not be allowed to dry out, to prevent irreversible damage to the membrane.***

WARNING: ***Failure to comply with the instructions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.***

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2.0 SAFETY

2.1 Introduction

This section provides general personal and environmental safety information for newterra MBR WWTP operators.

Always refer to local codes and regulations.

Specific equipment and parts safety information can be found in Appendix E. Material Safety Data Sheets (MSDSs) include detailed information regarding health & safety of chemicals used in wastewater treatment process and are presented in Appendix F.

Information and guidelines outlined in this manual **must** be followed at all times prior to system installation and during operation and maintenance.

ESSENTIAL FOR SAFE OPERATION:

1. Installation and operation of the newterra MBR WWTP **must** only be carried out by **trained and qualified** personnel.
2. All necessary **safety precautions must** be carefully exercised, including but not limited to proper use of personal protective equipment considering given working environment and conditions.
3. All **electrical installations and troubleshooting must** only be carried out by licensed electricians.
4. All **plumbing work must** only be carried out by licensed plumbers or qualified personnel.
5. Please keep in mind that trees and shrubs taller than two meters located in close proximity to the plant buildings may become a safety concern at the time of installation or service.

DEFINITION OF SAFETY AND WARNING SIGNS USED IN THE MANUAL

ATTENTION SYMBOL

Special attention is required to ensure compliance with instructions concerning correct operating sequences to prevent damage to the plant or its function.

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GENERAL WARNING SIGN

This symbol accompanies all important instructions or warnings associated with risks of injury as well as possible equipment damage.

WARNING

CRITICAL WARNING SIGN

Warns against an unsafe situation or practice associated with severe injury as well as major equipment damage.

2.1 Personal Protective Equipment (PPE)

Personal protective equipment refers to protective clothing, helmets, goggles, or other garments used to prevent injury.

The following list includes the minimum scope of PPE that should be available to newterra MBR WWTP operators:

Eye and Face Protection:

Protective glasses, goggles and face shields prevent wastewater and chemical splashes, tiny dust particles and vapors from getting in eyes and face.

Foot Protection:

Each operator should wear safety boots with steel toe and shank inserts at all times in wastewater plant operating area to protect feet from falling /rolling objects, wastewater and chemicals splashes, and electrical hazards.

Hand Protection:

Wear protective gloves at all times working in wastewater plant operating area; chemical-resistant gloves must be worn when handling chemicals

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Clothing

Wear protective clothing to minimize risk of biohazards. Chemical splash apron must be worn when operator handles chemicals.

2.2 Bacterial Safety

The wastewater contains a mixture of viable bacteria and other biological organisms. A wastewater treatment plant poses a number of bacterial hazards and consequently potential health risk. Immunization protects operator against infection. The use of proper hygiene measures, protective equipment, good housekeeping and common sense prevent contact with pathogens.

These measures prevent infection!

Ensure that hands are washed with an antibacterial soap and warm water and dried by disposable towels on a regular basis, especially prior eating!

Do not expose cuts or open sores to wastewater!

Use personal protective equipment (PPE) at all times in wastewater treatment facility!

Any concern about possible infection should be brought to the attention of medical physician immediately!

2.3 Chemical Safety

The following chemicals are used in operation of newterra MBR WWTP:

- **Sodium hydroxide (NaOH)** is used for pH adjustment, in case there is a deficiency in alkalinity in influent sewage and pH drops. It is very corrosive and hazardous in case of skin/ eye contact, and ingestion.

- **Sodium hypochlorite (NaOCl)** and **Citric Acid ($C_6H_8O_7$)** are used for cleaning the membranes.

  √ **Sodium hypochlorite (NaOCl)** is a common disinfectant, which can be an irritant or corrosive, depending on its concentration. It cannot be mixed with organics, ammonia compounds or acids. ***Contact with acids produces highly toxic chlorine gas. It has to be mixed only with pure water.***

  √ **Citric Acid ($C_6H_8O_7$)** is hazardous in case of skin contact (irritant, sensitizer), or ingestion, eye contact (irritant) and inhalation (lung irritant).

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When handling chemicals, it is important to wear proper personal protective equipment such as chemical goggles with combination full face shield, protective clothing with chemical splash apron and chemical-resistant rubber gloves.

The detailed information regarding health & safety of chemicals used in wastewater treatment process can be found in MSDSs presented in Appendix F of the O&M Manual Material.

2.4 Locking out Equipment

Lockout procedures must be followed prior to performing mechanical or electrical maintenance to ensure that equipment has been de-energized.

- All relevant local guidelines and procedures must be applied

2.5 Entering Confined Spaces

Confined space is defined as an area which is enclosed with limited access. The confined space:

- is large enough and so configured that an employee's body can enter and perform assigned work;
- has limited or restricted means for entry or exit; and
- is not designed for continuous employee occupancy;
- the accumulation of hazardous or toxic gases, vapor, dust, fumes, or the creation of an oxygen-deficient atmosphere may occur in confined space.

Follow local laws and regulations with respect to entering a confined space.

2.6 Vision Hazard

An Ultraviolet light (UV) unit is used in the wastewater treatment plant for final disinfection of treated effluent. Do not look directly at the blue UV lamps. Immediate or prolonged exposure to UV light can result in painful eye injury and skin burn.

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2.7 Responsibility for Safety

Management:

Management is responsible for providing a safe working environment. This is accomplished partly by:

- Ensuring that all facilities and equipment are built and maintained in accordance with the appropriate safety standards
- Providing adequate funds for equipment and plant maintenance
- Establishing, promoting, and enforcing a ***safety policy***
- Establishing a safety training program
- Supplying easy accessible eyewash and first-aid stations and proper personal protective equipment (PPE) for personnel servicing wastewater treatment facility.

Worker:

- To develop a positive and professional attitude towards safety.
- To avoid mistakes caused by indifference to safety, poor work habits, lack of attentiveness, rushing the job, failure to observe established safety procedures and poor physical condition.

***Remember the "ABC" of accident prevention*:**

ALWAYS BE CAREFUL!!!

In addition to ***"being careful"*,** it is the responsibility of all workers to:

- Work in accordance with established safety procedures
- Follow the established safety rules
- Wear appropriate personal protective equipment (PPE)
- Report all accidents, no matter how minor
- Report potential safety hazards
- Participate in safety programs

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Plant Safety – Simple Rules to Follow

Common sense plays a very important part in the safe operation of any type of plant!

- Wear the appropriate personal protective equipment at all times.
- Keep walkways clear of snow and ice, and loose objects such as pails, shovels, tools, etc.
- Clean up spills of oil, grease, chemicals, or other substances immediately.
- Keep all tools and similar equipment clean, in good condition, and properly stored when not in use.
- Replace all manhole covers, access trap doors, etc. as soon as possible. Erect a safety barrier if it is necessary to leave the opening uncovered.
- Use the proper tools when removing or replacing a manhole cover.
- Wear a safety belt whenever there is the possibility of falling even a short distance, or when working over water.
- Lock out and tag electrical equipment before working on it or the associated equipment.
- Ensure that moving machinery is properly guarded. Wear ear protection in noisy environments.
- Ensure that fire-fighting equipment is in good working condition.

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Hazard Warning Signs/Symbols

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3.0 WASTEWATER TREATMENT PLANT DESIGN BASIS

The **newterra** MBR Wastewater Treatment Plants (WWTPs) are designed for treatment of domestic wastewater from 200-m Mine Site camp with an average design flow of 72 m^3/d and 175-m Milne Port camp with an average design flow of 63 m^3/d. The wastewater treatment plants have been designed to meet the required effluent quality.

newterra MicroClear™ MBR Process Specification

Parameters	Unit	Value	
		Mine Site WWTP	Milne Port WWTP
Design Hydraulic Load			
Average Daily Flow (ADF)	m^3/d	72	63
Selected Design Flow (Q_h)	m^3/h	3	2.63
Organic Load			
COD Load	[kgCOD/d]	76.32	66.78
BOD Load	[kgBOD/d]	38.16	33.39
TKN Load	[kgTKN/d]	5.4	4.73
TAN Load	[kgTAN/d]	3.24	2.84
TP Load	[kgTP/d]	0.86	0.76
TSS Load	[kgTSS/d]	41	35.9
Process Tanks			
One (1) Equalization Tank			
Effective volume	m^3	43.5	43.5
Hydraulic Retention Time (HRT_{EQ})	h	14.5	16.5
One (1) Aeration Tank			
Effective volume	m^3	48	48
$HRT_{AEROBIC}$	h	16	18.3
Two (2) Membrane Tanks			
Total Effective Volume	m^3	5.0	5.0
$HRT_{MEMBRANE}$	h	1.7	1.9

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Parameters	Unit	Value	
		Mine Site WWTP	Milne Port WWTP
MBR System (including aeration tank and membrane tanks)			
Overall Effective Volume	m^3	53	
Overall HRT	h	17.7	20.2
Overall SRT	d	15	16
Internal recirculation rate: Membrane tanks →Aeration tank		4 – 5x influent flow	
Average Design Flux	LMH	18	
Sludge wasting rate (at 1%, 10 g/L)	m^3/d	3.8	2.93
Minimum / maximum design operating temperature	°C	10 / 35	

MicroClear™ MB3-1 membrane module		
MCXL cassettes in each MB3-1 module	nr	15
Individual MB3-1 module filtration area	m^2	105
MB3-1 modules in each membrane tank	nr	1
Total Membrane Filtration Area in two (2) membrane tanks	m^2	210
MB3-1 Module Dimensions (L x W x H)	m	1.30 x 0.70 x 1.85
Housing materials	-	Stainless steel 1.4571 (316 Ti)

Sludge Treatment System	**Unit**	**Value**
One (1) Mixing Tank		
Effective Volume	m^3 (gal)	0.9 (240)
One (1) 6 ft^3 (expandable to 10 ft^3) 630 mm filter press		
Feed from aeration tank		
Sludge volume	m^3	2.93
Sludge concentration	%	1
Dewatered sludge dryness	%	25
Filter press daily run time		
Cycles	c/day	4
Cycle duration	h	4
Overall daily run time	h	16
Construction materials	-	Heavy duty steel skeleton, panted with two part epoxy
Polymer consumption (40 mg/L addition ratio of polymer at 0.25%)	L/d	150

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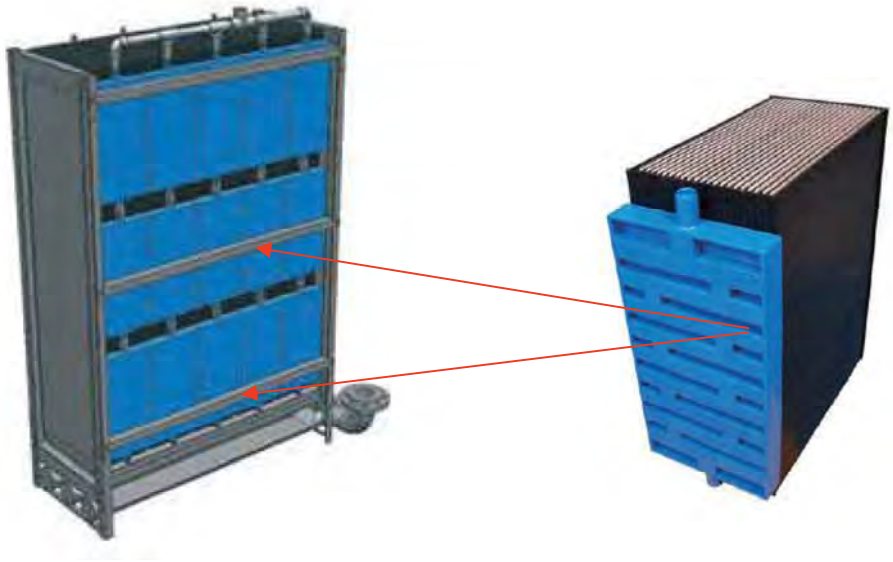

MicroClear™ MB3-1 membrane module

MicroClear™ MCXL membrane cassette

Influent Wastewater/Treated Effluent Characteristics:

Parameters	Unit	Influent Quality	Effluent Quality	
			Mine Site WWTP	Milne Port WWTP
pH	s.u.	6.0 – 9.0	6.0 – 9.5	6.0 – 9.5
Turbidity	NTU		<5	< 5
Fat, Oil, Grease (FOG)	mg/L	< 30	No visible seen	No visible seen
Chemical Oxygen Demand (COD)	mg/L	1060	-	-
Biological Oxygen Demand (BOD_5)	mg/L	530	< 10	< 20
Total Suspended Solids (TSS)	mg/L	570	< 10	< 20
Total Kjeldahl Nitrogen (TKN)	mg/L	75		-
Ammonia Nitrogen (NH_3-N)	mg/L	45	< 2	< 2
Total Phosphorus (TP)	mg/L	12	< 0.1	-
E-Coli / Fecal Coliform	CFU/100 mL		< 200*	< 200*
Alkalinity (assumed)	mg/L as $CaCO_3$	10 – 14	-	-

**After UV disinfection*

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Prohibited Items

The raw wastewater should not contain any of the following substances:

- Hydrocarbons – lubricants, gasoline, diesel, etc.;
- Paints, solvents, silica, silicones and polymers;
- Antibacterial solutions, and products with quaternary ammonia;
- Large quantities of chemicals such as water softener, disinfectants, strong acids & alkalis, pesticides or photographic chemicals;
- Silicone based defoamers;
- Non-biodegradable solid waste (plastic, rubber products, disposable diapers, etc.);
- High amount of metals, such as iron, magnesium, calcium, barium and strontium.

TOXIC MATERIALS SHOULD NOT BE THROWN INTO THE DRAIN!

The raw wastewater should also comply with the following compatibility chart. The lipophilic substances concentration must be lower than **50 mg/L.**

MicroClear™ Membrane Compatibility Chart

Group	Substances	SP-Type Membrane
Chlorinated solvents	Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane (<1%)	--
Esters	Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%)	--
Ethers	Ethyl Ether, Polyethylene Oxide (<1%)	--
H_2O_2	<2000 ppm	++
Inorganic acids	HF, HCl, H_2SO_4	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	--
NaOCl	100,000 ppmxh	++

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Organic acids	Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic Acid, Acetic Acid, Acrylic Acid, Latic Acid	pH 0 - 14
Phenols		--
Silicones		--
Alcohols	Ethanol, Butanol, Isopropranol (<50%)	+
Aldehydes	Formaldehyde (<1%)	++
Alkali		pH 0 - 14
	Dimethyl Formamide, Dimethyl, Acetamid Dioxane, N-Methyl, Pyrrolidone, Tetramethyl Acetamide	--
Aprotic Solvents	Benzene, Toluene, Xylene, Anthracene, Naphatalene, Gasoline	--
Aromatic hydrocarbon	Methoxyethanol, Ethoxyethanol, Buthoxyethanol	?

(++ = Very good, + = good, - = fair, -- = not recommended)

Removal of Oily Materials

The wastewater must pass through a grease trap (or similar facility for grease/fat removal), if there is kitchen usage onsite. The large amount of oil and fat can harm treatment facility (e.g., clogging pumps and piping and cause foaming in the aeration tank). To avoid premature membrane fouling, maximum FOG concentrations should not exceed 30 mg/L.

Fats, oils and grease (FOG) must be removed prior to MBR. Removing of FOG significantly reduces membrane fouling, foaming potential and increases aeration efficiency.

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4.0 PLANT INSTALLATION, INSPECTION, AND TESTING

The **newterra** MicroClear™ MBR WWTP is a packaged plant which comes complete with containerized inlet screen, equalization tank, post EQ screen, aeration tank, membrane tanks, UV disinfection systems and a sludge dewatering unit. The plant is housed inside multiple 40-ft modified high-cube shipping containers - completely pre-assembled, pre-piped, pre-wired and pre-tested, ready for a quick site installation and start-up. The standard containerized design also allows for modular expandability, portability and quick deployment, particularly beneficial features for work camp applications.

4.1 Site Conditions Requirements

- Installation site for the **newterra** MicroClear™ MBR WWTP should be close to the sewer drain and have a sufficient power source (refer to Electrical Drawings in **Appendix A** of this manual).

- Location must permit easy access for equipment capable of transporting, offloading, and handling of the designed loads.

- There should be adequate space around the containers for safe operation and maintenance.

- The firm base (foundation) must be built to support the full operating weight of the plant to prevent buildings from shifting and pipe/electrical conduit connection failure – pilings or rig mats are recommended (based on site conditions).

The firm base for the container must be level and must be capable of supporting the operating weight.

WARNING: ***Always check with the local utility companies for the location of water lines, electrical and telephone cables, or any additional hazards below grade, prior to excavation. Failure to do so could result in severe bodily injury or death.***

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4.2 Inspection upon Delivery

The **newterra** MicroClear™ MBR WWTP is carefully manufactured, checked, and tested at the manufacturing plant. All equipment is pre-wired, pre-piped, mounted inside the enclosure and factory tested. Upon receiving the system, please perform the following:

- Place the containers onto the prepared firm base to avoid sagging, equipment vibration, and shifting. When lifting the container, ensure that lifting equipment is clear of overhead obstructions such as power lines, trees or rooftops. Be careful during this procedure!
- Be careful when offloading the containers to prevent damage to the internal pipe work.
- Check the containers for any signs of shipping damages.
- Inspect the containers to ensure that no components or parts are missing (refer to the **Packing Slip** presented in **Appendix B** of this manual). Also, inspect for visual damage of the tanks, pumps, blowers, piping, and control panel.
- If the containers, equipment inside and any parts shipped loose are free of damage, proceed with the installation.

For any damages or loss of equipment, **please notify newterra ltd. at (800) 420-4056 immediately.**

4.3 Plant Initial Set up

WARNING: ***The installer must ensure that the installation site is safe from hazards. These could include excavations left open overnight, debris left lying around, and tanks & equipment not properly blocked. Provisions must be made to eliminate the potential hazards by roping off and proper shoring around the excavations, cleaning up at the end of each workday, and proper storage of equipment. Failure to do so could result in severe injury or death.***

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Enclosures Specifications

WWTP Enclosures	newterra MicroClear™ MBR WWTP consists of six (6) cMET certified, built to NEC standard enclosures
Enclosure #1 (SCREEN BLD-7903)	Room #1 - Class 1 Div 2, contains Screen Modules with Screw Screen Compactors (SCR-201/SCR-401), Screen Discharge Tanks (TNK-202/TNK-401), and pumps
	Room #2 - General Purpose (GP), contains Control Panel
Enclosure #2 (EQUALIZATION BLD-7901)	General Purpose (GP), contains Equalization Tank (TNK-301)
Enclosure #3 (AERATION BLD-7902)	General Purpose (GP), contains Aeration Tank (TNK-501)
Enclosure #4 (MBR FILTRATION BLD-7900)	General Purpose (GP), contains Membrane Tanks (TNK-601/TNK-602), scouring blowers, pumps, permeate withdrawal systems, UV system, and chemical units
Enclosure #5 (EFFLUENT BLD-7905)	General Purpose (GP), contains Effluent Tanks (TNK-811/TNK-812/TNK-813/TNK-814), pumps, and chemical units
Enclosure #6 (SLUDGE BLD-7904)	Room #1 - Class 1 Div 2, contains sludge dewatering module including Filter Press (FP=901), mixing tank (TNK-901), air , and pumps
	Room #2 - General Purpose (GP), contains pumps and blowers for aeration tank, and office space
Estimated Dry shipping weight for each enclosure	SCREEN BLD-7903 – 20 000 lb (9072 kg) EQUALIZATION BLD-7901 – 26 000 lb (11 793 kg) AERATION BLD-7902 – 28 000 lb (12 700 kg) MBR FILTRATION BLD-7900 - 23 000 lb (10 432 kg) EFFLUENT BLD-7905 - 15 000 lb (6804 kg) SLUDGE BLD-7904 – 20 000 lb (9072 kg)
Enclosures Dimensions	All enclosures are 40-ft high-cube modified shipping containers: 12.2 m L x 2.44 m W x 2.89 m H (40' L x 8' W x 9'6" H)
Influent supplied head	3.0 m (10')
Treated effluent discharged head pressure	1.5 m (5')
Inlet pipes	3" steel FNPT for wastewater from lift station; 3" steel with female camlock from sewage truck
Discharge pipe	2" steel pipe with 2" flange

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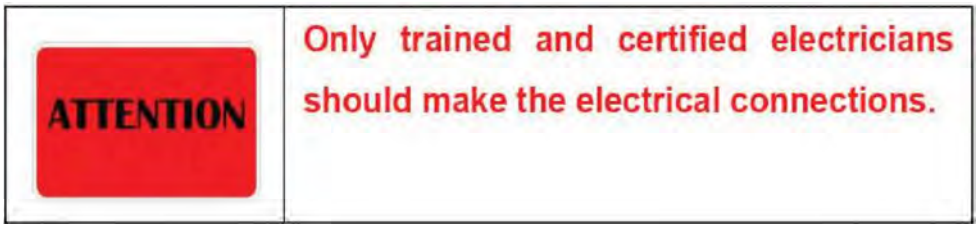
Verify site power per system design criteria.

System Electrical Specifications:

System Power	600-V, 3-Phase, 3-Wire, 60 Hz
Main Disconnect	200 A
Panel Approval and Classification	cMET, Classified
System Approval and Classification	cMET, Classified GP & C1 Div 2
Telemetry Setup	-

Please refer to the as-built electrical drawings in Appendix A of this manual.



Installation Instructions:

1. Remove hatch covers from the interconnecting ports.
2. Place containers tight against each other with the interconnecting ports lining up.
3. Connect electrical power to the **Main Switch Panel** located inside the enclosure **(BLD-CONTROL)** 3 phase, 380 V from available source ensuring correct phase rotation.
4. Ensure that proper electrical grounding and lightning protection is available.
5. Switch **Main Switch Panel's isolator** to the **ON** position.
6. Check all internal lighting, heating, and ventilation for correct operation.
7. Install packed external lighting into brackets above the doorway (double man doors), route the cables to the inside of the container through the ports provided and plug into sockets provided (check for correct operation).

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8. Ensure that a potable water supply is available (used for hydraulic testing during start-up, membrane cleaning, washing hands and for performing onsite testing).

9. **Ensure availability of an emergency eyewash station and personal protection equipment onsite.**

10. Verify membrane modules are secured within the membrane tanks – i.e. verify wheel chocks (if applicable) are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tanks.

4.4 Plant Initial Testing

The **newterra** MBR WWTP (except the membrane modules) undergoes electrical and leakage tests in our manufacturing facility prior to shipment; however, fittings could shift during shipment, so it is our standard practice to perform plant initial testing including **dry and hydraulic tests.**

4.4.1 Dry Test

The following tasks have to be performed **before potable water** is introduced into the system:

- Ensure that all tanks are clean and free of any dirt or debris (this is to prevent obstruction or damage to the piping, pumps, and membranes).
- Ensure that all connections have been provided and joints have been tightened.
- Check the placement of the air diffusers in the equalization tank **(TNK-301)** and aeration tank **(TNK-501)** if incorrectly positioned, proper adjustment has to be performed.
- Ensure that a functional check of the electrical and control system has been performed (please refer to the **newterra Pre-commissioning Test Checklist** presented in **Appendix C**).

4.4.2 Hydraulic Test

The hydraulic test is performed using potable water to:

- Check for and fix any leakage;
- Check the setting of level switches/transmitters;
- Check the hydraulic flow through the plant;

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- Check if all the ancillary equipment and controls of the plant function as per design;
- Recalibrate instruments (if applicable);
- Perform clean water test on membranes.

Caution: Once wetted, the membrane should remain wet, and not be allowed to dry out to prevent irreversible damage to the membrane.

Performing the Hydraulic Test

- Fill the system [equalization tank (TNK-301) and aeration tank (TNK-501)] with potable water, run the pumps and check for any signs of leakage.
- Perform electrical and instrumentation (E&I) functional checks and adjustment of level switches.
- Turn on the air blowers B-301/B-302/B-303/B-304/B-305/B-306 for the equalization tank (TNK-301) and blowers B-501/B-502 for the aeration tank (TNK-501), and check for:
    - Buoyancy of air diffusers and if this occurs, empty the tank and fix;
    - Air leakages: if this occurs, tighten up the fittings;
    - Manually check water temperature and DO (dissolved oxygen): with a hand-held DO meter and adjust air flow to keep it up to 0.5 – 1 mg/L for equalization tank (TNK-301) and 2- 3 mg/L for aeration tank (TNK-501); check the DO readings on the touch screen.
    - DO Control System: check automatic ON/OFF of aeration tank air blowers at low and high settings of DO without the return of aerated water from the membrane tanks to aeration tank, and record blower ON/OFF duration.

Membrane Tanks (TNK-601/TKN-602):

- Enable membrane operation.
- Start the pumps (P-501/P-502) for aeration tank and fill the membrane tank (TNK-601) with potable water.
- Start the air blowers (B-601/B-602/B-603/B-604/B-605) for membrane tank (TNK-601) and blowers (B-606/B-607/B-608/B-609/B-610)for membrane tank (TNK-602) and check for an even distribution of air across the membrane filter area and air bubble uniformity above the membrane modules/cassettes.

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- Check hydraulic flow pattern through the membranes and between membrane modules/ cassettes and tank wall.
- Make a clean copy of the **Clean Water Testing Sheet** presented in **Appendix K** of this O&M Manual.
- Start the permeate (vacuum) pumps P-701/P-702
- Record all checked parameters in the **Clean Water Testing Sheet:**
    - Record the vacuum (TMP) on gauges PI-701/PI-702 [for clean water could be 0.05 to 0.07 bar (20" to 29" WC)].
    - Record ambient temperature, and water temperature and DO with a hand-held DO meter.
    - Gradually increase the permeate flow while recording the vacuum (TMP) on the gauges up to the anticipated peak wastewater flow.
- Forward a complete **Clean Water Testing Sheet** to **newterra** for analysis.

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5.0 OPERATION of newterra MicroClear™ MBR

Membrane Bioreactor (MBR) treatment technology is an effective combination of an activated sludge biological treatment process with MicroClear™ MBR membrane filtration technology. The MBR operates at MLSS (mixed liquor suspended solids) concentrations between 8,000 to 12,000 mg/L.

This section provides a brief description of the treatment process and how it is controlled. Most of the equipment in the **newterra** WWTP can be operated in either manual or automatic mode. The system is designed to always run in auto mode. The manual option is provided mainly for maintenance purposes. Equipment and instrumentation identification numbers are referenced from the **Process & Instrumentation Diagram** and **System Layout** presented in **Appendix A** of this O&M Manual.

Automatic Operation

The PLC-based control system is the default operation mode for the **newterra** MicroClear™ MBR. The system operates as a programmable computer that:

- Receives analog and digital input signals from the switches and transmitters being controlled;
- Processes this information using the structure and rules entered into the program;
- Generates outputs that control the equipment - turn equipment **OFF** or **ON**.

Under normal operation, all switches are set in the **AUTO** position on the **HMI**.

All alarms are visually indicated on a beacon stack on the roof of the exterior of the container:

- Green – System OK
- Green Flashing – System Auto Restart
- Red Solid – Warning Alarm
- Red Flashing – Critical Alarm
- No Light – Loss of Power

The MBR will always remain in auto run mode, unless the kill switch is pressed or power is down. The MBR will automatically restart after power failure given that the system was running when the power failed.

All high high level alarms (identified as LSHH on P&ID) indicate a critical situation for imminent tank overflow and could result in pump(s) shutting off to avoid overflow situations and requires immediate operator attention.

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Manual Operation

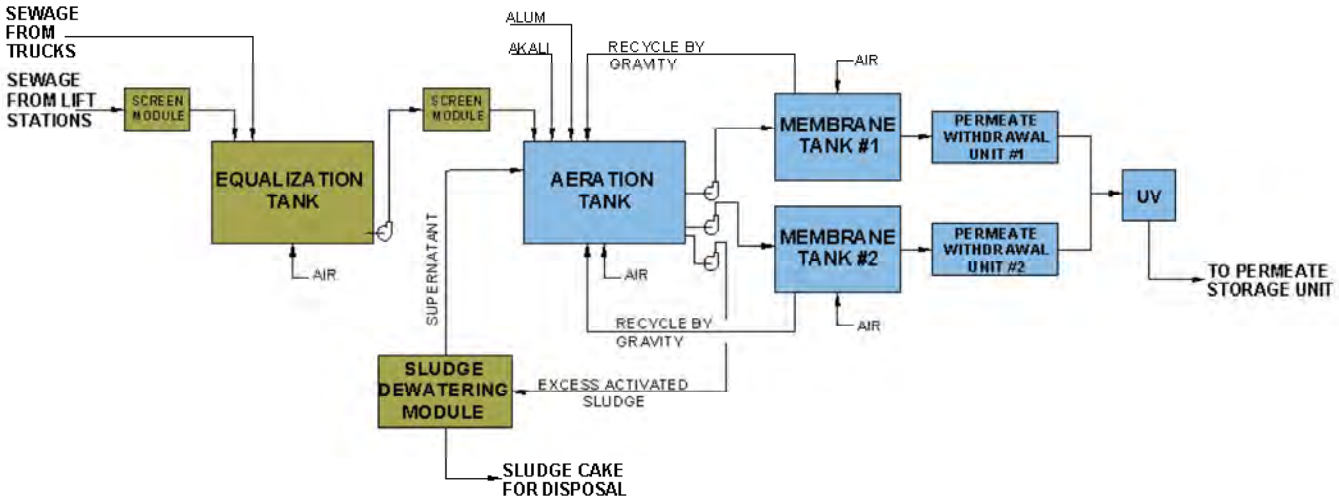
The manual mode of operation is provided for maintenance purposes and for emergency operation of the plant in the unlikely event of a failure of the automatic control system (default operation mode). Operators **must be present when equipment is operated in the manual mode.**

A HAND-OFF-AUTO (H-O-A) switch is provided on the touch screen of the control panel. The HAND position on the switch allows the equipment to be operated in the manual mode.

For safety reasons, a motor in the HAND position will only run for two minutes before it will be automatically stopped.

5.1 Wastewater Treatment Process Description / Control Narrative

The **newterra** MBR WWTP comprises screen modules, equalization tank, aeration tank, membrane filtration module, UV system, permeate storage tank, and sludge dewatering module.



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5.1.1 Buildings/ Utilities

The newterra MBR WWTP is housed inside six (6) enclosures (buildings):

- Screen building (BLD-7903) with two (2) rooms: Room #1 (Electrical Classification – Class 1, Div 2 area), and Room #2 (GP area)
- Equalization tank building (BLD-7901)
- Aeration building (BLD-7902), GP area
- Membrane Filtration building (BLD-7900), GP area
- Effluent building (BLD-7905), GP area
- Sludge building (BLD-7904) with two (2) rooms: Room #1 (Electrical Classification – Class 1 Div 2 area), and Office Room #2 (GP area)

The main control panel is located in the Screen building (BLD-7903), Room #2 (GP area)

5.1.1.1 Wastewater Treatment Plant Power Supply

Please refer to the as-built Electrical Block Diagram presented in Appendix A of this manual.

A power monitor has been installed in the main power distribution panel to ensure proper power and phase rotation is delivered to the system. The main power distribution panel is located in the Screen BLD-7903, Room #2 (GP area).

E-STOP

There are several emergency stop buttons wired to a common system kill circuit (KILL-7901) in the plant:

- Kill Switch Emergency Stop **MCP-01** (ESD-8201) located in the control room of the BLD-7903, Room #2, (GP area)
- Emergency Stop **MCP-02** (ESD-8202) located in BLD-7900
- Emergency Stop **MCP-03** (ESD-8203) located in BLD-7905
- Emergency Stop **MCP-04** (ESD-8204) located in BLD-7904, Room #2 (GP area)
- Emergency Stop Screen (ESD-7931) located in BLD 7903, Room #1 1 (Class 1 Div 2 area)
- Emergency Stop Membrane Filtration (ESD-7911) located in BLD-7900

The following emergency stop switches are used for local shut off:

- Emergency Stop Effluent (ESD-7905) located in BLD-7905
- Emergency Stop Sludge (ESD-7941) located in BLD-7904

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5.1.1.2 SCREEN BLD-7903

Ventilation

Two (2) exhaust blowers (B-7931 & B-7932) provide constant ventilation for the Screen Modules and Building BLD-7903 Room #1 (Electrical Classification – Class 1 Div 2 area). The air from the blowers is passed through a heat recovery system prior to discharging outside. The blowers run at all times at a rate of ~12 air changes per hour to ensure the requirements of the electrically classified location are met.

Alarms

If the blowers' motors stop running an alarm signal will be sent to the PLC from current switches (YI-7931/ YI-7932).

A single exhaust fan (F-7911) is locate in the Room #2 (GP) of the BLD-7903 where the main control panel is located. The purpose of the fan is to prevent the building temperature from climbing higher than desired room set point temperature. The desired room temperature must be set by the operator with the building high temperature switch TSH-7911. If this switch is tripped the exhaust fan will run until the temperature drops below the set point.

Note: The fan (F-7911) is to be used primarily during the summer months - freezing cold air in to the building can lead to condensation/potential freezing risks for critical pieces of equipment.

Hydrogen Sulphide Detection

A Hydrogen Sulphide (H_2S) Detector (AIT-7931) is installed in the screen building (BLD-7903) Room #1 (Electrical Classification – Class 1 Div 2 area). This sensor allows continuous monitoring for H_2S gas. In the event the H_2S alarm level set point is exceeded an alarm will be triggered and indicated on the HMI, an internal and external audible buzzer will sound, the alarm beacon light will illuminate. The water treatment process will continue to run.

Temperature control

For building (BLD-7903), temperature is controlled manually at the local thermostats of the heaters: H-7931/H-7932 for the Room #1 (Electrical Classification - Class 1 Div 2) and H-7933 for the Room #2 (GP area). They are not linked to the PLC.

The operator is required to set the desired building temperature set point in ^{o}F at the temperature switches (TSL-7931 and TSL-7932) located in the general purpose room of this building. If the building temperature falls below the temperature switch setting the electric heaters (H-7931/H-7932) will turn on. H-7933 is locally controlled only.

CAUTION: The temperature switch units are in ^{o}F.

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Alarms

If the temperature of the room #1 and room #2 in the BLD-7903 drops below the low low temperature set point, the alarm switches (TSLL-7931 & TSLL-7932) will trip and after 300 sec a low temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7931/H-7932) are faulty.

5.1.1.3 EQUALIZATION TANK BLD-7901

Ventilation

The Equalization Tank (TNK-301) is equipped with a ventilation exhaust blower (B-307) located in classified area of BLD-7903. The blower runs at all times providing constant ventilation of the equalization tank. The blower vents air at a rate of 12 air changes per hour and exhausts to the exterior of the building.

If the blower's motor stops running an alarm signal will be sent to the PLC from current indicator switch (YI-307).

5.1.1.4 AERATION TANK BLD-7902

Ventilation

The aeration tank head space is vented by a blower (B-503) to the aeration foam tank (see details in subsection 5.2.3).

5.1.1.5 MEMBRANE FILTRATION BLD-7900

Hydrogen Sulphide Detection

A Hydrogen Sulphide (H_2S) Detector (AIT-7911) is installed below the control panel in the permeate extraction system room of building 7900. This sensor allows continuous monitoring for H_2S gas. In the event the H_2S alarm level set point is exceeded an alarm will be triggered and indicated on the HMI, an internal and external audible buzzer will sound, the alarm beacon light will illuminate. The water treatment process will continue to run.

Temperature control

For building (BLD-7900), temperature is controlled manually at the local thermostats for the wall mounted heaters: H-7911/H-7912. They are not linked to the PLC.

The operator is required to set the desired building temperature set point in ^{o}F at the temperature switch (TSL-7912). If the building temperature falls below the temperature switch setting the wall mounted electric heaters (H-7911/H-7912) will turn on.

CAUTION: The temperature switch units are in ^{o}F.

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Alarms

If the temperature in the BLD-7900 drops below the low low temperature set point, the alarm switch (TSLL-7901/TSLL-7905) will trip and after 60 sec the room's temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7911/H-7912) are faulty.

5.1.1.6 EFFLUENT STORAGE BLD-7905

Temperature control

For BLD-7905, temperature is controlled manually at the local thermostat for the wall mounted heaters (H-7951/H-7952). They are not linked to the PLC.

The operator is required to set the desired building temperature set point in ^{o}F at the temperature switch (TSL-7952). If the building temperature falls below the temperature switch setting the wall mounted electric heaters (H-7951/H-7952) will turn on.

CAUTION: The temperature switch units are in ^{o}F.

Alarms

If the temperature in the BLD-7905 drops below the low low temperature set point, the alarm switch (TSLL-7951) will trip and after 60 sec a building temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7951/H-7952) are faulty.

5.1.1.6 SLUDGE BLD-7904

Ventilation

Building (BLD-7904), Room #1, Class 1 Div 2 is equipped with an exhaust blower (B-7941). The blower runs at all times providing constant ventilation of the room. The blower vents air at a rate of 12 air changes per hour. The air from the blower (B-7941) is passed through a heat recovery system prior to discharging outside the BLD-7904.

If the blower's motor stops running an alarm signal will be sent to the PLC from current (YI-7941).

Temperature control

For BLD-7904, temperature is controlled manually at the local thermostats for the wall mounted heaters: H-7941/H-7942 for the Room #1, Class 1 Div 2 and H-7943 for the Room #2 General Purpose. They are not linked to the PLC. There are temperature switches in the BLD-7904: TSL-7941/TSL-7942 for the Room #1 (Class 1 Div 2).

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Alarm

Alarm switch (TSLL-7941) is activated when the temperature falls below set point. This may indicate that heaters (H-7941/H-7942) are faulty.

Compressed air

Air compressor (C-901) supplies air to operate the filter press (FP-901). The air compressor has level switches:

- an oil level switch alarm (LSLL-901) is activated when the oil level is low
- if pressure switch (PSL-901) is activated an alarm will register on the HMI indicating the air compressor has malfunctioned.

5.1.1.7 FIRE AND EXPLOSION PROTECTION

There are some areas in the plant defined as Class 1 Div 2 according to the National Electrical Code Classification (NFPA 70). These areas are:

- Screen building (BLD-7903), Room #1
- Equalization tank zone, (BLD-7901)
- Sludge building (BLD-7904), Room #1

This classification refers to the areas with potential hazards as flammable gas which is not present under normal conditions.

Fire alarm system is implemented across the plant. The fire protection measures include fire alarm system (FAS), fire detection system (FDS), and portable fire extinguishers. Please refer to the Fire Alarm Layout Drawing presented in Appendix A of this manual.

5.1.2 Process Description

5.1.2.1 Screen Modules Building (SCREEN BLD-7903)

Function: a screening process is provided to remove hair, and fibrous materials from wastewater supplied from the lift stations and delivered by sewage trucks.

There are two (2) screen systems in the plant:

- screen module (SCR-201) for screening incoming raw sewage pumped from lift stations
- screen module (SCR-401) for screening effluent from equalization tank (TNK-301) taking into account addition of raw sewage delivered by sewage trucks and added into the equalization tank (TNK-301)

Both screen modules are located in the building (BLD-7903), Room #1 (Class 1 Div 2 area).

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Screw Screen Compactor (SCR-201)/Screen Tank

The screw screen compactor module consists of:

- screw screen compactor with 2-mm opening, equipped with solids bagging
- discharge tank (TNK-202) for collection of the screened wastewater
- external discharge pumps (P-201/P-202) to transfer screened wastewater to the equalization tank (TNK-301)
- self cleaning spray nozzles set on a timer through the HMI

Screw Screen Basin Level Control

The screw screen (SCR-201) will run when the permissive signal (YC-101) to receive from the lift station is ON, and the high level in the screen tank has been reached. If the high level in the screw screen basin has been reached this indicates the screen is clogged. The screw will continue to turn for 2 minutes after the high level condition has cleared.

Screened wastewater flows by gravity from screw screen basin to the screen discharge tank (TNK-202) through 6" discharge pipe.

Alarms

If the clogged screen cannot be cleared and the high high level in the screw screen basin is reached the LSHH-201 will trip. If the LSHH-201 level switch is tripped, an alarm will be generated and will remain visible on the HMI until the alarm condition has cleared. The permissive to receive wastewater from the lift station will be lost. **Operator intervention is required in the event of this alarm!**

In the event the SCR-201 motor trips off on overload an alarm will register on the HMI and the red beacon light will flash.

Screen Tank Level Control:

The screen discharge tank (TNK-202) is equipped with:

- (2) external discharge pumps (P-201 Duty and P-202 Standby)
- discharge pressure indicator (PI-201/ PI-202) to measure the discharge pressure
- motor current switch (YA-201 /YA-202)
- variable frequency drive (VFD-201/VFD-202)
- discharge tank (TNK-202) is equipped with level transmitter (LT-202) and high high level switch (LSHH-202)

After completion of 4 cycles the standby pump will run for 1 cycle. Each time a pump starts the cycle count goes up. As long as the wastewater level in TNK-202 is between the high and low set point, the PLC will allow the operation of the pumps (P-201/P-202) to transfer wastewater to the equalization tank (TNK-301).The VFD's regulate the flow of the pumps to keep the discharge flow rate at the desired set point flow.

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If current switches (YA-201/YA-202) are ON and level transmitter (LT-202) indicates the high set point, then the pumps turn on until the level transmitter (LT-202) gets to its low set point.

If the high level set point is on for more than 5 seconds, pumps (P-201/P-202) will increase speed to clear the high level condition.

Alarms

In the event the screen tank discharge pumps motor current switches (YA-201/YA-202) trip, an alarm will register on the HMI and the red beacon light will flash.

Screen Cleaning:

A potable water connection to the screw screen compactor unit (SCR-201) is used to clean the screw screen. A solenoid valve (SV-201) is controlled on a timer to open the solenoid valve for 2 seconds every 60 minutes, with the goal of removing solid build up on the screw screen. Frequency of cycle can be changed through the HMI.

5.1.2.2 Equalization Tank (TNK-301)

Function: Buffers influent variable flow to prevent concentration fluctuations in (i.e. BOD, TSS etc.) through the MBR treatment system.

The equalization tank (TNK-301) receives screened wastewater from the screen tank (TNK-202). The equalization tank (TNK-301) can also receive raw wastewater from the sewage trucks. There are two truck hook-ups from the screen building (BLD-7903) side equipped with 3" female camlocks, valves and 3" PVC pipes.

WARNING: NO CONTROLS ARE IN PLACE TO SHUT OFF TRUCK INFLUENT TO THE EQUALIZATION TANK IN THE EVENT OF A HIGH OR HIGH HIGH LEVEL CONDITION IN THE EQUALIZATION TANK. THE LEVEL OF THE EQ TANK MUST BE MANUALLY MONITORED AT ALL TIMES DURING THE OFFLOADING OF TRUCKS.

The effective volume of the EQ tank is 43.5 m^3, providing a hydraulic retention time of 14.5 hours. The equalization tank is equipped with:

- level monitoring/control equipment
- 2 electric immersion heaters with local temperature control
- blowers (B-301to B-306) supply air to the air diffusers
- 10 EDI fine-bubble air diffusers for mixing and assisting the elimination of potential odour
- 12 magnesium anodes which act as the tank ground and will be sacrificially eroded as a means of prolonging the tank life
- discharge pumps (P-301/ P-302) for transferring wastewater to the SCR-401

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Air Diffusers Control

Blowers (B-301- B-306) supply air to the air diffusers installed in the bottom of the equalization tank. A pressure indicator (PI-301) and switch (PLS-301) is installed on the discharge side of the blowers.

Alarms

If the blower air pressure drops below set point, the low pressure switch (PLS-301) will trip and a low pressure alarm will be activated through the PLC. The flashing red beacon light will illuminate.

Temperature Control

The equalization tank (TNK-301) is heated via 2 electric immersion heaters (H-301/H-302).Temperature in the tank is controlled via a local thermostat. Recommended temperature setting for TSL-301/TSL-302 is 10^{o}C to 15^{o}C.

Alarms

If the Temperature Switch Low Low (TSLL-301) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

Note: As a low water level in the tank can cause damage to the heaters, the Level Switch Low Low (LSLL-301) is installed in the equalization tank to protect the immersion heaters and if tripped will shut the tank heaters off and initiate an alarm signal from the PLC.

Transfer Pumps/Level Control

The equalization tank (TNK-301) has two (2) external pumps (P-301, P-302) with one of the pumps acting as a standby. Pump (P-301) operates for 4 cycles, pump (P-302) for 1. This pump transfers the wastewater from the equalization tank (TNK-301) to SCR-401 screw screen basin tank.

The equalization tank discharge pumps (P-301/P-302) have local pressure indicators (PI-302/PI-303) to measure discharge pressure and motor current switches (YI-301/YI-302). The discharge pressure can be used to determine an estimation of the flow rate based on the pump curve.

A level transmitter (LT-301) is used to indicate the liquor level in the equalization tank (TNK-301). As long as the level in the tank is above set point, the PLC will allow the operation of either EQ tank discharge pump (P-301 or P-302). If the high level in the EQ tank is met the screen tank supply pumps will be turned off.

Alarms

In the event the equalization tank discharge pumps motor current switches (YI-401/YI-402) trip, an alarm will register on the HMI and the red beacon light will flash.

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The Level Switch High High (LSHH-301) if tripped will send a signal to the PLC to warn of imminent overflow in the equalization tank (TNK-301).

Post EQ Screw Screen Compactor (SCR-401)

The screw screen compactor module consists of:

- screw screen compactor with 2-mm opening, equipped with solids bagging
- discharge tank (TNK-401) for collection of the screened wastewater
- external discharge pumps (P-401/P-402) to transfer screened wastewater to the aeration tank (TNK-501)
- self cleaning spray nozzles set on a timer through the HMI

Screw Screen Basin Level Control

The screw screen (SCR-401) will run when the high level in the screen tank has been reached. If the high level in the screw screen basin has been reached this indicates the screen is clogged. The screw will continue to turn for 2 minutes after the high level condition has cleared.

Screened wastewater flows by gravity from screw screen basin to the screen discharge tank (TNK-401) through 6" discharge pipe.

Alarms

If the clogged screen cannot be cleared after 5 minutes a high high level alarm (LSHH-402) will be triggered and will remain visible on the HMI until the alarm condition has cleared. The permissive to receive wastewater from the equalization tank (TNK-301) will be lost. **Operator intervention is required in the event of this alarm!**

In the event the SCR-401 motor trips off on overload an alarm will register on the HMI and the red beacon light will flash.

Screen Tank Level Control:

The screen discharge tank (TNK-401) is equipped with:

- (2) external discharge pumps (P-401 Duty and P-402 Standby)
- discharge pressure indicator (PI-401/ PI-402) to measure the discharge pressure
- motor current switch (YA-401 /YA-402)
- discharge tank (TNK-401) is equipped with a low level switch(LSL-402), high level switch (LSH-402) and a high high level switch (LSHH-202)

After completion of 4 cycles the standby pump will run for 1 cycle. Each time a pump starts the cycle count goes up. As long as the wastewater level in TNK-401 is above the low level switch level, the PLC will allow the operation of the discharge pumps (P-401/P-402) to transfer wastewater to the equalization tank (TNK-301).

Alarms

In the event the screen tank discharge pumps motor current switches (YA-201/YA-202) trip, an alarm will register on the HMI and the red beacon light will flash.

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Screen Cleaning:

A potable water connection to the screw screen compactor unit (SCR-401) is used to clean the screw screen. A solenoid valve (SV-401) is controlled on a timer to open the solenoid valve for 2 seconds every 60 minutes, with the goal of removing solid build up on the screw screen. Frequency of cycle can be changed through the HMI.

5.1.2.3 Aeration Tank (AERATION BLD-7902)

Function: Oxygen is added to the wastewater to ensure microorganism concentration is at optimum levels to metabolize contaminants. (i.e. oxidation of carbonaceous BOD; nitrification (conversion of TKN to NO_3-N).

One (1) aeration tank (TNK-501) located in BLD-7902 has an overall effective volume of 48 m^3, providing a hydraulic retention time of 16 hours. TNK-501 receives screened wastewater from the screen tank (TNK-401) of the post EQ screen module (SCR-401), return flow from the membrane tanks (TNK-601/ TNK-602), and supernatant from (TNK-901) of sludge dewatering module.

Blowers supply air to the submerged fine-bubble diffusers to ensure biological oxidation (aeration) and to keep solids in the water suspended. Mixed liquor is constantly re-circulated from the bottom of the tanks to the top through spray nozzles. This recirculation process is in place for foam suppression. Alum and soda ash chemical metering systems are in place to ensure regulation of aeration tank water pH and phosphorus levels.

The aeration tank (TNK-501) is equipped with:

- level, temperature, pH, and dissolved oxygen (DO) monitoring and control equipment.
- 2 electric immersion heaters (H-501/H-502) to keep the temperature of the biological process above 15-20° C.
- Blowers (B-501, B-502) equipped with VFD's to supply air to the fine-bubble air diffusers in (TNK-501)
- 30 EDI fine-bubble air diffusers
- Tank recirculation/sludge removal pump (P-503)
- Tank discharge pumps (P-501/P-502) transfer wastewater to the membrane tanks (TNK-601/TNK-602)
- Chemical Metering Systems – soda ash tank (TNK-6101) with dosing pump (P-6101) and alum tank (TNK-6102) with dosing pump (P-6102)

<u>Temperature Control</u>

The aeration tank (TNK-501) is heated via electric immersion heaters (H-501/H-502). Temperature in the tank is controlled via a local thermostat. Recommended temperature setting for TSL-301/TSL-302 is 15°C to 20°C.

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Alarms

If the Temperature Switch Low Low (TSLL-501) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

Note: As a low water level in the tank can cause damage to the heaters, the Level Switch Low Low (LSLL-501) is installed in the equalization tank to protect the immersion heaters and if tripped will shut the tank heaters off and initiate an alarm signal from the PLC.

Discharge Pump/Level Control

The aeration tank (TNK-501) has two (2) external transfer pumps (P-501, P-502). Pump (P-501) transfers wastewater to membrane tank (TNK-601) and pump (P-502) transfers wastewater to membrane tank (TNK-602).

Level transmitter (LT-501) indicates the liquor level in the aeration tank (TNK-501). As long as the level in the tank is above set point the PLC will allow the operation of both discharge pumps (P-501 or P-502).

Alarms

If the Level Switch High High (LSHH-501) is tripped an alarm will register on the HMI, the flashing red beacon light will illuminate and the equalization discharge pumps will be shut down or disabled from running for the duration of the high high level condition.

The aeration tank discharge pumps (P-501/P-502) have pressure indicators (PI-501/PI-502) to measure discharge pressure and motor current switches (YA-P501/YA-P502). The discharge pressure can be used to determine an estimation of the flow rate based on the pump curve.

Alarms

In the event the aeration tank discharge pumps motor current switches (YA-P501/YA-P502) trip, an alarm will register on the HMI and the red beacon light will flash.

Dissolved Oxygen Control

The aeration tank (TNK-501) is equipped with a dissolved oxygen (DO-501) sensor. The PLC is programmed to ensure the level of DO remains above 2 mg/L. If the level of DO falls below the set point value a 4-20 mA signal is sent to the VFD (VFD-501) that controls the speed of the blowers (B-501, B-502).The speed of the blowers is regulated to maintain the DO at set point level.

Alarms

In the event the Dissolved Oxygen level set point cannot be achieved within 15 minutes of the detection of the level being outside of the set point range a low DO alarm will register on the HMI and the red beacon warning light will illuminate. The duty blower will run at full speed for

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15 minutes to attempt to regain the oxygen level. If after 15 minutes the oxygen level has not returned to below set point the duty blower defaults to a manual speed setting until operator intervention is possible.

pH Control

A chemical dosing pump (P-6101) is provided to inject soda ash (Na_2CO_3) into the aeration tank (TNK-501) to maintain the pH at desired pH set point. If the pH measured by pH probe (PH-501) falls below set point, the PLC will turn the pump on for 30 seconds, turn the pump off for 30 seconds and repeat this cycle until tank pH has regained desired set point. The pump stroke must be set by the MBR system operator.

Alarms

In the event the pH level set point cannot be achieved a low or high pH alarm will register on the HMI and the red beacon warning light will illuminate. The system will continue to adjust to achieve set point pH throughout the duration of the alarm.

Phosphorus Concentration Control

A chemical dosing pump (P-6102) is provided to inject alum [$Al_2(SO_4)_3$]. The dosing pump will be stroked based on an influent volume set point entered on the HMI by the system user. Alum is used to remove phosphorus from the influent. The alum dosage volume is manually set locally at the metering pump by adjusting the pump stroke.

Foam Suppression

The aeration tank (TNK-501) is equipped with an external pump (P-503) and a spray nozzle system for foam suppression. The pump (P-503) has a pressure indicator (PI-503) measuring its discharge pressure. The flow is controlled by opening a manual gate valve installed in the foam suppression line. The foam suppression line is equipped with a de-ragger unit to prevent spray nozzles from plugging.

Sludge Dewatering Unit Supernatant Return

Supernatant can be returned to the aeration tank (TNK-501) if the MBR system is operating in conjunction with a sludge dewatering system. Supernatant will be returned as long as the aeration tank level is below the High Level set point. The PLC will shut down pump (P-503) for the duration of the return cycle.

Sludge Removal

A sludge removal pipeline is provided at a tee off of the aeration tank recirculation line, isolated by a manual ball valve. The manual isolation valve must remain closed at all times. To remove sludge the manual isolation valve is opened along with the manual isolation valve at the entrance of TNK-901, while P-503 is running.

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5.1.2.3 Membrane Filtration (TNK-601/602)

Function: Mixed liquor filtration and supplemental biological oxidation.

Membrane filtration is comprised of a membrane tank and permeate extraction unit

Membrane unit includes:

- Two (2) membrane tanks, each tank is equipped with submersible membrane filtration module, level controls, gravity recycling line, drain, access hatch, viewing window, and sample port
- Blower unit for membrane tanks; each unit contains five (5) blowers and it is equipped with pressure indicator, pressure switch low alarm, and motorized three-way valve
- Recirculation pumps transferring mixed-liquor from the membrane tanks (TNK-601/TNK-602) to the aeration tank (TNK-501)

Permeate extraction unit includes:

- Permeate pumps (P-701/P-702) with VFD, current switches, pressure and flow rate control equipment, solenoid valves, and motorized valves
- Backwash tank (T-801) equipped with level control switches, submersible pump (P-801), and solenoid valve
- UV disinfection unit with two (2) UV lights (UV-751/UV-752)

Membrane Unit Operation

External pumps (P-501/P-502) housed in (BLD-7900) transfer mixed liquor from the aeration tank (TNK-501) to the membrane tanks (TNK-601/TNK-602). Each membrane tank contains One (1) MicroClear™ MB3-1 submerged membrane module (membrane cassettes are complete with stainless steel housing and permeate piping with header).

Each membrane tank is equipped with air diffusers for the purpose of scouring the membranes to assist in the prevention of membrane fouling.

Mixed liquor from the membrane tanks (TNK-601/TNK-602) is constantly recycled back to the aeration tank (TNK-501) by external pumps (P-601/ P-602) to maintain even biomass inventory within the aeration tank and membrane tanks.

Each of the respective pumps (P-601/P-602) are equipped with pressure indicators (PI-603/PI-604) to measure the discharge pressure of the pumps, and current switches (YA-601/YA-602). The membrane tanks are also equipped with gravity overflow lines that recycle mixed liquor back to the aeration tank (TNK-501).

Membrane Tanks Level Control

The membrane tanks (TNK-601/TNK-602) contain high level switches (LSH-601/LSH-602) which activate the permeate pumps (P-701/P-702) to start pulling permeate out of the membrane tanks (TNK-601/TNK-602).

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Alarms

The level switches high high alarm (LSHH-601/LSHH-602) inform the operator of an imminent overflow. It also shuts off the aeration tank discharge pumps (P-501/P-502) to prevent more mixed liquor from entering the membrane tank (TNK-601/TNK-602).

Recycle Pump Control

Recycle (RAS) pumps (P-601/P-602) recycle mixed liquor from membrane tanks (TNK-601/TNK-602) back to the aeration tank (TNK-501) as long as the discharge pumps (P-501/P-502) are on, water level switches in the membrane tanks (LSH-601/LSH-602) are ON, and there is no High High Level in aeration tank.

Alarms

In the event the RAS pumps motor current switches (YA-601/YA-602) trip, an alarm will register on the HMI and the red beacon light will flash.

Blower Units Control

The membrane air scouring blowers (B-601 to B-605 for TNK-601 and B-606 to B-610 for TNK-602) are connected to the air diffusers in the membrane tanks (TNK-601/TNK-602) respectively. The common airlines to the membrane tanks are equipped with a discharge pressure indicators (PI-601/PI-602) and a pressure switches (PSL-601/ PSL-602).

Each blower unit is also equipped with an electrically actuated three-way valve (MV-601/ MV-602) to direct the flow of air through medium air diffusers or coarse air diffuser. The valves (MV-601/MV-602) are installed with closed position switches (ZSC-601/ZSC-602) that is monitored by the PLC.

The blowers scouring the membranes:

- Operates continuously **(24/7)**
- Turned off for one minute every hour to relax the membranes

Coarse Air Diffuser Cycle

Under normal operation, air is directed through the medium air diffusers at the base of the membrane housing. If the level switch high (LSH-601) has not been reached in 30 minutes, the air is diverted to the coarse air diffusers in the membrane tank. Changing where air enters into the membrane tank (TNK-601) changes the direction of scouring, helping remove debris on the membrane modules/cassettes.

The air will be directed to the coarse air diffusers for the time interval set point entered through the HMI. The duration of the coarse air diffuser cycle time is adjustable up to 15 minutes, by changing the set point on the HMI screen to meet the particular plant operating conditions.

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Blower for scouring air must be on 24/7, as failure of air supply can lead to clogging of the air diffusers and membranes.

Alarms

If the pressure switches low alarm (PSL-601/PSL-602) are tripped, a signal will be sent to the PLC which will generate an alarm indicating a potential blowers (B-601 to B-610) malfunction which will cause the corresponding membrane permeate tank discharge pumps (P-701/P-702) to stop. This interlock is in place to prevent damaging the membranes.

Please note: At no time shall the vacuum pumps P-701/P-702 operate when the pressure switches (PSL-601/PSL-602) are active; this is to ensure that air for membrane scouring is available at all times, and to protect the membranes from fouling.

Permeate Extraction Unit Operation

Vacuum pumps (P-701/ P-702) draw the water through the membranes under a preset flow rate of 31.5 Lpm (at a design flux of 18 LMH). Permeate is run through UV system for final disinfection before entering permeate storage tank (TNK-811).

Permeate Flow Control

There are two (2) operational modes for permeate flow control, flow mode (constant flux mode) or vacuum mode (constant TMP mode).The operator has the option of selecting the permeate flow control mode on the screen. Flow transmitters (FT-701/FT-702) are installed on the permeate discharge line to measure the effluent flow from each membrane tank.

Flow Mode (default for newterra MBR)

- Normal permeate flow rate is 31.5 Lpm (corresponds to a design flux rate of 18 LMH)
- This setpoint is used for vacuum pumps (P-701/P-702) VFDs control
- The maximum permeate flow setpoint is 52.5 Lpm (corresponds to a maximum flux rate of 30 LMH)
- The operator has the option of changing the permeate flow rate on the screen, but the set point should not be greater than 31.5 Lpm under normal operating condition and cannot exceed 52.5 Lpm, at any given time

Note: If the vacuum reaches -0.250 bar the system automatically switches to Vacuum Mode.

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Vacuum Mode

There are two vacuum set points for the permeate withdrawal system:

- Normal vacuum rate to pull the permeate out at a pre-set vacuum setpoint of -0.100 bar
- Higher vacuum rate (-0.120 bar) is used when the EQ tank's high level (LSH-301) is on, signalling the MBR to run at a higher vacuum to keep up with the incoming water
- The highest vacuum of the permeate extraction system is -0.300 bar

Permeate Discharge Pump Control

The permeate discharge pumps (P-701/P-702) will run continuously as long as the high level switches (LSH-601/P-602) in the membrane tanks (TNK-601/TNK-602) are activated. Permeate withdrawal is done based on the preset permeate normal flow rate or vacuum rate.

If the level switch (LSH-301) in the equalization tank (TNK-301) is active for more than 5 seconds, permeate pumps (P-701/P-702) start increasing the permeate flow rate using the variable frequency drives (VFD-701/VFD-702). The trans-membrane pressure (TMP) indicated by vacuum transmitters (VT-701/VT-702) and the calculated permeability are displayed on the touch screen. The permeability is a key indicator of membrane fouling state.

Membrane Relax Cycle

- After every 9 minutes of permeate flow the permeate discharge vacuum pumps (P-701, P-702) will stop and the electrically actuated valves SV-701/SV-702 will open to release vacuum through the membranes.

- The resulting removal of vacuum in the system allows the membranes to relax for 1 minute.

Membrane Backwash Cycle

- When necessary conditions have been met the backwash tank sump pump (P-801) will be activated, permeate pumps (P-701/P-702) shut off and the backwash supply valves (MV-701/MV-702) open, to allow the reversal of flow over the membrane surface.

- The duration of the relax and backwash time is adjustable by changing the set point on the **HMI** screen to meet the particular plant operating conditions. A combination of backwash and relaxation (no permeation) is carried out for the best performance of the membranes.

- Maximum head required for backwash is **one meter**.
- During the entire backwash cycle, the scouring of the membranes is continuous.

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At design flow when the membrane discharge vacuum exceeds 0.2 bar/80" WC (transmitted by VT-701, and indicated locally at PI-701), or permeability drops rapidly to 50 LMH/bar, it is necessary to take the membrane tanks (TNK-601/TNK-602) offline for chemically enhanced backwash **(CEB)** cleaning (please refer to Section 7 of this O&M manual)..

The permeability is a key indicator of membrane fouling state. A permeability of less than 50 LMH/bar (or transmembrane pressure exceeding 0.2 bar) indicates a membrane chemical clean is required.

A chemical addition unit is provided in the building (BLD-7900) for membrane in-situ chemically enhanced backwash (CEB) and recovery cleaning. The unit includes:

- Citric acid tank (TNK-802) with chemical dosing pump (P-802)
- Sodium hypochlorite tank (TNK-803) with chemical dosing pump (P-803)

Backwash Tank

The backwash tank (TNK-801) has 3 level switches (LSL-801, LSH-801, LSHH-801). When the low level switch LSL-801 is tripped this indicates a low water level in the backwash tank. Solenoid valve (SV-801) will open to fill the tank to the high level switch (LSH-801).

Alarms

LSHH-801 indicates imminent overflow. An alarm signal will register on the HMI and the flashing red beacon light will illuminate. **Operator intervention is required**.

Disinfection System

The MBR permeate is run through UV system for final effluent disinfection. The disinfection system consists of two high intensity UVmax Lights (UV751/ UV752) installed in series. The UVmax lights provide disinfection with a UV dosage of 40 mJ/cm^2 and a flow rate of 303 L/min. This system is installed for protection in the event of a membrane breakthrough. The UV-Lights are connected to a solenoid safety (UVL-751, UVL-752) to restrict the flow in case the UV-Light system have been compromised.

Turbidity Meter

Turbidity transmitter (AIT-801) connected after the UV systems indicates the turbidity (solids content) in the treated effluent. High turbidity will activate an alarm as this can indicate possible breakthrough of the membranes.

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5.1.2.4 Permeate /Treated Effluent Building (EFFLUENT BLD-7905)

Function: Treated effluent storage**,** ammonia oxidation with calcium hypochlorite followed by dechlorination.

Prior to final discharge to the receiving water body the treated effluent will be tested. In the event the biological process upset occurs, due to a toxic shock load or cold weather, it may result in a discharge of ammonia or total nitrogen into the receiving water body. Therefore, calcium hypochlorite addition system is supplied as a stand-by solution for ammonia removal in the wastewater. The sodium bisulfite dosing system is used for dechlorination.

The treated effluent from UV lights is stored in four (4) identical storage tanks (TNK-811, TNK-812, TNK-813, TNK-814). All tanks are connected with 3" PVC pipes.

Calcium Hypochlorite Concentration Control

Chemical dosing system including calcium hypochlorite tank and dosing pumps (P-813 Duty / P-814 Standby) is provided to inject calcium hypochlorite [$Ca(ClO)_2$] to the tank (TNK-811). The calcium hypochlorite dosage rate is manually set locally at the metering pump by adjusting the pump stroke. The operator must determine what the dosage rate needs to be and manually set the stroke at the pump and enter influent flow rate set point through the HMI.

The calcium hypochlorite tank is equipped with low level switch alarm (LSLL-815) indicating if tank is empty; this is to protect dry running of the pumps (P-813/P-814).

Effluent Storage System Discharge pumps / Level control

The storage tanks have two (2) external pumps (P-811 Duty / P-812 Standby) for sending treated effluent to final discharge. Each pump is equipped with discharge pressure indicator (PI-811/ PI-812) to measure the discharge pressure and motor current switch (YA-811 /YA-812).

Tank (TNK-814) is equipped with a high level switch (LSH-814) and low level switch. As long as the water level in the tank is above the low level height, pumps (P-811/P-812) will run.

Alarms

All effluent storage tanks (TNK-811/TNK-812/TNK-813/TNK-814) are equipped with level switches alarm (LSHH-801/LSHH-802 /LSHH-803/LSHH-804) for indicating imminent overflow; an alarm signal will register on the HMI and the flashing red beacon light will illuminate, operator intervention is required.

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Sodium Bisulfite Concentration Control

Chemical dosing system including sodium bisulfite tank and metering pumps (P-815 Duty / P-816 Standby) is provided to inject sodium bisulfite [$Na_2S_2O_5$] to the discharge line for effluent dechlorination. The sodium bisulfite dosage rate is manually set locally at the metering pump by adjusting the pump stroke. The operator must determine what the dosage rate needs to be and manually set the stroke at the pump and enter influent flow rate set point through the HMI.

The sodium bisulfite tank is equipped with low level switch alarm (LSLL-815/LSLL-816) indicating if tank is empty; this is to protect dry running of the pumps (P-815/P-816).

5.1.2.5 Sludge Treatment Module (SLUDGE BLD-7904)

Excess waste activated sludge (WAS) from the aeration tanks (TNK-501) is pumped to the sludge treatment module housed inside container (SLUDGE BLD-7904), Room#1 Cl1 Div 2.

Sludge treatment module includes:

- Polymer tank (TNK-902) with mixer (M-902), and polymer transferring pump (P-902)
- Sludge mixing tank (TNK-901) equipped with level control switch, mixer (M-901), and transferring pump (P-901)
- One (1) Filter Press unit equipped with air driven hydraulic pump, and sludge dumpster
- Supernatant tank (TNK-903) equipped with level control switches, and supernatant transferring pump (P-903)
- Air compressor (C-901) equipped with oil level switch and pressure switch; air compressor located in Room #2 GP of the building (SLUDGE BLD-7904)

Polymer preparation unit

The polymer unit is used for preparation and dosing polymer solution into the mixing tank (TNK-902) for sludge treatment. The batch-wise polymer preparation process includes:

- Hydration stage, when dry polymer is added to the tank for mixing with potable water
- Blending the polymer to a homogenous and activated solution, when the gentle agitation/mixing is provided
- Dosing the polymer activated solution into the sludge mixing tank (TNK-901) for sludge treatment using air diaphragm pump (P-902)

The mixer (M-902) and the pump (P-902) are driven by compressed air supplied by air compressor (C-901). Compressed air lines are equipped with pressure indicators (P-901/P902) to measure pressure in the air lines. The mixer (M-902) and the pump (P-902) are operated manually.

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Sludge mixing unit

The waste activated sludge is pumped from the aeration tank (TNK-501) into the mixing tank (TNK-901) where it is mixed with the polymer solution sent by pump (P-902) from the polymer tank (TNK-902). The sludge is mixed with polymer by submersible mixer (M-911). The mixer is driven by compressed air supplied by air compressor (C-901); compressed air line is equipped with pressure indicator (P-903) to measure pressure in the air line.

Alarm

The mixing tank (TNK-901) is equipped with level switches alarm (LSHH-901) indicating imminent overflow; an alarm signal will register on the HMI and the flashing red beacon light will illuminate, operator intervention is required. If the high high condition occurs an if the sludge transfer pump is running the PLC will shit P-503 off.

Treated (flocculated) sludge is transferred from mixing tank (TNK- 901) to the filer press (FP-901) by air diaphragm pump (P-901); compressed air line is equipped with pressure indicator (P-904) for measure pressure in the air line.

Filter press

The incoming treated sludge enters the filter press (FP-901) via the center feed pipe. The center feed plates contain a recess on either side of the plates. The cylinder will be shut closed (and hence compress the plates together) with the air driven hydraulic pump and then pressurized shut with approximately 4300 PSI of pressure. When the plates are closed, a cavity is created between the plates where the sludge will be captured.

The filtered water (supernatant) exits through the filter cloth (while the solids are captured within the clothed chambers) and goes to the supernatant tank (TNK-903) by gravity.

The feed pressure of the filter press (FP-901) may start at about 25 PSI, due to the low resistance of an empty filter press. As solids accumulate in the chambers of the filter press, the feed pressure will need to be increased to maintain a stroke count of about one stroke every 1-5 seconds or until a maximum feed pressure of 100 PSI is obtained.

Once the filter press (FP-901) is filled with sludge, the feed pump (P-901) and air driven hydraulic pump are shut off and the sludge blow down process will then commence for further water removal. The air enters via air valve into the sludge chamber via the upper left hand corner of the three button plates, and exits via the bottom right hand corner of the one button plates. This process will push excess water out through the outlet manifold.

Once the sludge blown down process is complete, the filter press is ready to be opened. To open the automatic filter press, reverse the air valve on the automatic pump to allow the pump to slowly pull open the pushing plate. For opening and closing the filter press the controls are right on the hydraulics for safety reasons. It is a forward, off, reverse lever.

Now that the plates are released, index the plates one by one, and most of the sludge will fall into the sludge dumpster below the press. A sludge spatula is provided to aid in the sludge removal.

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Once all plates are clean, the filter press (FP-901) is ready to be closed hydraulically. The three outlet manifold ball valves should be opened, the center feed pipe should be opened and the pump is ready to be turned on again.

Supernatant unit

The supernatant tank (TNK-903) receives spernatant from the filter press (FP-901). The tank is equipped with:

- Liquid level switches (LSL-902/LSH-902/LSHH-902)
- Pump (P-903) transferring supernatant from the supernatant tank (TNK-903) to the aeration tank (TNK-501) located in the building (AERATION BLD-7902); pump is equipped with current switch (YA-903) and pressure indicator (PI-903) for pressure control.

Level / Pump Operation and Control

The supernatant transferring pump (P-903) will run based on liquid level in the supernatant tank (TNK-903):

- Pump (P-903) run, when level switch LSL-902 is ON and YA- 903 is ON
- Pump (P-903) stops, when level switch (LSL-902) is OFF; this is to protect dry running of the pump

Alarms

LSHH-902 indicates the imminent overflow. Operator intervention is required.

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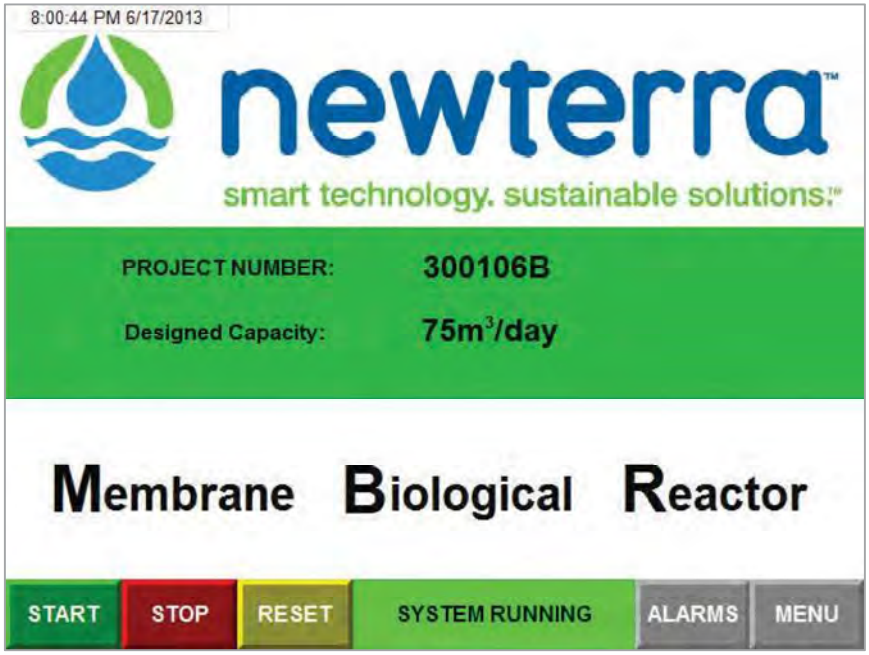
5.2 Process Control System Touchscreen Operation

The MicroClear™ MBR system is designed to be fully automatic. Since the unit operates through a touchscreen, simply press the screen in an area where a button or text appears.

5.2.1 Main Control Screen



System Operation Commands

- **START** button puts the system in **RUN** mode
- **STOP** button stops the system operation. Some equipment continues to run even after this **STOP** button has been pressed, however the **E-STOP** button (located on the panel front) will stop all equipment
- **RESET** button is used to clear alarms after they have been addressed
- **SYSTEM ON (RUNNING) / SYSTEM OFF** indicates whether the system is currently in RUN mode or turned off
- **ALARM** button - when it is flashing red (it is on), it indicates an alarm is present in the system. Press **ALARMS** button to be routed to the alarm screen
- **MENU** button is used for screen navigation to show individual screens

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5.2.2 Process Screens

The main process screens are accessed from the main menu by pressing either the “BIOLOGY” button or the “MBR SYS” button.

On the main process screens, switches are displayed as **Grey** when **OFF, Green** when **ON** and **Red** when in alarm condition.

- LSHH – level switch high high
- LSH – level switch high
- LSLL – level switch low low
- TSHH – temperature switch high high
- LSL – level switch low
- PSL – pressure switch low

Individual devices can be monitored and controlled from the process screens.

- The letter indicated beside a device shows the current operational status of that device (**H** for hand, **O** for off, **A** for automatic)
- Touching a device on the process screen will open an **HOA** popup for that device.
- Devices are shown in green if they are currently running

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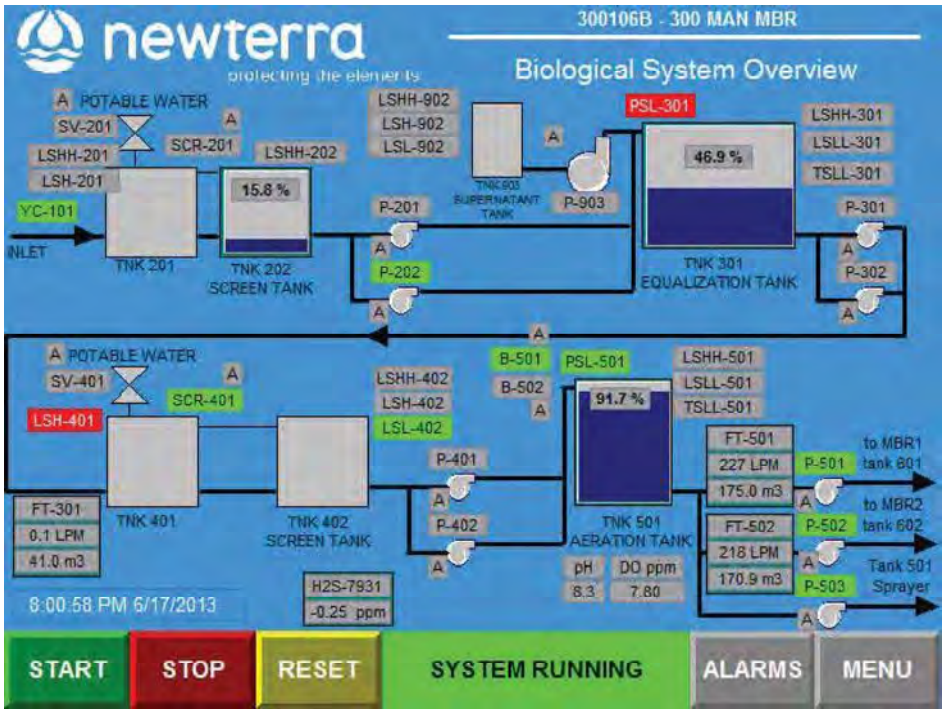
5.2.2.1 Biological System Overview Screen



On the Biological System Overview Screen the following equipment and parameters are displayed:

- Inlet screen module (SCR-201) including screen basin (TNK-201) connected with screen tank (TNK-202), pumps and controls
- Equalization module including EQ tank (TNK-301) with controls, blowers; EQ tank level is displayed in %
- The second screen module (SCR-401) including screen basin (TNK-401) connected with screen tank (TNK-402), pumps and controls
- Aeration Tank (TNK-501) with all interconnecting piping, pumps and controls. Aeration tank level is displayed in % , dissolved oxygen (DO) and pH is displayed for the tank
- Status of blowers, pumps, level switches, flow transmitters and H_2S detector are displayed

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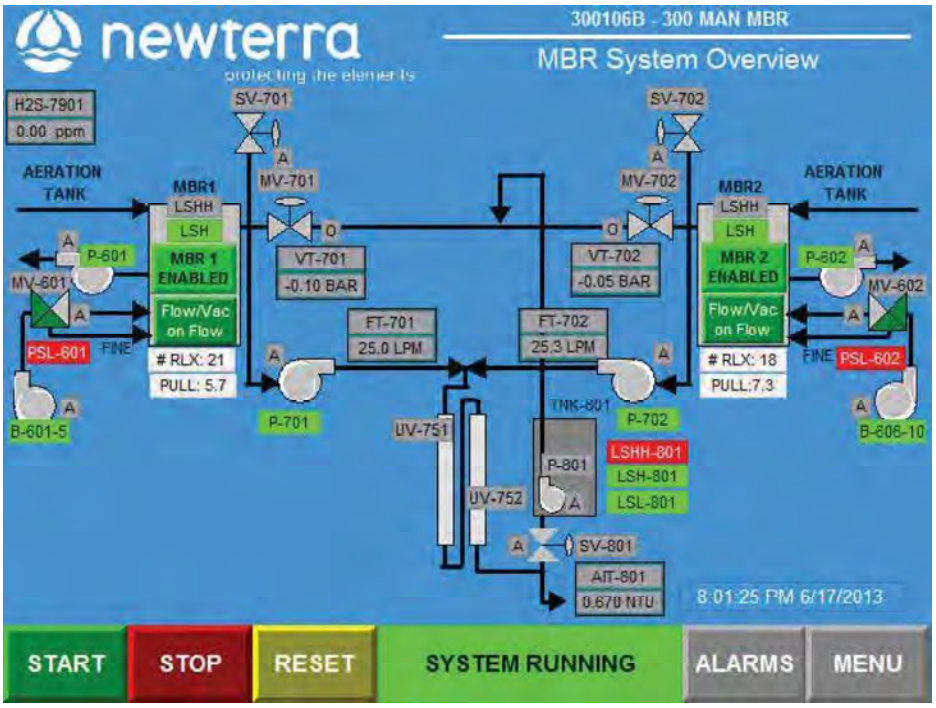
5.2.2.2 Membrane Filtration System (MBR) Overview Screen



On this screen the following equipment and parameters are displayed:

- Membrane Tanks (TNK-601 and TNK-602), and Backwash Tank (TNK-801) with all interconnecting piping
- Permeate flow and vacuum are indicated for both membrane systems
- The number of relaxes performed in the current cycle is displayed
- The time on the current pull cycle is displayed
- Status of blowers, pumps, level switches, flow transmitters and H_2S detector are displayed
- The time on the current pull cycle

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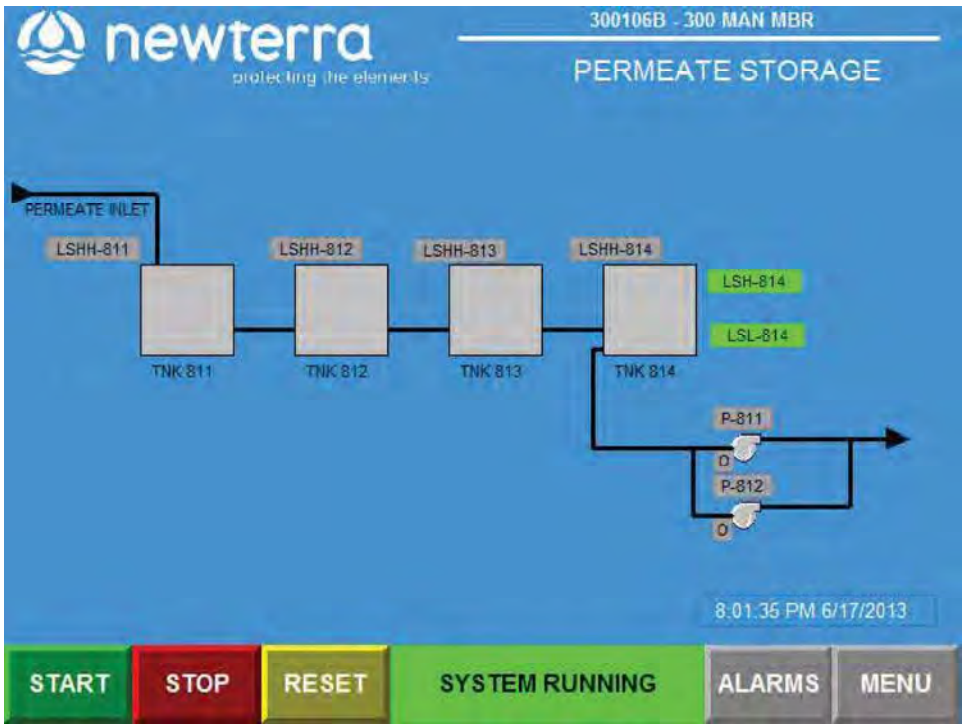
5.2.2.3 Permeate Storage Module Overview Screen



On this screen the following equipment and parameters are displayed:

- Permeate Storage Tanks (TNK-811/TNK-812/TNK-813/TNK-814) with all interconnecting piping and pumps
- Status of level switches and pumps are displayed

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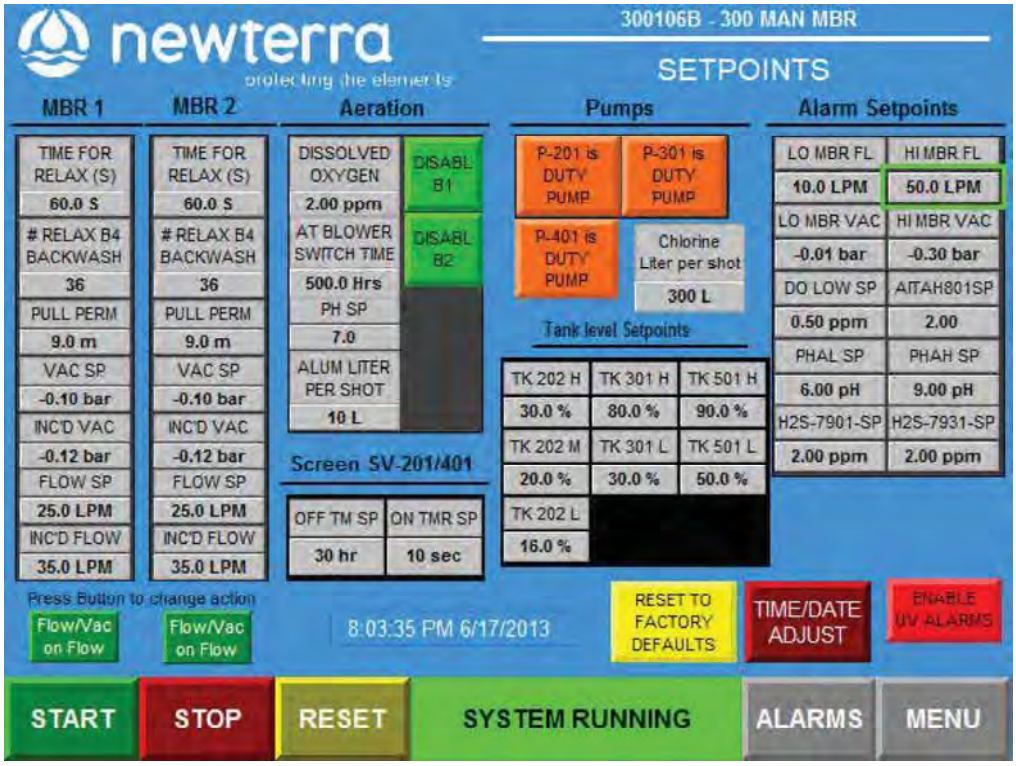
5.2.3 Process Setpoints Screen

The **Setpoints Screen** is accessed from the main menu by pressing the **"SETPOINTS"** button. This screen allows optimization of the system operation. Once the system is correctly set up, these values **should not be changed**.



See the table on the following page for the description of setpoints.

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newterra MBR Operational Setpoints Description

Process Location	Setpoint	Value	Description
Inlet Screen Module (SCR-201)	OFF TMR SP	30 hr	Setpoint for the amount of time when solenoid valve (SV-201) used for potable water delivery for screen cleaning is closed (OFF)
	ON TMR SP	10 sec	Setpoint for the amount of time when solenoid valve (SV-201) used for potable water delivery for screen cleaning is open (ON)
The second Screen Module (SCR-401)	OFF TMR SP	30 hr	Setpoint for the amount of time when solenoid valve (SV-401) used for potable water delivery for screen cleaning is close (OFF)
	ON TMR SP	10 sec	Setpoint for the amount of time when solenoid valve (SV-401) used for potable water delivery for screen cleaning is open (ON)
Membranes	TIME FOR RELAX (S)	60 sec	Setpoint for the amount of time the membrane relaxes between pulls, in seconds (shown for MBR 1 & MBR 2)
	# RELAX B4 BACKWASH	36	Setpoint for the number of relaxes before a backwash is triggered.
	PULL PERM MBR 1	9 min	Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-601 before relaxing
	PULL PERM MBR 2	9 min	Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-602 before relaxing
	VAC 1 SP	-0.10 bar	Setpoint for the vacuum in TNK-601 (in bar) the system will put on the membrane under normal operating conditions
	VAC 2 SP	-0.10 bar	Setpoint for the vacuum in TNK-602 (in BAR) the system will put on the membrane under normal operating conditions
	INC'D 1 VAC	-0.12 bar	Setpoint for the vacuum in TNK-601 (in bar) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank)
	INC'D 2 VAC	-0.12 bar	Setpoint for the vacuum in TNK-602 (in bar) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank)

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Process Location	Setpoint	Value	Description
Membranes	FLOW 1 SP	25.0 LPM	Normal flow setpoint for permeate flow rate (in LPM) in TNK-601. Under normal operation the system will default to this setpoint
	FLOW 2 SP	25.0 LPM	Normal flow setpoint for permeate flow rate (in LPM) in TNK-602. Under normal operation the system will default to this setpoint
	INC'D 1 FLOW	35.0 LPM	Increased Flow setpoint for permeate flow rate (in LPM) in TNK-601. If LSH-301 is activated the system will use the Increased Flow setpoint.
	INC'D 2 FLOW	35.0 LPM	Increased Flow setpoint for permeate flow rate (in LPM) in TNK-602. If LSH-301 is activated the system will use the Increased Flow setpoint.
Aeration Tank	DISSOLVED 0XYGEN	2.00 ppm	Setpoint for the amount of dissolved oxygen in ppm in the aeration tank
	AT BLOWER SWITCH TIME	500.0 Hrs	Setpoint for switching between aeration tank blowers under normal operation. The switch time is usually 500hrs.
	pH SP	7.0	Setpoint for the pH level in the aeration tank
	ALUM LITER PER SHOT	10 L	Setpoint for the amount of alum (L) added in the aeration tank
Tank Level Setpoint	TK 202 H	30.0 %	Setpoint for the high level (in %) for the screen tank (TNK-202)
	TK 202 M	20.0 %	Setpoint for the medium level (in %) for the screen tank (TNK-202)
	TK 202 L	16.0 %	Setpoint for the low level (in %) for the screen tank (TNK-202)
	TK 301 H	80.0 %	Setpoint for the high level (in %) for the equalization tank (TNK-301)
	TK 301 L	30.0 %	Setpoint for the low level (in %) for the equalization tank (TNK-301)
	TK 501 H	90.0 %	Setpoint for the high level (in %) for the aeration tank (TNK-501)
	TK 501 L	50.0 %	Setpoint for the low level (in %) for the aeration tank (TNK-501)

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newterra MBR Alarm Setpoints Description

Alarm Setpoints	LO MBR FL	10.0 LPM	If the discharge flow is below this setpoint for more than 5 minutes, an alarm will be initiated.
	HI MBR FL	50.0 LPM	If the discharge flow is higher this setpoint for more than 5 minutes, an alarm will be initiated.
	LO MBR VAC	-0.01 bar	If the vacuum on the membrane is below this setpoint for more than 60 seconds, an alarm will be initiated.
	HI MBR VAC	-0.30 bar	If the vacuum on the membrane is higher this setpoint for more than 60 seconds, an alarm will be initiated.
	DO LOW SP	0.50 ppm	If the dissolved oxygen in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated.
	AITAH801SP	2.0 ppm	If the % solids in the aeration tank is above this setpoint an alarm will be initiated.
	PHAL SP	6.00 pH	If the pH in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated.
	PHAH SP	9.00 pH	If the pH in the aeration tank is higher this setpoint for more than 15 minutes, an alarm will be initiated.
	H_2S-7901-SP	2.00 ppm	If the concentration of detected H_2S reaches this setpoint for more than 5 minutes, an alarm will be initiated.
	H_2S-7931-SP	2.00 ppm	If the concentration of detected H_2S reaches this setpoint for more than 5 minutes, an alarm will be initiated.

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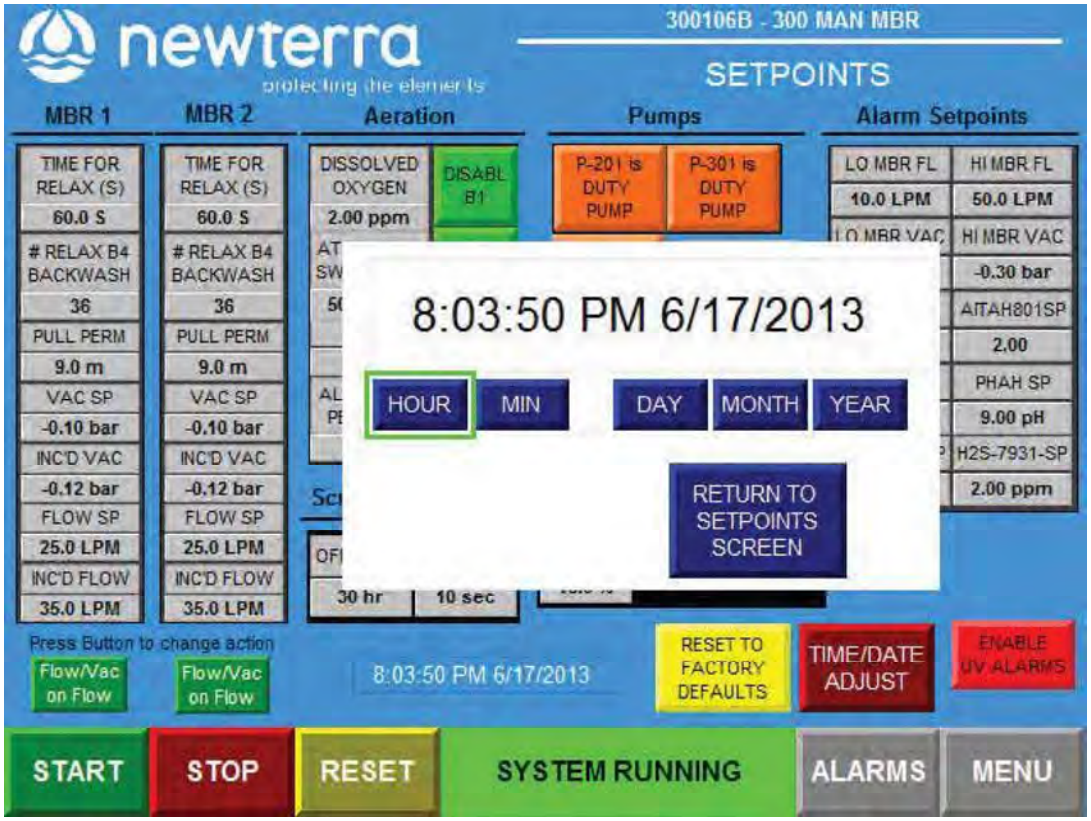
ATTENTION

The following screen shows **setpoints** modification procedure. **Setpoints** should only be modified under the direction of **newterra** engineers to prevent damaging the membranes.

RESET TO FACTORY DEFAULT (yellow button) - Pressing this button will reset all process and alarm setpoints to the default values at the factory.



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5.2.4 System HAO's (HAND /AUTOs/ OFF)

The **Hand / AUTO / OFF** screen is accessed from the main menu by pressing the "**HAO**" button.

- Each PLC controlled motor or valve in the system has **a Hand/Auto/Off (HAO)** Switch to control its operation. This screen displays all the system HAO's
- For normal operation, all switches should be in the **AUTO (A)** position
- The **HAND (H)** position of a switch is used for testing and troubleshooting of the system. As a safety precaution to prevent damage to equipment, the equipment will operate for two minutes in hand mode and will then return to the **OFF (O)** position

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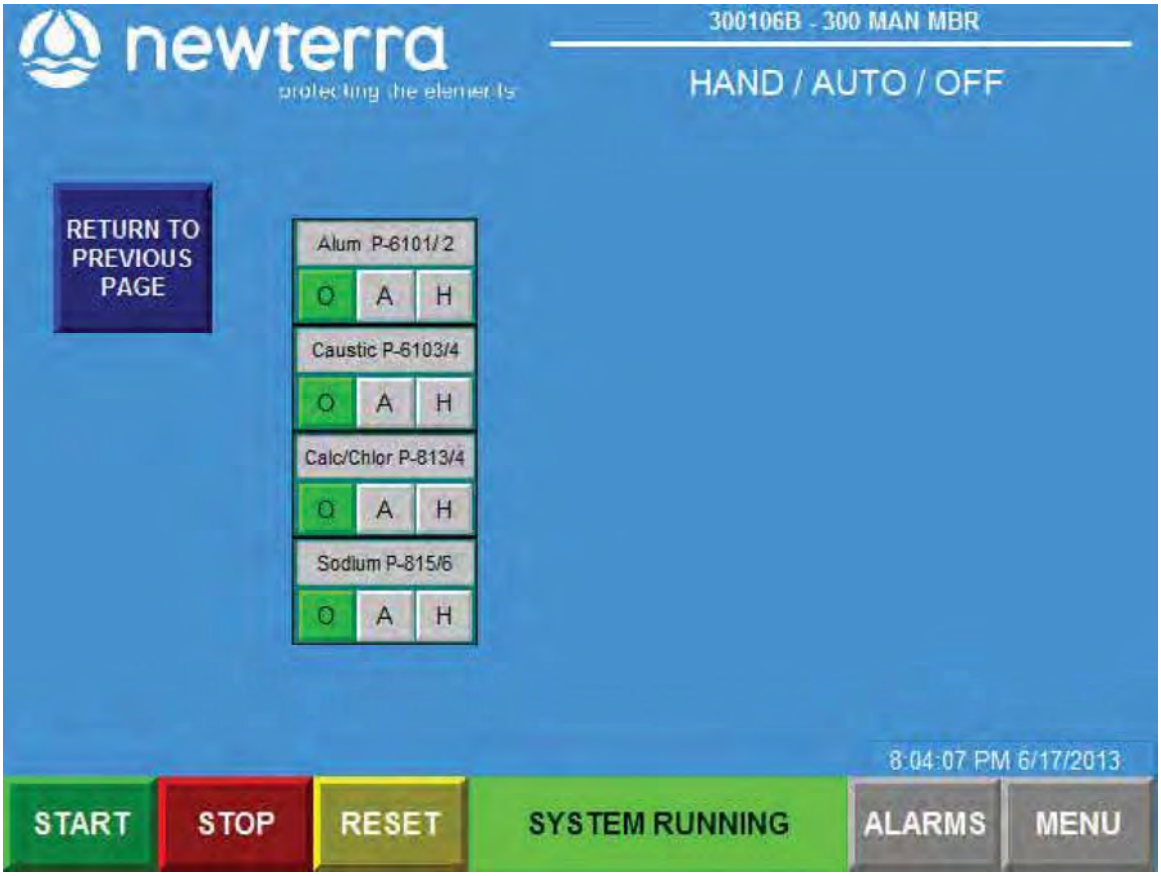

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5.2.5 Motor Info Control Screen

The following screen shows the status of the VFD's and their PID control values.

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5.2.6 Moto Hours Control Screen

Motor Hours screen is accessed from the main menu by pressing the “Motor Hours” This screen shows the total number of hours that each motor can run.

- When the SERVICED button is pressed, it resets the hours since service to zero (0)
- When the REPLACED button of a motor is pressed, it resets the total hours to zero (0).

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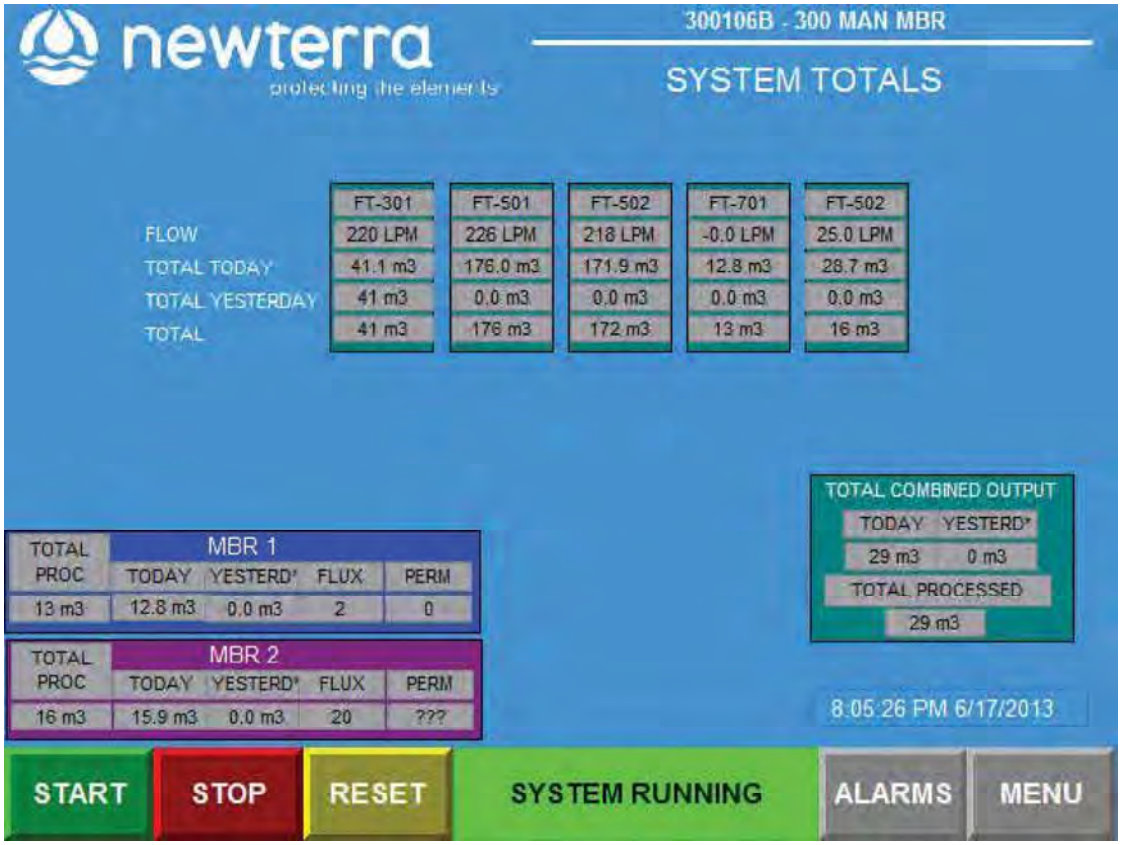
5.2.7 System Totals

The **System Totals** Screen is accessed from the main menu by pressing the **"TOTALS"** button



This screen is used to show:

- The total amount of water processed through the process train, and also current (today) amount and amount of water processed yesterday
- Flux (**J**) for membrane unit expressed in **LMH (L/m²·h)**
- Permeability **(K)** for membrane unit expressed in **LMH/bar**

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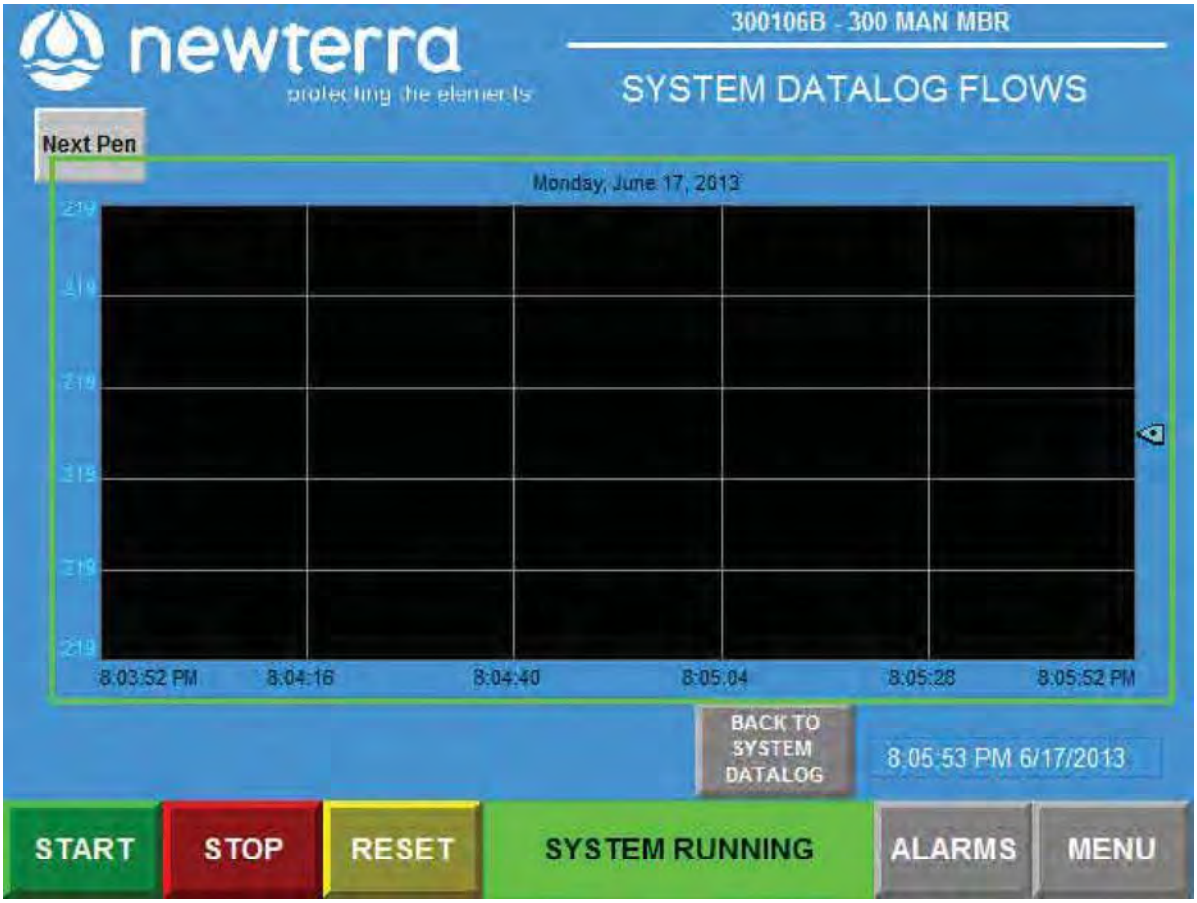
5.2.8 System Data Log Screens

- The following screens show how system is setup with extensive dada log to keep a history of the performance.
- It shows real time data log of critical process operating parameters
- This information is saved on a USB stick that is located on the front of the control panel
- The LOG INTERVAL setting determines how often data points are stored. The factory default setting is 600 seconds



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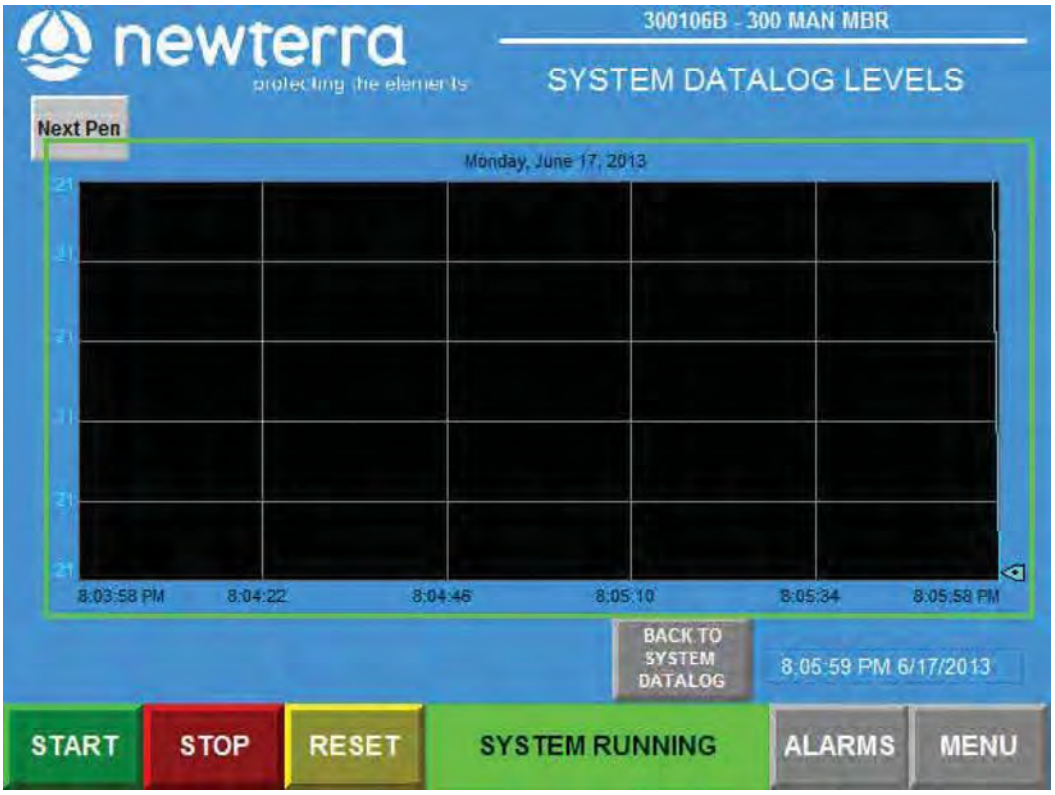

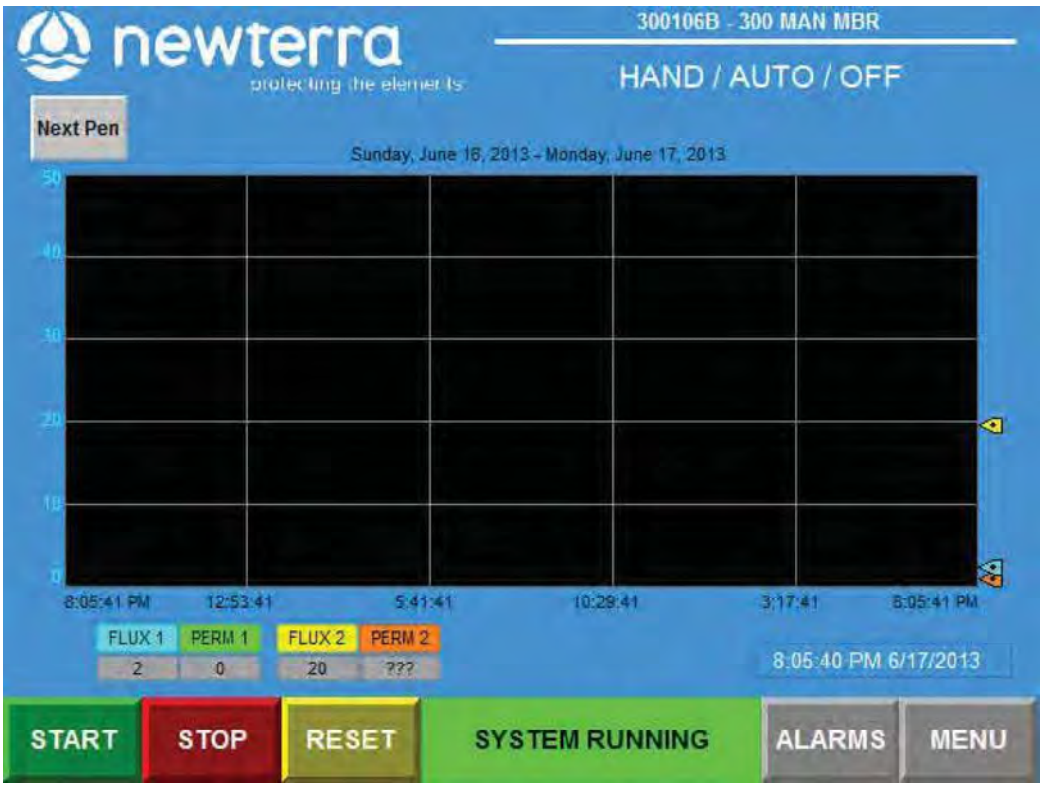

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6.0 PLANT START-UP, OPERATING GUIDELINES AND MONITORING

6.1 Plant Start-Up

Mechanical & Electrical Start-up Procedure:

- If the system is being started for the first time, work your way through the **newterra Pre-Commissioning Test Checklist** presented in **Appendix C** of this O&M Manual.
- If the kill switch on the panel (red mushroom shaped button) is pulled out, then push it in to confirm that the MBR system is off.
- Push the reset button on the operator interface to reset all alarms.
- Make sure there are no obstructions over any moving parts, for example a jacket laying on a belt drive.
- Put all HAND/OFF/AUTO switches to AUTO **(A)** mode.
- Pull the kill Button (red button on panel) out to start the process.
- Push the start button on the Operator Interface.

Process Start-up:

Seeding

The procedure for determining the amount of seed sludge required for process start-up, and methods for seeding the system are as follows:

1. Calculate the volume of seed sludge required to ensure that there is a minimum of 3,000 mg/L MLSS in the membrane tank. The volume of seed sludge required can be calculated with the following formula.

$$V_s = \frac{3000 \times V_t}{MLSS_s}$$

V_s: Total volume of seed sludge for MBR system (m^3)
V_t: Total volume of process tanks in MBR system (m^3)
$MLSS_s$: MLSS concentration of seed sludge from a similar treatment system (mg/L)

2. Arrange for delivery of fresh seed sludge from an activated sludge system employing a suspended growth type process. If it is possible, obtain seed sludge from a facility treating a similar wastewater and operated with similar processes (nitrification etc).

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3. Drain the water used for clean water testing from the reactor, if the returned activated sludge (MLSS<10,000 mg/L) is used. Do not drain the water after clean water testing, if the dewatered sludge is used.

4. **Screen all seed sludge with the 2 mm basket screen** before the sludge is transferred to the aeration or membrane tanks **to remove gross solids and rags and hair**.

5. Remove grit from the screen if required.

6. Once the tanks are fully seeded in aeration tank and membrane tank is turned on, the system can start to work. Do not waste sludge, as membrane filtration continues, until the MLSS in the aerobic or membrane tank becomes concentrated to the targeted concentration. The system will be started at a reduced design flow/loading initially per **newterra** start-up schedule.

7. Foaming may occur during start-up, which is normal. However, after a period of time (1 week), the foam should disappear. Foaming can be addressed by water spraying, food based defoamer **(silicone based defoamer is strictly prohibited**) addition, or aeration minimization in the membrane tank.

8. If a defoamer is required, contact **newterra ltd**. for recommendation of an acceptable antifoaming agent and dosing quantities.

9. Process start-up and adaptation periods can last for two or three weeks.

10. If fresh activated seed sludge is not available, **newterra** can supply dry cultures bacteria (a consortia group of different kinds of bacteria) for start-up. Please consult newterra ltd; quantities of dry bacteria and procedure of seeding will be confirmed by newterra technical representative during commissioning / start-up period.

ATTENTION	No untreated wastewater should enter the membrane tank. Make sure wastewater is completely biologically treated before it gets to the membrane tank

ATTENTION	It is advisable to start the MBR system with a minimum MLSS concentration of 3,000 mg/L to minimize foaming. The seed sludge should come from a plant which has a screen of 2 mm. It is critical to screen the seed sludge with 2 mm perforated screen prior to seeding for membrane protection.

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6.2 System Operating Guidelines and Monitoring

6.2.1 Operating Guidelines

The operators are expected to run the MBR system at all times in accordance with the maintenance, operational procedures and details specified in this manual. The following two tables provide operating parameters that can be easily maintained, and define the range of operating values.

There may be situations where the system needs to operate outside of the conditions covered in this manual. If these conditions develop, please consult newterra ltd. to discuss operation and methods to optimize performance.

Generally, the following points can be used to operate the MBR system properly:

1. The MBR system is designed to treat wastewater with specified influent characteristics.
2. Never operate the MBR tank below the minimum membrane submerged level. It is necessary to maintain a minimum of 250 mm liquid level above the membrane modules to ensure they are wet at all times and to allow for proper filtration.
3. Always supply the required amount of air for scouring to the membrane module.
4. Always filter wastewater at or below design flow rate.
5. Periodically, relax the membranes by ending filtration while allowing the membrane aeration scour to operate continuously and initiate backwash operation during membrane relaxation (default relaxation mode preset in PLC - permeation continues for 9 min and stops for 45 sec, and backwash the membrane).
6. Always operate the MBR in accordance with the parameters listed in the following tables.
7. Clean the membranes in-place with a dilute chemical in accordance with **Section 7** of the O&M Manual.

Membrane Filtration Operational Conditions

Parameter	Recommended Value	Notes
Diffuser Relaxation	10 minutes/day	Effluent filtration must be turned off, blower shuts down for 10 mins/day
Relax Time	1 min/10 min	Filtration must be off and blower are operating continuously
Backwahing	48 cycles	Built-in backwash mode during relaxation mode
In-situ Chemically Enhanced Backwash (CEB)	200 ppm as NaOCl	Requires 3 L to fully backwash one MCXL cassette. Frequency of CEB may vary. Refer to Membrane Cleaning Section 7.3 for cleaning procedure.

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Avg Flux Rate	15 LMH (9 gpd)	Average flux rate with permeation 9 minutes out of 10 minutes
TMP	< 0.2 bar (2.9 psi)	Membranes to be cleaned once the TMP exceeds 0.2 bar (2.9 psi)

MBR – Recommended Biological Operational Conditions

Parameter	Recommended	Range	Notes
MLSS (mg/L)	10,000	8,000 – 15,000	Never operate the membranes if MLSS < 3,000 mg/l. Sludge wasting should be undertaken as required to maintain target MLSS
Temperature (°C)	15 - 35	10 – 35	Avoid sudden changes in temperature. Minimum operating temperature is 15 °C
pH (s.u.)	6.8 - 8.5	6.0 – 9.0	Membrane module can handle a change in pH, however it is recommended to keep pH between 6.8 - 8.5
Aeration Tank, DO (mg/L)	≥ 2.0	1.0 – 8.0	This can be maintained by adjusting the volume of air supplied to the aeration tank
Viscosity (mPa-s)	Not applicable	0 – 300	–
Membrane Tank to Aeration Tank Recirculation	400%	200 – 600%	–
F:M (kg BOD/kg MLSS/d)	0.1	0.03 – 0.2	F:M = [Flow (m^3/d) x BOD conc (mg/l)] / [Process volume (m^3) x MLSS conc (mg/l)]
F:M (kg COD/kg MLSS/d)	0.15	0.05 – 0.3	F:M = [Flow (m^3/d) x BOD conc (mg/l)] / [Process volume (m^3) x MLSS conc (mg/l)]
SRT	> 15	12 – 50	

Process Troubleshooting Guide is presented in **Appendix M** of this O&M Manual.

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6.2.2 Sampling

To ensure accurate system monitoring and the validity of laboratory test data, samples must be collected as outlined below. These are only recommended guidelines. It is imperative that scheduled testing protocols are performed in compliance with local regulatory agency requirements. Composite samples of the MBR systems may need to be sent out to a certified laboratory for testing, based on the local regulatory requirements

Monitoring and Testing Requirements

Parameter***	Influent	Aeration Tank	Membrane Tank	MBR Effluent
Flow rate	D (PLC)			D (PLC)
Fat, Oil and Grease (FOG)	AR			AR
Alkalinity	AR			
Biological Oxygen Demand (BOD)	W			W
Total Suspended Solids (TSS)	W			W
Total Kjeldahl Nitrogen / Total Nitrogen (TKN / TN)	M			AR
Ammonia Nitrogen(NH_4-N)				AR
Nitrate Nitrogen (NO_3-N)				AR
Total Phosphorus (TP)	W			W
Mixed Liquor Suspended Solids (MLSS)			W	
Mixed Liquor Volatile Suspended Solids (MLVSS)			AR*	
Temperature		D (PLC)		
pH	AR	D (PLC)		W
Dissolved Oxygen (DO)		D (PLC)		
Filterability			TW	
Turbidity				AR**
Fecal Coliform / *E-Coli*				W

Legend: D = daily; W = weekly; TW = three times weekly; M = monthly; AR = as required.

* If MLVSS /MLSS ratio of a minimum of 0.7 is detected, MLVSS testing can be done periodically, on an "as required" basis.

**The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.

*** Explanation and definition of abbreviations, acronyms and terms used in the manual are presented in **Appendix G – Glossary & Terms and Appendix H – Biological Treatment & Monitoring Parameters.**

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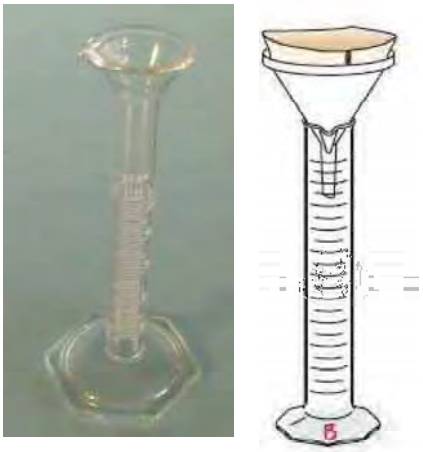
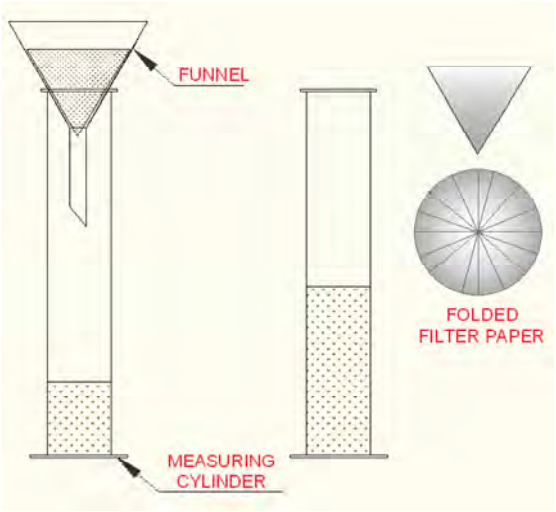
Filterability Test

The objective of the filterability test is to evaluate the condition of the working biomass. This is assessed by measuring the volume of filtrate passing through the filter paper. If filtrate is greater than 10 mL/10 min, then biomass filterability is acceptable; however, if it is less than 10 mL/10 min, modifications to the plant operating condition are required to prevent premature membrane fouling.

Laboratory Glassware and Filter Paper





Apparatus:

Filterability Kit is distributed by **newterra ltd (Part # 24146).**

Filterability Kit includes:

- Filter paper distributed;
- Funnel (75 mm diameter recommended);
- 2 - 50 mL graduated cylinder;

Stop watch

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Measurement Procedure:

1. Pleat filter paper by folding in half, quarters etc.
2. Line the funnel with pleated filter paper and place the funnel in the graduated cylinder.
3. Collect 50 mL of activated sludge sample in a beaker and stir.
4. Pour the 50 mL sample into the funnel.
5. Start timer when the first drop of water filtered through the filter paper.
6. After 10 minutes of filtration, record the level of filtrate in the graduated cylinder.

Filterability (FT)	Action	State of urgency
> 10 ml	Excellent, no action req'	
5 - 10 ml	Tweak process operation	
< 5 ml	Process adjustment req	**Contact newterra ltd.**

6.2.3 Record Keeping

An essential component of quality control in any facility is sound record keeping. A log book covering the entire treatment system performance should be maintained, updated, and readily accessible to all operators. The log book should be used to record observations, set point alterations, and unusual conditions.

For each wet chemistry parameter analysis, a separate work-sheet has to be prepared. Work-sheet data for at least the previous year should be kept for possible consultation.

The second step in quality control is to train all operators to follow an established procedure for each test. Identical samples should be periodically tested for any parameter by different operators, and the variability among results should be compared. Consistent variability in results may lead to the technique improvement of operators.

Duplicate analysis of a sample should also regularly be done. And, split samples should regularly be sent to an outside accredited laboratory and analysis results should be compared with those done in-house.

In addition to summary sheets, it is highly recommended that data should be entered into prepared Excel spread-sheets. Spread-sheets greatly aid in the data presentation and manipulation, and would be of immeasurable value when report writing is required.

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6.2.4 Process Trending

Other than pre-planned process changes or major upsets, process modifications should be based on trends shown in the process data. A trend is nothing more than an indication of real change in a process parameter over time. A trend chart is simply a graph of data being trended.

As the graph changes, upward or downward trends are detectable. Smoothing trends by graphing the 3-, 7-, or 30-day average of the data allows the trend to be shown more clearly. Because the individual data point may be questionable, the actual value of data point are less important compared with the trend regarding the process monitoring.

Trend graphs are a part of the Excel data spread-sheet; the operator can trend and analyse many parameters in just a few minutes in order to assess process performance.
When a trend is identified, its indication to the process can be evaluated, and corrective action may be carried out, if needed. Statistically, the more data points there are in a trend chart, the more reliable the trend.

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7.0 SYSTEM MAINTENANCE

CAUTION: Shut off all electrical power before working on the mechanical or electrical equipment.

The system should be routinely checked for any signs of operational problems. Such problems could include, but are not necessarily limited to, abnormally high peak flows, unpleasant odour, and diffuser clogging, and so on.

7.1 Plant Visual Checks

Noise	During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs.
Smell	The MicroClear™ MBR is an aerobic system. During normal operation, the system has an earthy smell similar to that of a well-maintained compost pile. If other odours are noticed, the aeration process may not be operating or the system has been overloaded. Check the DO manually and the blower to verify proper operation.
Sight	Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, there is a pin hole in the membrane or a leakage in the piping. Take the unit out of operation and investigate. **Check uniformity of membrane air distribution periodically to ensure air scoring is effective across all membrane plates.**

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7.1.1 Air Scouring Patterns in Membrane Tanks

Membrane air scouring check is essential procedure for **newterra** MBR WWTP. Air scour has to be observed for uniformity of bubbling action all across the membrane module/cassette on regular basis.

A visual inspection of the aeration patterns should be performed with the liquid level 2-3" (5 – 7.5 cm) above the permeate pipe.

Proper air scouring in membrane tank

Uneven aeration in membrane tank

It is easy to observe aeration patterns through clear window in membrane tank. Operator should note any unusual patterns of air distribution. The visual inspection also should be performed before any membrane cassette removal from membrane tank. Operator has to check for:

- damage of air diffusers - if this occurs, empty the tank and fix the diffuser;
- air leakages - if this occurs, tighten up the fittings.

If there is insufficient air scouring, localized dewatering (**clogging, sludging, caking and plugging**) may occur and may in turn lead to membrane fouling.

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7.2 Schedule for Routine Operation and Maintenance Checkups (if Applicable)

Location	Item	Day	Week	Month	Quarter	Year	Comments
HEADWORKS	**Inspect and maintain grease trap in the kitchen of the work/mining camp**		X	X*			*Kitchen grease trap(s) should be checked weekly and cleaned monthly to ensure proper performance.
	Inspect lift station with sump pumps		X				
	Remove grease from lift stations and top of PC tank		X				
PROCESS	**Perform visual check**	X					Refer to Plant Visual Checks
	Check for proper wasting to sludge system		X				
	Record permeate flow rate	X					
	Record DO in the aeration tank	X					
	Record pH in the aeration tank	X					
	Record vacuum pressure at the membranes	X					Normal range: 0.07 – 0.15 bar (28" -61" WC)
Note: When the vacuum at the membranes reaches 0.2 bar/2.9 psig/80" WC), stop the permeation and perform recovery cleaning (please see procedure separately)							
MECHANICAL & PROCESS	**Inspect membranes and permeate withdrawal system**		X				1 hour
	Clean and calibrate the DO sensor			X			1 hour
	Inspect and maintain valves & fittings for leaks		X				
	Clean manually Fine Screen and direct solids to primary settling/sludge holding tank		X				may require daily cleaning during start-up (subject to PI502 reading)
	Membrane in-situ cleaning				X		2-4 hours
	Remove membrane module for mechanical cleaning and inspection					X	Drain membrane tank. Roll out membrane cassette. Remove membranes and inspect. (1 -2 days)
	Visual inspection of air bubbles in the equalization, aeration and membrane tanks		X				Replace diffusers if big uneven bubbles/high turbulence is found.

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Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	**Remove, inspect and maintain diffusers in equalization, aeration and membrane tanks**					X	This involves a complete draining of tanks (1-2 days)
	Pump out solids collected in the primary settling/sludge holding tank for offsite disposal				X		
	Check and record UV instrumentation: % Transmissivity vs required minimum; Remaining Lamp Life; Total Days of Operation		X				
	Inspect and maintain pump bearings			X			
	Check blower operation (if vibrating)		X				
	Check time clock setting		X				
	De-ragger (foam suppression unit)						may require daily cleaning during start-up
	Inspect functionality of baseboard heater				X		
	Check ventilation systems for container					X	
ELECTRICAL	**Check electrical leads**				X		
	Inspect and maintain breakers, fuses, resets and anodes			X			
	Check motor mounting bolts			X			
	Clean dust away from electric motor			X			
	Check PLC and control panel functionality		X				

All connections (hoses, hose clamps, camlocks) have to be checked periodically (on a monthly basis) to make sure all of them are in good conditions.

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7.2.1 De-ragger operation and maintenance cleaning

Please refer to the drawing presented in **Appendix A** of this O&M Manual.

De-ragger is part of the anti-foaming system which is provided in the system for foam suppression in the aeration tank. The main purpose of a de-ragger in this system is to avoid the spray nozzles clogging by catching fibres and other impurities found in the recirculation water pumped through the system.

De-ragger is simple equipment consisting of a PVC clear pipe, a nylon bristle brush installed in the pipe, and a fernco coupling for quick disconnection. During the water spraying process the brush (with a sliding fit in the pipe) catches fibres and other impurities
.
When the de-ragger is filled with impurities, perform maintenance as follows:

- Turn off P-503 operation.
- Close 2' PVC isolation valve and open 1' PVC drain valve and drain the content to a 20-L pail.
- Disconnect fernco coupling.
- Remove brush and rinse with clean water.
- Close the drain valve and reassemble the fernco coupling.
- Make sure all connections are tight.
- Open isolation valve.
- Turn on P-503 operation.

7.2.2 Polymer Make-up Instructions

Please refer to the P&I Diagram presented in **Appendix A** of this O&M Manual.

1. Fill polymer make up tank (conical bottom mixing tank) with 100L clean water
2. Open air mixer speed valve by turning valve one and a half revolutions (1 ½) to allow mixer to run at high speed
3. Slowly add 1 cup (~250ml) of Powdered CC4509 polymer into vortex beside mixer shaft (keep bag sealed when not in use)
4. Run mixer on high speed for 5 min
5. Reduce mixer speed to low by turning value back to half (1/2) a revolution open, continue mixing for 45 min
6. Polymer is now ready to use

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7.3 Membrane Cleaning

7.3.1 Membrane In-situ Chemically Enhanced Backflush (CEB)

Chemical cleaning is only to be carried out by qualified and trained personnel! Chemicals can lead to serious injuries. Always wear personal protective equipment (PPE) when handling chemicals! Obey the chemical safety handling procedure as listed in the Material Safety Data Sheets.

It is recommended that in-situ CEB be carried out before the TMP exceeds 0.2 bar (or permeability drops rapidly to 50 LMH/bar) This is typically done once every couple weeks/months depending on biomass characteristics and system operating condition.

On certain occasions, membrane module/cassette may need to be physically inspected for membrane integrity if membrane permeability performance is not recovered after the cleaning (i.e., suspect of membrane deterioration); please refer to subsection **7.3.3**.

The maximum backwash pressure of MicroClear™ MCXL filter is 0.1 bar or equivalent to a 100 cm water line. Only use gravity force to perform the backflush.

Note: Membrane have a maximum active chlorine tolerance of 100,000 ppm.h.

For better cleaning performance, it is recommended:

- Potable water (permeate is acceptable if potable water is unavailable)
- Water temperature is above 20 ^{0}C (better cleaning efficiency if water temperature ranges from 20 to 30 ^{0}C)

Procedure

Note: Only clean (backwash) one membrane tank at time.

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***Step 1: Cleaning with sodium hypochlorite (NaOCl)* - 3L cleaning solution required per MCXL cassette for in-situ CEB. The CEB is performed manually.**

1) Press the disable membrane button on the screen.

2) Open valve (SV-801) and allow water to fill up the backwash tank (T-801) to LSH-801 level.

3) Close valve (SV-801).

4) Add concentrated NaOCl into the backwash tank to a concentration of 500 mg/L (acceptable range of 200 to 1,000 mg/L).

Volume of concentrated NaOCl required can be calculated with the following formula,

$$V_x = \frac{V_m \times 0.05}{C_s}$$

V_m: Volume of the solution (Gallon, or Litre), equal to 3 L multiplying the number of MCXL cassettes;
C_s: Concentrated NaOCl concentration (%)
V_x: Volume of concentrated NaOCl required (Gallon, or Litre)

5) Open valve (MV-701 or MV-702) and inject chemical solution by pump (P-801) into membrane tank (TNK-601 or TNK-602) until reach LSL-801 level in backwash tank. (T-801).

6) Soak the membranes in NaOCl solution for 1-2 h. Adjust air scour in interval, if necessary, to control potential foaming.

7) Resume normal operation by turning off the disable membrane button. Check permeability. Normal permeability after cleaning: 150 to 300 LMH/bar.

8) Repeat the cleaning procedures if the normal permeability value is not attained.

Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness.

Rinse membrane filter thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!

1) Repeat the above steps with 0.2% citric acid solution (a max of 2%)

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7.3.2 Membrane Recovery Cleaning

The membrane recovery cleaning is to be done once a year at a minimum. On certain occasions, membrane cassette may need to be inspected for membrane integrity (suspect of membrane deterioration, membrane permeability performance does not recover after the cleaning, etc.).

Disable operation of the dedicated membrane tank that needs to be cleaned by pressing the disable membrane button on the screen.

For better cleaning performance, it is recommended:

- Potable water is used
- Water temperature is above 20 ^{0}C (better cleaning efficiency if water temperature ranges from 20 to 30 ^{0}C)

Procedure

Step 1: Cleaning with Sodium Hypochlorite (NaOCl)

1. Drain all mixed liquor from the membrane tank to the sump/recycle back to the process tanks.

2. Clean (wash down) the membrane tank with potable water and drain the dirty liquid to the sump/recycle back to headwork.

3. Turn off air scour, fill the membrane tank with potable water until the membranes are completely covered, and add NaOCl into the membrane tank to a concentration of 500 mg/L as free chlorine (max. 1,000 mg/L). Turn on air scour for 5 min to mix the solution and turn it off during membrane soak.

   Volume of NaOCl required can be calculated with the following formula:

$$V_x = \frac{V_m \times 0.05}{C_s}$$

V_m: Volume of membrane tank (Gallon, or Litre)
C_s: NaOCl concentration (%)
V_x: Volume of NaOCl required (Gallon, or Litre)

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4. Keep the membranes soaked for a min 12 hours in the NaOCl solution (longer soak time required if severe fouling is evident). Air scour can be on intermittently during soak time (5 min every 4 hrs).

5. Drain spent NaOCl solution to the sump/recycle to headwork.

6. Rinse membrane filter thoroughly with potable water and drain the entire tank. Rinse waters are drained to the sump/recycle back to the headwork.

Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness

Rinse membrane filter thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!

1. Fill the membrane tank with potable water, turn on scouring air, and add citric acid to pH 2.0. Turn off air scour when the pH of 2.0 is reached.
2. Keep the membranes soaked in the citric acid solution for 2 hours (longer soak time required if severe fouling is evident).
3. Drain spent citric acid solution, rinse membranes thoroughly with potable water and drain all the rinse waters. Spent citric acid solution and rinse waters are drained to the sump/recycle back to headwork.

Step 3: *Resume normal operation*

Step 4: Checking Permeability on Clean Water

Normal permeability after cleaning: 150 to 300 LMH/bar.

Repeat the cleaning procedures If normal permeability is not achieved.

Note: Membrane maintenance (CEB) and recovery cleaning has to be recorded according to Membrane Cleaning Log Sheet presented in Appendix K of the manual.

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7.3.3 Membrane Physical Check

WARNING*: A membrane cassette that has been in operation weighs more than dry membrane cassette before installation.*
Failure to comply with the instructions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.

To remove membrane module from membrane tank

This procedure is required if the membranes are being inspected as part of routine maintenance for physical check or being replaced.

Once membrane inspection or replacement has begun, it must be completed promptly. It is important that the membrane DO NOT DRY OUT OR FREEZE during this procedure.

1. Lifting the membrane cassette out of a tank or emptying a tank should take at least 5 min. For each single filter layer.

MicroClear™ Membrane Module	Filter Layers	Acceptable time for membrane filter lifting out of the membrane tank or empting the tank
MB2- series	2	10 min
MB3- series	3	15 min
MB4- series	4	20 min (module must be separated in to 2 parts)
MB5- series	5	25 min (module must be separated in to 2 parts)

Note: Non observance will lead to damage of the filters because of exceeding the maximum backwash pressure.

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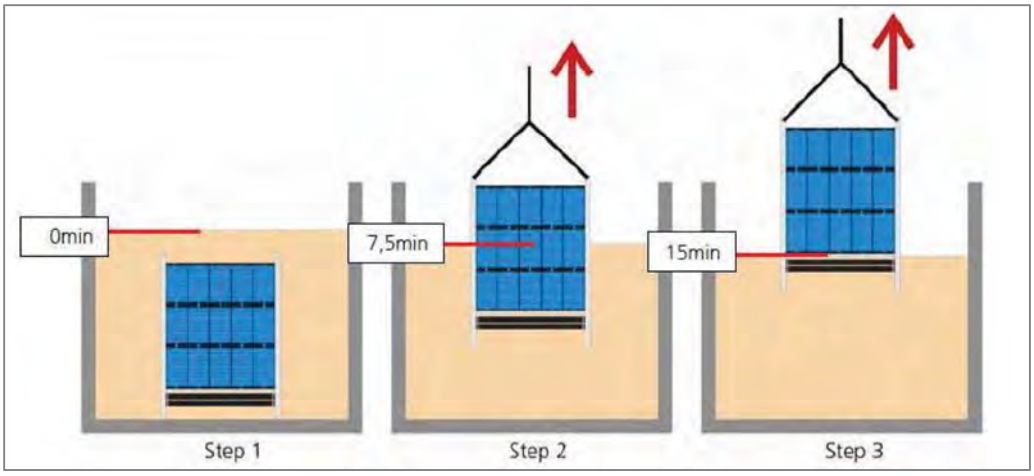

Schematic of MicroClear™ membrane module lifting / emptying of the membrane tank

Membrane module replacement

If membranes require changing *v*erify membrane modules are secure within the membrane tanks after re-installing the modules – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tank.

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8.0 SHUT DOWN

8.1 Temporary Shut Down

A temporary shutdown for a few days requires continuous aeration of the biomass to keep the DO level at least 2 mg/L and continues biomass recycle between the bioreactors.

8.2 Permanent Shut Down / Winterizing

Permanent shut-down is required if system operation stops at least for 2 weeks without inflow. Permanent Shut Down includes the following procedure:

- Perform membrane cleaning before permanent shut down / winterizing.
- Drain all tanks.
- Remove membranes and winterize
    - For short term storage (up to 6 months): soak membranes in 10 ppm NaOCl solution, and membranes are not allowed to dry out), never expose the membrane unit to frost, dust, rain, or direct sunlight.
    - For long term storage: soak membranes in preservation solution - 20 % glycerin solution (by weight).The glycerin will pass through the membrane via diffusion and provides pore protection from freezing and from drying out.
- Disassemble all PVC ball valves and drain any water inside (open and close to ensure trapped water escapes).
    - Leave all valves ½ open during reinstallation
- Open all drain valves and leave open.
- Clean and reinstall all sprayer nozzles.
- Find all check valves and make sure water is not being held by valve (Wet/Dry Vac works well here).
- Drain / remove all pumps from tanks, ensure no water is left inside the pump.
- Use RV biodegradable Antifreeze to
    - Refill any check valve
    - Dump in 2 (qty) 4-L bottles in each tank
- Remove pH and DO probes (if unit is equipped) and store with membranes in a heated area ensure probes are kept wet.
- Remove power from system.

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Double check and ensure that there is no water left in any pipes, fittings etc. If it is not possible to remove the water fill with antifreeze.

Glycerine Solution Solution Components and Solution Make-Up

1. Chemicals:
Technical Glycerin (86.5%)
Distilled water

2. Solution make-up procedure:

Dissolve technical glycerin (86.5%) in water and homogenize according the following table.

Preservation Solution 20 % Glycerin	Technical Glycerin [86,5%]	Distilled Water
[kg]	[kg]	[kg]
1	0.23	0.75
10	2.3	7.5
100	23	75
1000	230	750

The preservation solution has a density of 1,045 g/cm^3. The concentration of preservation solution can be tested and corrected with a density meter.

Membrane preservation procedure

- Allow the membrane unit to soak in preservation solution for a few hours.
- Remove the membrane unit and allow excess glycerin to drain.
- Shrink wrap the unit with a thick (1.5 mm) plastic bag and seal membrane unit using a hand sealer or tape.

For long term storage preserved unit should be stored in a cool (4^{0}C - 20^{0}C), dry area, away from direct sunlight and protected from accidental damage.

Re-commissioning the unit is straight forward. Once unit is lowered into MBR Tank, first start the aeration, then the permeate pump. In order to let all the traces of glycerin in the permeate to dissipate, make the arrangement for the permeate to recycle back to the aeration tank for the first half hour.

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9.0 SERVICE & SUPPORT

Commissioning and Start-up

newterra MicroClear™ MBR System's **commissioning & start-up** is the last step of the **newterra** project execution process. Experienced engineers and technicians are available to assist clients in these procedures including system initial set up and primary start-up and providing all performance tests according to the pre-commissioning checklist.

Initial on-site training program is an important part of the commissioning service as well. During on-site training, **newterra** technical representative will cover process monitoring, system operation, maintenance, and troubleshooting activities related to the **newterra** ™MBR System. Customized training packages are available. Contact **newterra** for more information.

Post commissioning Services

A comprehensive range of post commissioning services is available from within **newterra** beyond system design and installation. Specific services are included:

- Technical support (including after-hours emergency telephone support).
- Spare parts order and delivery.
- Training program.
- Plant optimization and upgrades.
- Telemetry control and monitoring.
- Assistance in preparing system performance reports (process data monitoring & analysis).
- Preventive maintenance cleaning (including membrane cleaning).
- System audits for reviewing the performance of all MBR subsystems and the efficiency.

1. **Technical support** is available to assist in troubleshooting of **newterra** MBR system during normal working hours 8:30 am to 5:00 pm (Eastern Time Zone for **newterra** ltd.). Telephone service is available via **1.800.420.4056.**

Emergency **24/7 telephone technical support –** This will be activated upon subscribing to **newterra's** 24/7 technical support service.

If problem cannot be resolved through telephone or e-mail supports, **newterra** engineers are available for site visit.

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Appendix F Steensby and Rail Camps FWSSWMP – Plans for Future Work

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Updates to this Appendices will be done when required for construction of the Steensby Component and will be included in a future Annual Report to NWB as required by Part B, Item 4 of existing Type A Water Licence. Block Flow Diagrams for Steensby and Railway Camps will be updated when required.

A.1 Freshwater

A.1.1 Freshwater System Process Description

A.1.1.1 Steensby Port Site

Currently, there are no construction activities planned for Steensby Inlet. During the future construction phase the on-site population will be approximately 600 people. Half the camp personnel will be accommodated on a barge which will be equipped with potable water treatment systems. The potable system onboard the barge will be a reverse osmosis based system. The full configuration will include coagulation, filtration by media filter, reverse osmosis and chemical disinfection. The remaining personnel will be accommodated by a land based potable water treatment system. This system will continue to operate during the operation phase while the barge-based system will only be used during the construction phase.

The existing freshwater equipment will not be used and a new freshwater distribution system will be installed. The freshwater demand for construction and operation are shown on the drawing Steensby Site - Water Supply Balance Block Flow Diagram in Appendix C.

For the land-based system, a heated and insulated pump house will be built at Lake ST347 with duty/standby pumps to deliver freshwater to a freshwater tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the freshwater requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some freshwater requirements such as road dust suppression, stockpile dust suppression, concrete and explosives manufacturing will be provided directly from nearby lakes using a vacuum truck.

The land based potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual

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chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine. The barge-based potable water treatment scheme will include the same equipment as well as a membrane-based system to desalinate the seawater source.

A.1.1.2 Mid-Rail Site

Currently, there are no construction activities planned for the Mid-Rail Site. During the future construction phase, the on-site population will be approximately 200 people. A new potable water treatment system and freshwater distribution system will be put in place to support the construction phase operations. The freshwater demand for construction and operation are shown on the drawing Mid-Rail - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at an adjacent Unnamed Lake with duty/standby pumps to deliver freshwater to a freshwater tank during summer. During the winter, water will be trucked from Ravn Camp Lake to the freshwater tank. This tank will be located in close proximity to the new potable water treatment plant. Water from this tank will be used to provide fire water as well as meet the freshwater requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some freshwater requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

A.1.1.3 Ravn River Site

Currently, there are no construction activities planned for the Mid-Rail Site. During the future construction phase, the on-site population will be approximately 400 people. A new potable water treatment system and freshwater distribution system will be put in place to support the construction phase operations. The freshywater demand for construction and operation are shown on the drawing Ravn River - Water Supply Balance Block Flow Diagram in Appendix C.

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A heated and insulated pump house will be built at Ravn Camp Lake with duty/standby pumps to deliver freshwater to a freshwater tank (to be located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the freshwater requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some freshwater requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

A.1.1.4 Cockburn Tunnels Camp Site (Cockburn North Camp)

Currently, there are no construction activities planned for the Cockburn Tunnels Camp Site. During the future construction phase, the on-site population will be approximately 100 people. A new potable water treatment system and freshwater distribution system will be put in place to support the construction phase operations. The freshwater demand for construction and operation are shown on the drawing Cockburn Lake Tunnels Camp - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Cockburn Lake with duty/standby pumps to deliver freshwater to a freshwater tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the freshwater requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some freshwater requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

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A.1.1.5 Cockburn South Camp Site

Currently, there are no construction activities planned for the Cockburn South Camp Site. During the future construction phase, the on-site population will be approximately 400 people. A new potable water treatment system and freshwater distribution system will be put in place to support the construction phase operations. The freshwater demand for construction and operation are shown on the drawing Cockburn South - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Cockburn Lake with duty/standby pumps to deliver freshwater to a freshwater tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the freshwater requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some freshwater requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

A.2 Sewage Treatment

A.2.1 Sewage Treatment Process Description

A.2.1.1 Steensby Site

During the construction and operation phase, the camp population will increase to approximately 600 people. There is no planned construction at Steensby Site in the immediate future.

During construction start-up, sewage generated by the workforce will be treated in an existing sewage treatment plant that is on-site but not yet installed. During the construction phase, 300 people will be accommodated by a temporary sewage treatment system in place for the construction period. In addition, the temporary sewage treatment plant will be designed to process raw or partially treated sewage from the Cockburn Lake rail camps, which will be conveyed to the Steensby

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temporary sewage treatment facility by truck. The remaining workforce will be accommodated by a permanent sewage treatment system that will remain in service during the operation phase.

These sewage treatment plants will be housed in a temperature-controlled area and as such their performance will not be negatively impacted by arctic conditions.

Effluent from the sewage treatment plants will be stored in effluent tanks. The effluent tanks will have a hydraulic retention time of two days (at minimum) based upon nominal flows. It is intended that the effluent tank will be at a low level during operation such that if sampling indicates that the effluent quality does not meet the applicable criteria further discharge can be prevented for a period in excess of a day to allow this effluent to be mixed, retreated, and retested. In addition, this retention volume will allow for a minimal amount of recirculation through the STP using any spare STP capacity. This will improve the quality of the final effluent in the tank. The volume is sufficient to allow for periodic sampling and testing of the treated effluent before discharge or reuse. The new permanent sewage treatment facility will be RBC based technology or superior.

Should the tanks reach near max capacity due to off-spec effluent, the non-compliant effluent will be removed from the tank and placed into the sewage plant feed tank for re-processing or re-located to the PWSP for further treatment. In the event there is an electrical power outage that causes the STP to be completely inoperable, raw sewage will be temporarily diverted and trucked to the PWSP, until such time that the STP becomes operable. At that time, partially or untreated sewage from the PWSP(s) will be trucked back to the treatment plant(s) for treatment or treated using an in-situ at the pond location treatment system and discharged to the appropriate outfall location. The PWSP discharge plans for Milne Port and the Mine Site may be used as a guideline to ensure effluent discharged meets the applicable water criteria outlined in the Type A water Licence. In the event that treatment methods differ significantly from the PWSP discharge plans for the Mine Site and Milne Port, Baffinland will seek third party consultation to confirm the appropriate water treatment methods. Treated effluent will be discharged to the ocean. Sedimentation and erosion controls will be installed if deemed necessary at the outfall location leading to the ocean.

The equalization tank that feeds the temporary sewage treatment plant will be sized to accommodate the sewage from the Cockburn Lake and Cockburn South rail

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camps. The rail camp sewage will be added during periods of low sewage generation at Steensby in order to reduce excessive surge volumes building up in the tank.

The sludge generated will be dewatered using a mechanical dewatering device such as belt filter or filter press and then incinerated. Sludge cake will be stored in an animal proof secure area. Odour generation will be limited because the sludge will be aerobically digested, dewatered and incinerated regularly such that the sewage cake is not stored for significant periods. Odour control carbon vents will be installed where deemed necessary. The incinerator design will consider the solids content of the sludge from the dewatering device.

Prior to construction of the Steensby components of the project, the Mine Site STP can also serve as the sewage Management System for personnel residing in the Ravn, North and South Cockburn camps, and Mid-Rail camp. Likewise, all construction will follow the applicable requirements as set out in the Type A Water Licence for construction and/or modifications.

The equalization tank that feeds the new sewage treatment plant will be sized to accommodate the sewage from the Cockburn Lake and Cockburn South rail camps. The rail camp sewage will be added during periods of low sewage generation at Steensby in order to reduce excessive surge volumes building up in the tank.

The sludge generated will be dewatered using a mechanical dewatering device such as belt filter or filter press and then incinerated. Sludge cake will be stored in an animal proof secure area. Odour generation will be limited because the sludge will be aerobically digested, dewatered and incinerated regularly such that the sewage cake is not stored for significant periods. Odour control carbon vents will be installed where deemed necessary.

A.2.1.2 Mid-Rail and Ravn River Sites

Sewage waste generated at the Ravn River and Mid-Rail camps and Sewage generated at the Cockburn North and Cockburn South camps can only be transported and treated at either the Mine Site Sewage Treatment Facility or the Steensby Port Sewage Treatment Facility, unless otherwise approved by the Board in writing.

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Sewage generated at these sites will mainly be conveyed to the Mary River permanent sewage treatment facility by truck. During the first year when there will only be access to the camp via an ice road, sewage can only be trucked from January to April. During the remaining months the sewage will be stored. There would be an opportunity to partially or fully treat sewage prior to storage. Sewage storage facilities may be aerated to prevent the waste from becoming septic (generating odours and noxious gases). Sludge will form and settle in the facility depending on how long the sewage resides there. This sludge will be withdrawn and delivered separately to the dewatering system at the Mine Site. Given the quantity of waste to be moved or stored every effort will be made to reduce this volume by using low flow showers and toilets and potentially segregating gray water to be treated and reused as urinal flush water. Other potential waste minimization techniques will also be reviewed. These will be evaluated during the detailed design. In addition, the surrounding water bodies will be modelled and sampled to potentially support having sewage treatment and waste discharge near the camp sites. An additional amendment to the Type A Water Licence would be required to support this option.

The equalization tank at Mary River will be sized to provide sufficient residence time for freshly added sewage from the Mid-Rail or Ravn River to mix with sewage generated at the Mine Site. Given that sewage generation follows diurnal patterns, the sewage from the remote sites will be added during the low generation periods at the Mine Site.

A.2.1.3 Cockburn Tunnels (Cockburn North) and Cockburn South Sites

Sewage generated at these sites will be conveyed to the Steensby permanent sewage treatment facility by truck. Raw to partially treated sewage will be conveyed to Steensby Inlet by means of established roads along the rail alignment or by ice road. Depending on the volume of sewage to be stored at site, the sewage storage facilities will be sized accordingly. At the north camp there will only be access to the camp via an ice road and as such, sewage can only be trucked from January to April. During the remaining months the sewage will be stored. Sewage storage facilities will be aerated to prevent the waste from becoming septic (generating odours and noxious gases). There will be the opportunity to partially or fully treat sewage prior to storage. Sludge will form and settle in the facility depending on how long the sewage resides there. This sludge will be withdrawn and delivered separately to the dewatering system at the Steensby site. Given the quantity of waste to be moved

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every effort will be made to reduce this volume by using low flow showers and toilets and potentially segregating gray water to be treated and reused as urinal flush water. Other potential waste minimization techniques will also be reviewed. These will be evaluated during the detailed design. In addition, the surrounding water bodies will be modelled and sampled to potentially support having sewage treatment and waste discharge near the camp sites. An additional amendment to the Type A Water Licence would be required to support this option.

The equalization tank at Steensby will be sized to provide sufficient residence time for freshly added sewage from the Cockburn Tunnels (Cockburn North) and Cockburn South camps to mix with sewage generated at the Steensby site. Given that sewage generation follows diurnal patterns, the sewage from the remote sites will be added during the low generation periods at the Steensby site.

A.2.1.4 Design Considerations from 'Lessons Learned'

Previous studies have recommended the use of Polishing Waste Stabilization Ponds (i.e. Mary River Project Appendix 10D-3 Wastewater Management Plan SD-EMMP-003, March 31, 2010) followed by a secondary waste polishing system. The existing infrastructure at the Mine Site and Milne Port include these ponds in part to allow for secondary treatment of the sewage treatment plant (STP) effluent which was not meeting the phosphorus discharge limit. However, based upon practical experience at the site with the STP it was projected that a secondary polishing system will not be required in the future.

The new systems will be installed with temporary storage ponds for off-spec water but will not require secondary polishing for the following reasons:

- The proposed new STPs will be based on membrane technology. This technology produces better quality effluent, is less susceptible to the impact of varying loads and has shorter start-up periods.
- The STP trains will be better able to handle upsets by using the available spare capacity to operate the equipment at more conservative flow rates.
- The existing equipment (at the Mine Site) was designed to meet a phosphorus discharge criterion of 0.5 mg/L. The new STPs shall be designed to meet a much lower phosphorus discharge criteria of <0.1 mg/L.

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Sewage Treatment equipment vendors will be assessed based upon their experience producing equipment for arctic environments.

A.2.2 Oily Water/Wastewater Treatment Process Description

The process descriptions for both oily water/wastewater treatment systems for Steensby are described in the section that follows.

A.2.2.1 Steensby Site

Future Construction and Operation Phase

Oily water may be generated from the following sources (this neglects minor oily water generated from accidental spills, which will be handled by the Spill Response Plan):

- Vehicle maintenance and wash facilities (i.e. truck wash, equipment and floor wash down water).
- Fuel tank farm run-off.
- Emulsion plant wash water.
- Freight dock.
- Airstrip.

The vehicle maintenance and wash facility will have a sump located in close proximity to the maintenance facilities. Wash water produced in the maintenance facility (truck washing, equipment and floor wash-down) will flow by gravity and be collected in the local sump. Suspended material in the wastewater will settle in the sump. Free oil in the wastewater will be removed by an oil/water separator system in order to meet the required oil discharge limits. The waste will then be further treated in the oily water treatment plant by activated carbon and clay to meet other specific parameters. The effluent will then be pH adjusted, if required, to meet discharge criteria.

Treated effluent from the oily water treatment plant will be pumped to discharge, or recycled and reused as wash-down water at the maintenance shops. If effluent does not meet the criteria outlined in the Type A Water Licence, the water willmay be reprocessed, or transferred to astored in a new PWSP for further treatment, or treated in-situ prior to discharge.pursuant to the applicable Type A Water Licence

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sections for modifications and constructions, for further in-situ pond treatment, or treated through the Steensby or Mine Site STP's.

The separated waste oil will be stored in a local tank. Periodically, the oil will be drained and shipped off site or incinerated. Accumulated suspended solids will be periodically removed and sent to the landfarm for treatment, if necessary.

Run-off from the tank fuel storage areas will have to be treated by the mobile oily water separator system that will be used as needed. The resulting water will be discharged directly to the receiving body (Steensby – Ocean). The water will be periodically tested such that if any parameter is out of compliance the water will be removed by vacuum truck and treated in the vehicle maintenance shop wastewater treatment plant.

Run-off water from the freight dock will be collected and treated in a manner similar to the treatment scheme for the run-off from the tank fuel storage areas.

The emulsion plant shall be supplied with its own wastewater treatment plant, which utilizes an evaporation system to evaporate the water leaving solid residue and oil. This residue will be tested for toxicity and if necessary taken off-site for disposal at a licensed facility otherwise the waste will be land filled.

Run-off water from the airstrip run-off also has the potential for some oily water content. As such, this water will be collected through a drainage system and transported as needed by vacuum truck to the vehicle maintenance shop wastewater treatment plant.

Small amounts of propylene glycol will be used for de-icing of aircraft. The spent propylene glycol will be collected, stored in containers and sent by ship off-site to a licensed treatment/disposal facility. Some interim treatment of the spent propylene glycol may occur to reduce the overall waste volume generated. This will be evaluated during the detailed design.

Some dust suppression solution will be applied to roads at the Steensby site. The suppressant will be DL-10. This is an asphalt-based emulsion and as such, some water will be consumed for the dilution of the solution. This is an approved dust suppressant as specified by the Nunavut Department of Sustainable Development Environmental Protection Service (Environmental Guideline for Dust Suppression).

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In addition, some Calcium Chloride solution will be used for drilling activities. The spent brine will be applied to nearby roads as a dust suppressant. This is an approved dust suppressant as specified by the Nunavut Environmental Protection Service. Treated oily water will be blended with treated sewage and discharged or discharged directly based on sampling.

A.2.2.2 Rail Camps

Two tunnels are to be built along the railway and a small amount of water will be consumed in the tunnelling operation. Calcium Chloride brine solution is used for tunnelling. This waste brine generated during the tunnelling will be collected and disposed of as per the Waste Management Plan for Construction, Operation and Closure. In addition, some Calcium Chloride solution will be used for drilling activities.

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Appendix G PWSP Effluent Discharge Plan

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Technical Memo

To: Connor Devereaux, Baffinland Iron Mines

From: Jack Hinds, P.Eng, Wood E&IS

Reviewer: Jered Munro, P.Eng, Wood E&IS

Project No.: TPC192071

Date: 29 April 2020

Re: PWSP Treatment and Discharge

1.0 Background

Baffinland Iron Mines Corporation (Baffinland) has retained Wood Environment and Infrastructure Solutions, a Division of Wood Canada Ltd (Wood E&IS) to prepare this technical memo, outlining treatment, and disposal options for the water stored in the polishing/ waste stabilization ponds (PWSPs) at the Milne Inlet and Mary River sites.

The PWSPs can receive wastewater, sludge, grey water, and non-compliant sanitary effluent from various locations across both sites. These sources include, but are not limited to:

- Non-compliant effluent from wastewater treatment plants
- Excess sludge generated at wastewater treatment plants
- Raw sewage from spills
- Raw sewage from lift stations as a result of malfunction or emergency
- Greywater from lift stations

This plan updates and amends the previous plan that was completed in March 2012. The intent of this memorandum is to outline options that could be employed to treat the PWSPs to a level that is compliant with the approved Type A Water Licence requirements and be discharged to the environment under those requirements. The proposed treatment options may be used individually or combined with other treatment options to form a treatment system that is capable of achieving compliant effluent quality. This approach has been selected to provide operators with the ability to address various water quality issues that can occur due to changing conditions in the PWSPs, caused by the various site sources noted above, and the natural environment.

The PWSPs can potentially require treatment for:

- Removal of BOD/COD
- Removal of total suspended solids (TSS)
- Removal of total ammonia
- Removal of total phosphorus
- Removal of oil and grease
- Destruction of faecal coliforms
- Acute Toxicity associated with inorganic or organic compounds
- Control of pH

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1.1 Onsite Water/Wastewater Treatment Equipment

There are a number of water and wastewater treatment equipment available at the Project site that are available for use in treating the PWSPs. The equipment is owned and maintained by Baffinland, and is typically operated by Baffinland, or is operated under contract with an engineering or operations firm. It is expected that Baffinland may be required to purchase additional equipment or replace existing equipment that is aging or no longer functional.

Baffinland maintains a supply of common treatment chemicals required by the treatment processes. Less common chemicals used for treatment are brought on site on an as-needed basis.

2.0 Treatment of PWSPs

PWSP treatment occurs during the spring and summer discharge seasons, when the water in these ponds is not frozen. Water quality in the PWSPs can be variable, and often changes over the course of the year. These variations in water quality are typically caused by:

- Contributions of impacted water to the PWSPs
- Spring melt, and ice retained within the PWSPs
- Fluctuations in temperature and pH
- Biological activity and consumption of nutrients
- Diurnal effects, exacerbated by long periods of daylight/twilight during the mid-summer months

The treatment methods presented below represent the treatment techniques that may be employed to achieve compliant water quality in the PWSPs, and allow for discharge to the environment. The options presented have been listed discretely but may be combined as required in order to address the influent water quality. As the water quality is variable over the course of a single season, multiple treatment methods or approaches may be required in a single season in order to maintain compliant effluent quality.

2.1 Winter Discharge

During the winter season, the PWSPs will stratify and eventually freeze the entire water column down to the lined bottom of the pond. If no additional non-compliant effluent is added to the ponds, it is possible that melted ice could be compliant for discharge. This offers Baffinland an opportunity to perform a discharge during winter months, if additional storage space is required before the spring melt.

To do so, Baffinland would use in-line heaters to recirculate hot water into the pond, to produce a layer of melt water. The melt water would then be heated, and returned to the pond, to further melt the surface ice. This process would be repeated, until there was sufficient free water on the surface to allow for sampling and discharge.

Samples will be collected for all criteria and analyzed prior to discharge. The discharge will be monitored for compliance following the guidelines given in Section 3.0, and will be shut down once water quality degrades below internally set limits.

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2.2 Spring Discharge

As noted in Section 2.1 above, during the winter months the PWSPs will typically freeze down to the lined bottom of the ponds. During spring freshet, warmer temperatures and increased daylight hours cause the top layer of ice to thaw first, creating a pool of clear water on the surface of the PWSPs.

Typically, this initial melt water is compliant for discharge due to settling of solids at the end of the previous season. If the water quality analysis confirms the meltwater is compliant, it may be discharged to the receiving environment without further treatment.

The discharge will be monitored for compliance following the guidelines given in Section 3.0.

2.3 Membrane Bioreactor Treatment

Baffinland owns and operates Membrane Bioreactors (MBRs) for treatment of sewage at both the Mary River and Milne Inlet sites. If there is available capacity in these plants, impacted water from the PWSPs may be treated through the installed MBRs. This may be achieved either through the use of a vac-truck offloading to the equalization tank, or through installation of a temporary or permanent pumped line to the equalization tanks. Appropriate controls would be installed to ensure the total volume of pond water treated is controlled and recorded, and the equalization tank and MBR treatment system are adequately protected from damage.

An alternate approach that could be considered by Baffinland is to install a package treatment process specifically for the PWSPs. In this case, impacted water from the ponds will be pumped directly into the equalization tank, and treated through the system.

Generally, a package treatment system is comprised of the following processes:

- Equalization tank and pumps
- Coarse filtration system
- Aeration tank, with aeration grid and blowers
- Biological treatment process, including membranes or media, blowers, backwash system, cleaning system etc.
- Sludge pumps and sludge storage
- Sludge handling system, such as a sludge press
- Final effluent holding tank and pumps
- Disinfection system
- Chemical dosing systems

2.3.1 Filter Cake Disposal

Filtered sludge cake generated by the biological treatment process is either incinerated onsite, or backhauled south for disposal at an approved facility. All sludge cake will be handled in accordance with the applicable portions of Baffinland's Fresh Water Supply, Sewage, and Wastewater Management Plan.

2.4 Dissolved Air Flotation

Dissolved Air Flotation (DAF) is a treatment principle typically used to remove solid materials from wastewater, through the use of a recycle stream of air-saturated liquid. Baffinland may employ owned, constructed, or rental DAF units at either site for treatment of the PWSPs. DAF systems typically only remove solid material in the water, making them applicable for removal of BOD, TSS, and total phosphorus.

Wastewater is pumped into the system from the source, through a tube flocculator where coagulation and flocculation chemicals are added prior to entering the main treatment tank through a distribution header. A recycle pump draws a stream of partially-clarified liquid off the side of the tank and pressurizes it in an air saturation tank. At the same time, compressed air is injected into the air saturation tank, creating a recycle stream saturated with dissolved air. This recycle stream is then released back into the main tank, where the saturated air comes out of solution as very fine air bubbles. These bubbles act as nuclei for flocculated/coagulated solids, causing them to rise to the surface. A skimmer transfers floated solids from the

surface of the tank to a hopper, where it's pumped to a tote or tank for storage and disposal. Clarified effluent flows over a weir and out of the system.

Generally, a DAF system is comprised of the following processes:

- Influent pump
- Tube flocculator
- Dissolved air floatation tank, with distribution headers
- Compressor
- Air control panel
- Air saturation tank
- Recycle pump
- Float skimmer and hopper
- Float pump
- Effluent weir
- Solids drain
- Effluent break tank or holding tank, and pumps
- Chemical dosing system

For coagulation, a DAF system may use the following chemicals:

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda

For flocculation, a DAF system may use the following chemicals:

- Vendor-specific, proprietary anionic or cationic polymers

2.4.1 Separated Solids Handling

Solids removed from the water by the flotation system are pumped into totes or other appropriate containers, labelled and manifested appropriately, and backhauled seasonally for disposal.

If possible, the floated solids may also be pressed through a filter press and incinerated, if the composition and water content allow.

2.5 Bulk Pond Treatment

If required, removal of TSS, BOD, total phosphorus, total ammonia, and/or faecal coliforms, may be performed in the ponds themselves. Doing so allows for rapid, bulk treatment of the contents of the PWSPs.

A typical treatment system would require:

- A pond mixing system
- Chemical dosing systems
- Inline mixers, such as a mixing tank, tube flocculator, or static mixer
- Flowmeter for flow measurement and totalization

Jar testing would be completed on the raw contents of the PWSP being treated to determine approximate chemical dosing rates required for treatment. The ponds would be mixed and chemicals would be injected into the mixing streams in accordance with dosing rates established during the jar tests. Chemical addition may be completed in multiple steps, to ensure no chemical is dosed beyond what is required for treatment.

Once dosing is complete, the PWSP will continue to be mixed for an appropriate amount of time, to ensure the chemical(s) reacts fully and all contents of the pond have been turned over. Once mixing is complete, the mixing system will be shut off, to allow any coagulated/flocculated solids to settle, or to allow for natural stripping

processes to occur. An effluent discharge system will be set up to allow for recirculation of effluent back into the PWSP. When water quality analyses confirm the clarified water is compliant for discharge, discharge may begin.

For in-pond treatment, the following chemicals may be used:

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda
- Vendor-specific, proprietary anionic or cationic polymers
- Sulfuric acid
- Citric acid
- Hydrochloric acid
- Phosphoric acid
- Nitric acid
- Sodium hydroxide
- Sodium bicarbonate
- Magnesium hydroxide

2.5.1 Settled Solids Handling

Solids removed as part of this treatment method will naturally settle to the bottom of the ponds. Based on observations made in previous years, the quantities of settled solids are low enough to be considered insignificant in comparison to the total storage volume of the pond. Any settled solids typically remain settled and degrade naturally over time. If necessary, Baffinland may elect to drain any one of the ponds and remove and dewater any sludge remaining in the bottom.

2.6 pH Adjustment

pH adjustment may be required as a standalone treatment or may be required as part of a larger treatment system in order to maintain compliance. pH adjustment can be carried out in-pond or adjusted inline prior to discharge, depending on the requirements of the system and the condition of the PWSPs.

A typical pH adjustment system could require:

- A pond mixing system
- Chemical dosing systems
- Temporary chemical storage
- Inline mixers, such as a mixing tank, tube flocculator, or static mixer

Past observations suggest that pH in the PWSPs can be acidic, neutral, or basic, depending on what has been contributed to the pond, and what kind of natural biological activity has occurred. Various other treatment methods listed here may also have an impact on effluent pH and may require that pH adjustment be added as part of the treatment process to ensure compliant effluent.

The following chemicals may be used to form part of a pH adjustment system:

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda
- Sulfuric acid
- Citric acid

- Hydrochloric acid
- Phosphoric acid
- Nitric acid
- Sodium hydroxide
- Sodium bicarbonate
- Magnesium hydroxide

2.7 Filtration

Filtration systems provide a physical barrier, allowing for the removal of solid matter from a liquid stream. Doing so may be an effective means of reducing/removing TSS, BOD, and total phosphorus. Filtration may be used as a standalone treatment process or as part of a larger treatment system. Solids removal through filtration can also be used as tertiary treatment when combined with other treatment processes, to protect against carry-over or suspended solids.

A typical solids filtration system may employ one or more of the following technologies:

- Basket strainers
- Bag filters
- Disposable cartridge filters
- Backwashing cartridge filters
- Sand filters
- Continuous backwash sand filters
- Multimedia filters
- Rotary drum screens
- Belt filters
- Microfiltration
- Ultrafiltration
- Nanofiltration
- Membrane filtration

Filters used either alone, or in conjunction with other treatment processes, may be stand-alone, skid mounted, packaged, or contained within their own seacan.

2.7.1 Filtered Solids Handling

For most cartridge or bag filtration systems, solids are removed through capture on a fiber media, which cannot be backwashed. The media must be removed and disposed of according to Baffinland's Waste Management Plan.

Effluent from the backwashing of filters may be directed back into the PWSPs, or into dedicated storage for further treatment or disposal.

2.8 Adsorption Media Treatment

For treatment of dissolved compounds in impounded waters, various forms of adsorption media can be employed. The media would be loaded into plastic or steel media vessels and connected to the remainder of a constructed system using hoses. Various types of media may be used in series to remove different contaminants of concern. Media that may be used include:

- Granular activated carbon (GAC)
- Synthetic ion exchange resins
- Activated iron products
- Natural Zeolites
- Other adsorptive and ion exchange media as applicable

Use of adsorption media is typically sensitive to solids in the water, and may become fouled if solids concentrations are too high. Typically adsorption vessels would be preceded by a suitably selected filtration process to prevent fouling.

2.9 Oxidation

Some of the chemical treatment approaches listed use an oxidation-reduction reaction to remove contaminants. However, it is sometimes necessary to augment that oxidation reaction to further remove any contaminants, or to remove specific species that are otherwise hard to treat. Most forms of enhanced oxidation require additional

power and would be purpose-built systems constructed or purchased from vendors and brought to site. These could include:

- Hydrogen peroxide addition
- Ozone addition
- Ultraviolet light (UV)
- Electrochemical oxidation

2.10 Transfer of Water Between Sites

Under some circumstances, it may be necessary to transfer non-compliant effluent or pond water between sites, to facilitate treatment or provide additional capacity to handle upset conditions. Both sites have separate PWSPs, with different capacities and different available methods of treatment. By transferring water from one site to another, Baffinland can more effectively manage and treat non-compliant effluent, during treatment plant upsets.

Treatment between sites is achieved through the use of vacuum trucks specifically designated for hauling non-compliant effluent. The trucks would transport the water between the PWSPs at both sites, as required to achieve treatment and discharge.

3.0 Sampling and Performance Monitoring

The effluent discharge quality criteria for the PWSPs is defined in the Type A Water Licence 2AM-MRY1325 Amendment No. 1 as issued by the Nunavut Water Board, July 31, 2014. The following table summarizes the discharge criteria:

Parameter	Discharge to Freshwater Max concentration of any grab sample (mg/L)	Discharge to Ocean Max concentration of any grab sample (mg/L
BOD_5	30	100
TSS	35	120
Faecal Coliforms	1000 CFU/100 ml	10,000 CFU/100 ml
Oil and Grease	No visible sheen	No visible sheen
pH	>6.0, <9.5	>6.0, <9.5
Ammonia (NH3-N)	4.0	NR
Total Phosphorus	1.0	NR
Toxicity[1]	Not acutely toxic	Not acutely toxic

1: Acute lethality to rainbow trout (Method EPS/1/RM/13) and daphnia magna (Method EPS/1/RM/14)

Prior to commencing any treatment or discharge, Baffinland or their contractors will be required to develop and submit a discharge plan including details on monitoring and sampling frequency, safeguards, internal limits, etc. This plan shall be submitted to the Environmental Superintendent for review and approval before any treatment or discharge begins.

Baffinland will complete sampling to confirm treatment efficacy prior to and during discharge, which will be conducted at the intervals specified in the relevant discharge plan and the results of which will be used to guide treatment implementation and the ability to commence or continue discharge to the receiving environment. Discharge samples will be collected in accordance with the schedule laid out in the Type A Water Licence and provided to regulators to confirm treated effluent discharge meets the applicable criteria outlined above.

If there are any questions, comments, or concerns regarding the content of this memo, please feel free to reach out to Jack Hinds at 519-650-7143 or Jered Munro at 519-650-7130.

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Appendix H Mobile OWS Manual

(See BAF-PH1-830-T07-0001)

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Baffinland Iron Mines Corporation

Mobile Oily Water Separator (OWS) Manual

BAF-PH1-830-T07-0001

Rev 0

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Date: March 21, 2016

Signature:

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Date: March 21, 2016

Signature:

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1 PURPOSE AND SCOPE

The purpose of this manual is to provide guidance for the commissioning, operation, and decommissioning of the mobile oily water separator (OWS) in a safe, efficient and environmentally responsible manner.

2 REQUIREMENTS

2.1 REGULATIONS

Type A Water Licence No: "2AM–MRY1325 – Amendment No. 1", Nunavut Water Board

Nunavut Mine Health and Safety Act and Regulations.

2.2 HAZARDS AND REQUIRED HSE EQUIPMENT

2.2.1 HAZARDS

Identified hazards associated with commissioning, operation and decommissioning of the OWS include:

- Working with energized equipment and pressurized lines
- Working with electrically energized equipment near water
- Exposure to contaminated water and hazardous chemicals (i.e. diesel, bentonite)
- Working from heights
- Elevated noise levels (generator)
- Spills

2.2.2 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The following personal protective equipment (PPE) requirements have been assigned to the commissioning, operation and decommissioning of the OWS:

Standard PPE

- Hard hat
- Reflective vest
- Safety glasses
- Steel toed boots
- Rubber gloves

Additional PPE

- Face respirator and P100 particulate cartridge (for handling bentonite and lead media)
- Rubber gloves and hip waiters (when installing the berm sump)
- Nitrile gloves, safety glasses and lab coat when performing sample analysis

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- Ear protection (when working near generator)

All PPE must comply with applicable Baffinland's PPE policy and be inspected for damage prior to use.

2.2.3 Additional Safety and Environmental Equipment

The following safety and environmental equipment should be available at the OWS unit during operation.

- Fire extinguisher
- Spill kit
- Radio
- Spill pads (for fuel and free product tank)
- Quatrex bags (for used bag filters and spent media)

2.3 General Safety Instructions

- Monitor all pressure gauges and immediately shut down the OWS system if any exceedances occur
- Watch for pinch-points when exchanging bag filters
- Only trained personnel shall open or work on the electrical panels
- As a precaution against arc flashing, use your left hand and turn your body away from the electrical panel when switching off main breaker to the OWS
- When opening valves to vent air, do so slowly and carefully. Do not stand directly in front of valve.
- Ensure all electrical cords are in good condition and safely secured
- Practice good housekeeping inside and around the OWS unit
- Walk carefully between adsorption units, being careful not to become entangled with hoses or shut off valves by accident
- Wear all required PPE when working at OWS

2.4 Training and/or Qualifications

Any person commissioning, operating or decommissioning the OWS at the Project is required to have read and be familiar with this document. All operators will be trained by an experienced operator.

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3 DEFINITIONS

Total Adsorption Tank Bed Volume: the maximum total volume of water that the three (3) media vessels can hold when full of their respective medias (i.e. GAC, bentonite, anthracite).

GAC: granular activated carbon

GPM: gallons per minute

LPC: liquid phase carbon

HMI (Human Machine Interface): refers to the screen in the OWS control room.

API: refers to the baffled tank in the first stage of treatment where free product is removed.

BTE: refers to benzene, toluene and ethylbenzene.

4 RESPONSIBILITIES

The following responsibilities have been assigned to Baffinland's Environmental and Surface Works Personnel regarding the commissioning, operation and decommissioning of the OWS.

4.1 ENVIRONMENTAL COORDINATOR

Under the supervision of the Environmental Superintendent, the Environmental Coordinator will be responsible for implementing this SOP at their Project site. In the absence of the Environmental Coordinator, the Project Site Environmental Lead or his/her designate will assume all responsibilities outlined in this procedure. Specifically, the Environmental Coordinator shall:

- Ensure Environmental staff operating the OWS have read, understand and follow this SOP;
- Review and modify this SOP, as necessary;
- Provide updates to the Environment Superintendent and/or Environment Manager on the status and current operations of the OWS;
- Oversee and supervise all OWS operations;
- Report sample analysis results to the Environment Superintendent and/or Environment Manager.

4.2 OPERATORS

Under the supervision of the Environmental Coordinator, OWS operators will be responsible for adhering to and following this manual. Specifically, operators shall:

- Read and adhere to the protocols outlined in this manual
- Wear all required PPE;
- Conduct routine inspections of the OWS work area to ensure adequate controls are in place to mitigate known hazards;

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- Maintain a detailed log of all actions undertaken during operations and record all required data in the Daily Log Sheet (Appendix D);
- Complete required sampling and sample analysis (Section 5.5) to ensure OWS is operating as designed and that the final effluent meets water quality discharge criteria

4.3 Surface Works Personnel

Surface Works personnel shall support OWS operations, as necessary. Specifically Surface Works personnel shall:

- Provide a vacuum truck and operator for removing spent media;
- Assist in transporting, relocating and levelling the OWS unit;
- Assist operators in commissioning OWS by providing electrical support regarding power generation and ancillary components (wiring configuration and electrical switches);
- Provide logistical support in transporting barrels, Quatrex bags, supplies and other components to and from the OWS unit, as required.

5 PROTOCOL

5.1 Oily Water Separator (OWS) Overview

The OWS is a prefabricated system housed in a 40' foot seacan and is designed to remove oil, grease and BTE compounds from wastewater contaminated by hydrocarbons. The unit includes an API type separator to remove free product, a bag filter for solids removal and three adsorption units (one clay and two GAC) for hydrocarbon removal. In the event that the wastewater has lead concentrations that exceed the discharge limits outlined in Baffinland's Type 'A' Water License (2AM-MRY1325 Amendment No. 1), additional treatment barrels containing lead removal media will be added to the end of the OWS system. Refer to Section 5.3 for additional information on configuring the lead treatment barrels.

The OWS unit (Newterra model OWS-24) is sized for a water temperature of 7°C, specific gravity of 0.88 (diesel/furnace oil), TOG concentration of 50mg/L and flow rate of 50 gpm.

Error! Reference source not found. shows the Process Flow Diagram for the OWS.

Refer to Appendix A - Section 3 in the Newterra OWS O&M Manual for process and instrumentation drawings These drawings include equipment sizing, valves, and instrumentation as well as equipment/instrument tag and model numbers.

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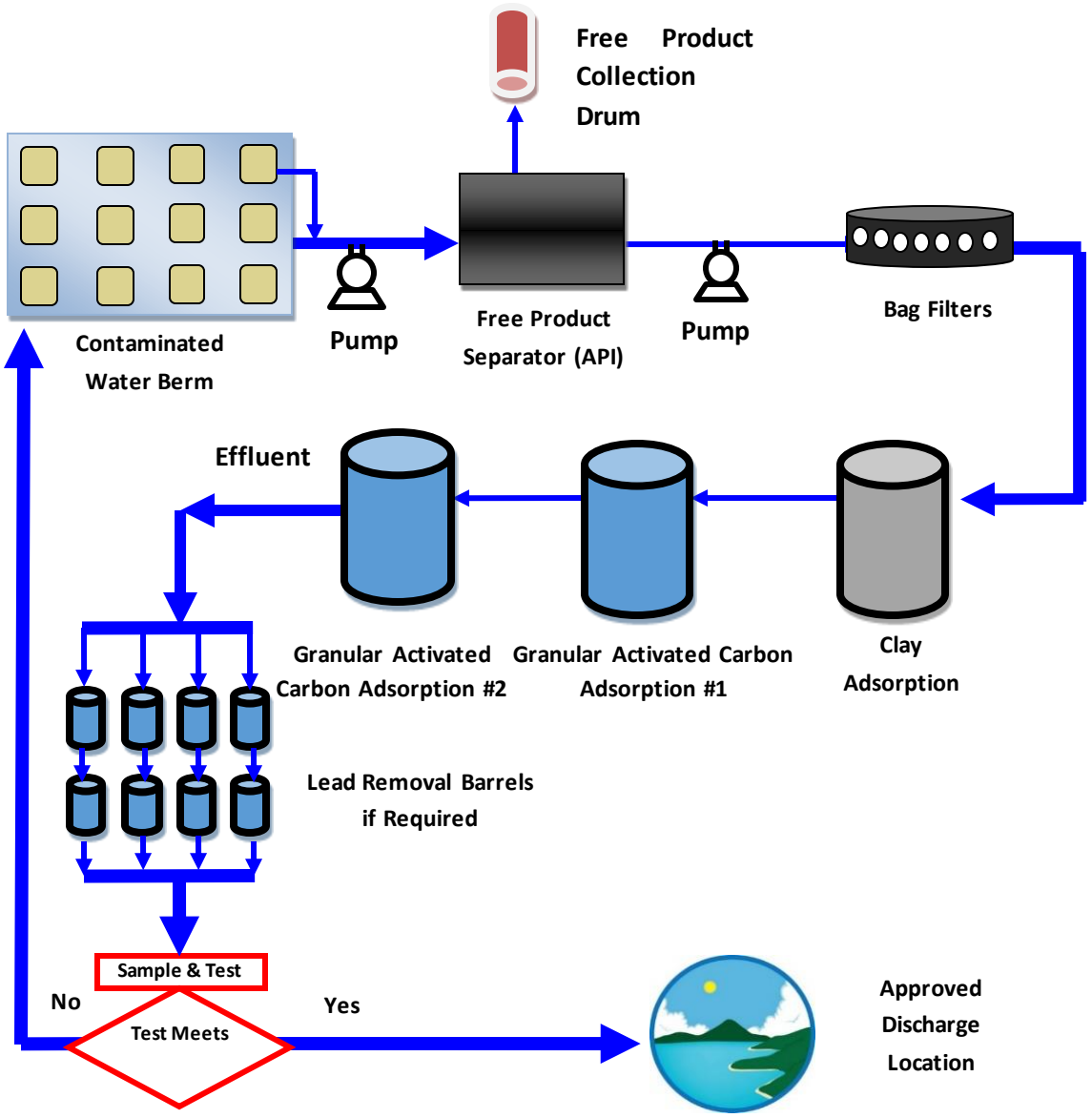

FIGURE 5-1 – OWS PROCESS FLOW DIAGRAM

The following protocols discuss in detail how to operate the OWS unit in a safe, efficient and environmentally responsible manner. Protocols discuss the commissioning, decommissioning and general operation procedures of the OWS unit as well as the water quality discharge criteria outlined in Baffinland's Type 'A' Water Licence (2AM-MRY1325 Amendment No. 1).

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5.2 Water Quality Discharge Criteria

The main sources of the contaminated water (wastewater) that the mobile OWS unit will be treating are the Bulk Fuel Containment Facilities/Berms and the Landfarm Facilities (including the Contaminated Snow Containment Berms).

All discharges from Bulk Fuel Storage Facilities will not exceed the following effluent quality limits outlined in Table 5-1. Applicable Monitoring Stations include MP-03, MP-MRY-7, MS-03, MS-04, MS-MRY-6, SP-04 and SP-05.

TABLE 5-1 – EFFLUENT QUALITY DISCHARGE LIMITS FOR BULK FUEL STORAGE FACILITIES

Parameter	Maximum Concentration of Any Grab Sample (ug/L)
Benzene	370
Toluene	2
Ethylbenzene	90
Total Lead	1
Oil and Grease	15,000 and no visible sheen

*Source: Type A Water Licence (2AM-MRY1325 – Amendment 1) Table 8

All discharges from Landfarm Facilities, including the Contaminated Snow Containment Berms, will not exceed the following effluent quality limits outlined in Table 5-2. Applicable Monitoring Stations include MP-04, MS-05 and SP-06.

TABLE 5-2 – EFFLUENT QUALITY DISCHARGE LIMITS FOR LANDFARM FACILITIES

Parameter	Maximum Concentration of Any Grab Sample (ug/L)
pH	Between 6.0 and 9.0
TSS	15
Oil and Grease	15,000 and no visible sheen
Total Lead	1
Benzene	370
Toluene	2
Ethylbenzene	90

*Source: Type A Water Licence (2AM-MRY1325 – Amendment 1) Table 9

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5.3 Commissioning the Oily Water Separator

Prior to commissioning the OWS, operators should review the OWS Commissioning Job Hazard Analysis (JHA) presented in Appendix B and inventory all chemicals/equipment required for OWS operation, including the supplies needed for sampling and conducting internal sample analysis.

As previously mentioned, the OWS system is a treatment train comprised of an API separator, a bag filter and three adsorption media vessels (tanks). The first process in the system's treatment train is the API separator which separates free-floating product with a skimmer and densely emulsified product with coarse screen filters. After the API separator, contaminated water is put through a bag filter unit to remove solids and is then percolated through three adsorption media tanks to remove any remaining hydrocarbon fractions. The first adsorption tank contains clay media comprised of two chemicals: anthracite and bentonite. Anthracite is a course media which is added to the tank first so that the anthracite is located at the bottom of the tank near the outlets. Anthracite is added first to prevent the finer bentonite media (added after the anthracite) from clogging the outlet filters located at the bottom of the tank. Following the clay adsorption tank, the second and third adsorption tanks are referred to as the GAC (LPC) tanks and are filled entirely with granulated activated carbon (GAC).

Table 5-3 provides the media types used in the OWS adsorption media tanks and their respective quantities.

TABLE 5-3 – ADSORPTION TANK MEDIAS AND QUANTITIES

OWS Adsorption Tank	Media Type	Quantity	# of bags/boxes
Clay (Tank 1)	Anthracite (added first and is utilized as course media around the outlet ports at the bottom of the tank)	1,000 lbs	18
Clay (Tank 1)	Bentonite	5000 lbs	103
GAC #1 (Tank 2)	Granulated Activated Carbon	3000 lbs	54.5
GAC #2 (Tank 3)	Granulated Activated Carbon	3000 lbs	54.5
Lead media (2 barrels per train, 3-4 trains in parallel)	Metsorb HMRG	3.5 cubic feet	3.5

Before commissioning the OWS system for the upcoming season, the influent and effluent TOG results from the previous year's treatment records should be assessed to determine if the existing media in the

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OWS adsorption tanks needs to be replaced. Percent removals for each applicable parameter (i.e. BTE, TOG, lead, etc.) should be calculated using the previous year's influent and effluent analysis results just prior to the previous year's winterization/decommissioning of the OWS system.

$$\text{Percent removal} = \frac{Conc\ influent\ - Conc\ effluent}{100}$$

The media is completely spent (used) and will need to be replaced when the influent concentration is equal to the effluent concentration (i.e. percent removal = 0%). The percent removal is used to assess and determine whether the media is capable of effectively treating current hydrocarbon concentrations found in the wastewater to be treated. The media will need to be replaced if the percent removal is not sufficient to reduce the contaminants concentrations below the discharge requirements outlined in Section 5.2. Contact Environmental Coordinator for direction if unsure.

The following steps are required to replace media from the adsorption media tanks:

1. Review JHA (Appendix B) with supervisor. Modify JHA, if necessary.
2. Wear all appropriate PPE (including respirator and P100 particulate cartridge)
3. Remove lids from adsorption tanks.
4. Contact Surface Works to provide vacuum truck to remove media from tanks.
5. Transfer spent media into labelled Quatrex bags (white).
6. Refill tanks with quantities listed in Table 5-3.
   Note: *Bentonite contains silica dust which is carcinogenic and therefore requires personnel to wear a half mask respirator equipped with a P100 particulate cartridge when handling bentonite. Refer to MSDS for full instructions before handling or opening bags.*
7. Reattach adsorption tank lids.

Whether the existing media from the previous year or brand new media is being used, the media in the adsorption tanks must be soaked in clean freshwater for 24 hours prior to running contaminated water through the system. This allows air trapped in the media's pores to be removed and the full surface area of the media to be utilized in treatment.

The following steps are required to soak the media within the adsorption tanks:

1. Contact Surface Works to provide a water truck with a full load of freshwater.
2. Open up all inlet and outlet valves on adsorption tanks except the outlet valve on the last adsorption tank (GAC#2). This will allow water to equalize among all three adsorption tanks
3. Open pressure valves on the top of each adsorption tank for air venting.
4. Hook up water line to inlet of the first adsorption tank.
5. Begin pumping water into the adsorption tanks using water truck. Ensure water truck pump is throttled to its lowest setting.
6. As tanks fill, use a rubber mallet to hit around the circumference of each tank to release any remaining air.

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7. Monitor pressure valves on adsorption tanks and ensure tank pressures **NEVER exceed 40 psi.** If necessary, shut off water truck periodically to allow pressure to release and equalize among tanks.
8. Shut off top pressure valves on each adsorption tank once water begins to come out of the each valve.
9. Shut off water truck once water has come out of each adsorption tank's top pressure valve.
10. Allow media to soak for 24 hours.

The OWS does not have its own power supply and therefore will need to be hooked up to a diesel generator to operate. For a generator and fuel tank, contact Surface Works. Refer to the Newterra OWS manual presented in Appendix A for engineered drawings and detailed instructions on how to hook-up the power line/supply, sump pump, water level float and free-product float.

Prior to starting the OWS unit, the wastewater to be treated (influent) should be sampled and analyzed internally to confirm the OWS unit is able to treat the hydrocarbon (TOG) levels found in the wastewater. If TOG levels are determined to be greater than 120 mg/L, contact the Environmental Coordinator for instruction.

Prior to discharging treated effluent from the OWS to the receiving environment, contaminated water should be re-circulated between the OWS unit and the wastewater containment berm. This is done to (1) flush out the freshwater used to soak the media in the adsorption tanks and (2) confirm the treated effluent discharged from the OWS meets the water quality discharge criteria outlined in Section 5.2 Approximately 10 m^3 (2640 USG) of wastewater must be recirculated through the OWS unit to flush the system of freshwater and confirm effluent quality.

Once the freshwater has been flushed out of the system, effluent samples can be collected for internal and external analysis. External effluent samples should collected and tested for all parameters required by the facility's effluent discharge criteria presented in Section 5.2. Internal samples should be taken in parallel to external samples and tested for TOG on-site using the procedure outlined in Section 5.5.3.

If after receiving the external analysis results, it is determined that lead treatment barrels will be required to ensure that the treated effluent meets the facility's discharge criteria, barrels will be setup following the third adsorption tank (GAC#2) of the OWS. Lead media barrels are typically configured into four trains in parallel with each train made of two barrels hooked up in series. The number of trains used is the limiting factor that determines the overall flow rate that can pass through the system, with each train having an approximate flow rate of 5 gpm. Each lead media barrel is equipped with a pressure gauge and water vent at the inlet valve located at the top of the barrel and an outlet valve at the bottom of the barrel. The effluent manifold should be placed at a higher elevation than the barrels to ensure barrels remain flooded when system is off. Air should be purged from the system upon start up. For more details on how to configure the lead treatment barrels and replace the lead removing media refer to Section 5.4.8.

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Do NOT discharge any treated effluent from the OWS system to the receiving environment unless it has been authorized by the Environmental Manager.

5.4 Operation and Maintenance Procedures

The following procedures provide detail on how to safely operate and monitor the mobile OWS system. Prior to operating the OWS, all operators should review the OWS Operation JHA presented in Appendix C.

5.4.1 Target Operating Conditions

The following table outlines the initial target operating conditions:

TABLE 5-4 – INITIAL OPERATING TARGETS

Parameter	Units	Initial Target
Flow rate from Pump 4901 (FQI 7001) without Lead Treatment trains.	gpm	45-50
Flow rate from Pump 4901 (FQI 7001) with four (4) Lead Treatment trains.	gpm	15-20
Discharge Pressure of Pump 4901 (PI 4901)	psi	55
Max Bag Filter Inlet Pressure (PI 6701)	psi	40
Max Adsorption Unit Inlet Pressure (PI 7001)	psi	40
Max Lead Treatment Barrel Inlet Pressure	psi	10

5.4.2 System Start-up

1. Turn generator **ON** if not already running. Ensure sufficient oil in generator and diesel in fuel tank. **Note:** All operators must be trained by Surface Works electricians on the proper starting and fueling procedures when operating the OWS system.
2. Ensure electrical panel is securely closed/locked. **Note:** Only trained personnel should open and adjust breakers in electrical panel.
3. Turn **ON** main disconnect for power to the OWS if not already on. **DO NOT** stand directly in front of panel when turning **ON** or **OFF** main disconnect.
4. The HMI screen will display system status and active alarms. Scroll right or left to view the active alarms. Address any alarms present. Refer to Section 3 of the Newterra O&M Manual presented in Appendix A for a list of alarms and activation/deactivation conditions.

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Note: Immediate power surge alarm will show on the HMI screen after power up. This will reset itself after five minutes. Address any other alarms present (float switches, free product barrel level, pressure alarms, etc.).

5. Once alarms are addressed go to main menu and clear alarms.
6. Walk through system to check for leaks and ensure influent pump and discharge lines are properly connected. Ensure all valves are properly positioned. Ensure there are no obstacles over any moving parts.
7. Ensure influent/sump pump and discharge lines are properly positioned and connected. If discharging, make sure a dissipater plate is in place at the discharge point to prevent surface erosion.
8. If no issues are observed turn the system **ON** at the HMI. Pumps should be manually set to **AUTO** mode.
9. Observe system operation to ensure the OWS is operating as designed. Check flow rates, pressures and confirm discharge.
10. Open valves at top of adsorption units and bag filter to purge air as described above.

5.4.3 System Shutdown

1. Turn system **OFF** on HMI.
2. Shutdown generator if system will be off for more than approximately 12 hours.
   Important Note: Turn **OFF** main disconnect in the OWS control room if personnel plan on conducting work on the OWS while the system and generator are off.

5.4.4 Routine System Checks

During normal operation the OWS system should be checked every four (4) hours at a minimum. As the amount of wastewater in the berm decreases or as specific concerns arise, the OWS system should be checked more regularly to ensure excessive amounts of sand or free product are NOT entering the system. The following instructions outline the tasks that should be completed during these routine checks.

1. Walk through system to check for leaks and ensure influent pump and discharge lines are properly placed/connected.
2. Confirm discharge flow and conduct visual inspection for any sheen or odor at the discharge location.
3. Record flow rates and pressures. Complete Daily Log presented in Appendix D. Collect samples as outlined in Section 5.5.2.
4. At the API, check level of free product using dipstick and water-detecting paste. If the free product level is 1/4" or more thick adjust the slotted pipe at the far end of the API using a 4" pipe wrench. The slit in the pipe should be at the surface of the liquid, just enough to remove any free product, and leave any remaining water in the tank. **Note: This is a completely manual step. Do not leave the slotted pipe at the liquid surface unattended for long periods of time as the free product**

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level will change over time and result in the free product collection barrel quickly filling up with water.

5. Check level of free product around sump in the berm. If there is significant free product present protect the intake pump with booms. If necessary, the OWS may need to be shut down temporarily to remove excessive amounts of free product within the sump area.
6. Adjust flow balance between influent pump (P 4001) and API discharge pump (P 4901) using the appropriate ball/globe valve if required.
   Note: The target flow rate from the API effluent pump (P 4901) is 30 gpm (20 gpm if using four lead treatment barrel trains in parallel). Flow balance should be such that the desired flow rate through the system is achieved, and the influent pump runs continuously if possible. If the influent pump flow rate is greater than the API effluent pump the LAHH 4901 switch will turn the influent pump off to prevent overflowing the API. This will result in frequent LAHH 4901 alarms on the HMI. A significant amount of flow rate monitoring and adjustment may be required during the initial startup/commissioning of the system to achieve the proper flow balance.
7. Monitor bag filter inlet pressure. Replace bag filters if the maximum bag filter inlet pressure, 35 psi, is reached. Bag filters may require frequent replacement. Refer to Section 5.4.7.
8. Replace GAC/clay media if inlet pressure to the first adsorption unit exceeds 35 psi or if breakthrough of contaminants is observed in the final effluent (visual sheen or high TOG results).
9. Purge any air collected in the system via the vents on the bag filter/adsorption units.
10. Perform/schedule any required maintenance as per the Newterra O&M manual.
11. Collect and analyze samples according to Section 5.5 and take appropriate action.
12. If at any point during the operation of the mobile OWS, the final effluent at the discharge point is discovered to have a sheen or hydrocarbon odour, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.
13. If at any point during the operation of the mobile OWS, the internal TOG analyses indicates the final effluent does not meet the required discharge criteria outlined in Section 5.2, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.

5.4.5 System Alarms

The OWS system has several shutdown alarms and non-critical alarms. Shutdown alarms will turn the system off. Non-critical alarms will be displayed in the HMI and will activate the alarm light but will not shutdown the system. If an alarm appears on the HMI, investigate the cause and take the appropriate action. Once the issue has been addressed, clear the alarm using the HMI.

Refer to Section 3 in the Newterra O&M manual for details on the how the alarms are activated/deactivated.

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5.4.6 MAINTENANCE

Several maintenance activities will need to be carried out after a recommended number of operating hours have passed. Refer to Section 8 in the Newterra O&M manual for details on the maintenance procedures and required, daily, weekly, monthly and yearly checks.

- Strainer cleaning: every 200 operating hours
- Pumps: every 800 operating hours
- Pressure gauges: every 4000 operating hours

In addition to these activities the filter bags and media will need to be replaced based on system pressures and water quality. See the following sections for more information.

5.4.7 FILTER BAG REPLACEMENT

Filter bags will need to be replaced when the inlet pressure to the filter housings reaches 35 psi. At 40 psi an alarm will be initiated.

To change out the filter bags complete the following steps:

1. Turn the system **OFF**.
2. Close inlet and outlet valves.
3. Relieve the pressure in the bag filter housing via the valve at the top of the housing.
4. Undo the housing bolts and remove lid.
5. If possible remove some of the water from the filter housing by partially draining the housing through the two inch line at the bottom of the stand or by removing the water from the top. Ensure drained water is contained and not spilled on floor. The bag filters can be replaced without removing the water however replacing the filter bags is easier when the housings is not full of water.
6. Place used filter bags into a pail or other container for disposal. The bags will be water logged and heavy. Use two people if required and proper lifting techniques (lift with knees NOT back). Filters can be burned and should be dropped off at the Waste Management Building to be incinerated onsite.
7. Insert new filter bags into the housing. The bags should fit flush at the top. Change all seven bags at the same time.
8. Apply silicon grease to the O-ring to prevent leaks from the lid if required.
9. Close the lid and bolt the lid down.
10. Check strainers and empty if required.
11. Open valves to bag filters.
12. Perform pre-start checks of system and turn system **ON**. Remove air trapped in filter housing by opening valve at top of housing until water is observed.

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5.4.8 Lead Removal Media

As discussed in Section 5.3, eight barrels containing lead removal media (Metsorb HMRG) should be added downstream of the system following the adsorption tanks if lead concentrations in the effluent exceed discharge criteria. The maximum flow through one barrel is 5 gpm, therefore the maximum flow through four barrels in parallel is 20 gpm. At an influent concentration of 5 µg/L (effluent of >1 µg/L) 1 ft^3 of media should be able to process approximately 70 m^3 of wastewater. Other heavy metals and contaminants in the wastewater will also be adsorbed by the media so the volume of water processed by each cubic foot of media will vary and depend on the total amount of metals in the wastewater. Taking samples of the final effluent and the discharge from the first row of barrels will indicate when the media needs to be replaced.

5.4.8.1 Lead Media Replacement Procedure

If breakthrough (exceedance) is observed at the discharge of the first row of four barrels, the media in these barrels should be replaced and the order of the barrels switched. **The four barrels with new media will be moved to the second row and barrels that were originally in the second row with be moved to the first row.**

To change out the lead media in the barrels complete the following steps:

1. Drain barrels.
2. Remove lids and scoop out spent media into labelled Quatrex bags for hazardous waste disposal.
3. Rinse barrels with a small amount of clean water.
4. Replace or rinse filter sock on bottom piping inside the barrels.
5. Put on appropriate respirators and review MSDS for procedures on handling media. Slowly pour new media into barrels being careful not to damage piping at bottom of barrels. Barrels will be approximately 1/3 full of media with 3-3.5 ft^3 of media. Settling of media inside the barrel can be aided by tapping the barrel sides with a rubber mallet.
6. Replace lids and ensure adequate seal.

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5.5 Sampling Schedule, Supplies and Procedures

The following table provides the sampling schedule and requirements for the commissioning and normal operation of the OWS. Confirm with Environmental Coordinator when sending out external samples.

Table 5-5 – **Sampling Schedule**

Parameter	Location within OWS	Internal Sampling Frequency	External Sampling Frequency
Oil and Grease	Influent	Start of open water season at each source/facility that contains wastewater potentially requiring treatment	Start of open water season at each source/facility that contains wastewater potentially requiring treatment
	API Effluent	Every 4 hours	
	Final Effluent	Every 4 hours	Prior to discharge/ Weekly during discharge
Total Lead pH TSS (only effluent)	Influent		Start of open water season at each source/facility that contains wastewater potentially requiring treatment
	Final Effluent		Prior to discharge/ Weekly during discharge
Benzene Toluene Ethylbenzene	Influent		Start of open water season at each source/facility that contains wastewater potentially requiring treatment.
	GAC #1 Effluent		Weekly
	Final Effluent		Prior to discharge/ Weekly during discharge

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5.5.1 SAMPLING EQUIPMENT

- Required PPE (refer to Section 2.2.2)
- Sampling bottles: Group 5 bottle set for external samples (See Appendix E for exact bottle set requirements), 250 mL glass wide-mouth jars for internal samples.

5.5.2 SAMPLING PROCEDURE

1. Obtain and wear appropriate PPE listed in Section 2.2.2.
2. Obtain sampling equipment outlined Section 5.5.1.
3. Check HMI to identify any active alarms.
4. Conduct a visual inspection to identify any leaks, system failures, and potential hazards (high pressures, electrical malfunctions, improperly opened valves, poor discharge/recirculation lines, etc.),
5. Record any system failures, leaks, hazards or inconsistencies observed on the Daily Log (refer to Appendix D).
6. Record all readings on the Daily Log.
7. Collect water samples at designated sampling ports for analyses (see Table 5-5 for required sampling locations and analysis).
8. Use 250mL wide-mouthed glass jars to collecting internal samples. Samples should be labeled with the date, time and sampling location/station. Internal sampling jars can be reused for internal analyses however, if reused, sampling jars should be used for the same sampling locations within the system (i.e. influent, effluent, etc.). Replace jars if suspected cross contamination is occurring.
9. All internal samples should be collected by following steps 1 through 6 at the required intervals outlined by Table 5-5.
10. Analyze internal samples for TOG following the analysis procedure outlined in Section 5.5.3.
11. Complete Daily Log with all the required information filled out including the date, time of routine checks, pressure readings throughout the system, totalizer values and internal TOG results. At the end of the day, information on the Daily Log will be transferred to the electronic Discharge Log located on the Mine Site Environmental Server (refer to Appendix D).
12. External samples must be collected according the Sampling Schedule (Table 5-5) and should be delivered to the onsite ALS lab within 24 hours of being collected accompanied with a completed COC.

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5.5.3 TOG Sample Analysis Procedure

Required Lab Supplies, Equipment and PPE

- 2 x 20ml glass graduated cylinder
- Glass funnel
- TOG analyzer + cuvette(s)
- Sulphuric Acid (98%) + pump
- S-316 Solvent
- Sodium Sulfate, anhydrous
- Spoon
- Pipette and tips
- Two glass mix jars for influent and effluent samples with 100ml marked
- Whatman filter Paper
- Kim wipes
- Nitrile gloves
- Lab coat
- Safety glasses

1. Turn TOG analyzer **ON** if it is not already on. Allow TOG analyzer to warm up for 1 hour.
   Note: The TOG analyzer can be kept on for the entire length of time the mobile OWS is operating.
2. Rinse all glassware with solvent: Horiba S-316 (i.e. funnels, graduated cylinders, pre marked 100mL mix jars, and cuvettes)
3. Add 100mL of sample to pre-marked mix jar.
4. Add 1mL of sulfuric acid (~98% conc.) to sample in mix jar.
5. Shake for 10 seconds.
6. Add 11mL of solvent to sample. The volume of solvent should be 10% of the total volume of solvent-sample mix.
7. Shake the mix jar for 2 minutes, opening mix jar at least twice to release any vapour buildup.
8. Allow mix jar contents to settle. A solvent layer containing the hydrocarbons in the sample should form at the bottom of the mix jar.
9. Fill cuvette with solvent, wipe thoroughly with Kim wipe and place in analyzer. This will serve as a blank.
10. Press and hold ZERO on analyzer. BAL will display on the screen followed by a number. Leave the cuvette in the analyzer and press RUN. If the result is within ±2 mg/L the analyzer is zeroed.
    Note: The cuvette should be placed in the analyzer with the frosted side facing you. The cuvette should always be placed in the analyzer in the same direction.
11. Add 1 spoonful of sodium sulfate to a folded Whatman filter in the glass funnel.
12. Extract settled solvent layer from bottom of mix jar with a 10mL pipette and filter it through the sodium sulfate inside the Whatman filter and into a clean graduated cylinder. This will remove any remaining water captured during the extraction of the solvent. Only 3-5 mL of filtered solvent

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is required to analyze the solvent layer and determine the hydrocarbon concentration in the sample (i.e. effluent, influent, etc.).

13. Fill cuvette with the filtered solvent, wipe thoroughly with Kim wipe and place in analyzer.
14. Press **RUN** to analyze.
15. Record results on Daily Log.
16. If TOG results seem high in comparison to external results, clean all glassware with solvent and redo analysis. If the hydrocarbon concentration in the influent sample water is equal or greater than 120 mg/L, system checks should be done more frequently and sampling should increase to every two (2) hours. Notify Environmental Coordinator of inflated TOG levels in influent.
17. If at any point during the operation of the mobile OWS, the internal TOG analyses indicates the final effluent does not meet the required discharge criteria outlined in Section 5.2, the OWS must be shut off and all discharge to the natural environment must stop immediately. Contact Environmental Coordinator.

5.6 Decommissioning the Oil Water Separator

The following procedures should be followed to safely and effectively decommission the mobile OWS unit when transporting the unit between Project sites or for winterization/end of season storage.

5.6.1 Decommissioning For Transport

Before transporting the mobile OWS unit between Project sites, the unit must be drained. The draining procedure required for transport is identical to seasonal storage draining procedure (refer to Section 5.6.2), however since this is completed to reduce weight for shipping, the lines and pumps are not required to be drained since this is a very time consuming process. Only media vessels and the API tank are required to be drained prior to transport. Additionally, all valves should remain closed during transport.

5.6.2 Decommissioning For Seasonal Storage

The decommissioning of the mobile OWS unit for seasonal storage requires all water to be drained from the system. Electricians are required to disconnect all wiring. All drained sensors and pumps should be placed and stored inside the control room. All hoses and lines must be drained of any residual water so that lines can be disassembled and will not rupture due to ice expansion. Hoses and lines should be drained using the valves at low points and available ports. Residual water must be drained back into the berm or captured in pails/tubs to be eventually transferred back into berm. Spilling contaminated water onto the ground is considered a spill and must be reported.

Complete removal of all water is required for the adsorption tanks and API tank.

To drain the three (3) adsorption tanks, a 3" trash pump must be hooked up to the bottom ball valve of each adsorption tank and used to effectively pump out all remaining water out of each tank. To minimize the possibility of removing any media in this process, the bottom ball valve on the bottom of each adsorption tank should only be partially opened and the trash pump should be throttled down to its lowest

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setting to reduce the overall flow rate/vacuum at the outlet of each adsorption tank. When each tank is empty and the trash pump begins to suck in air, the trash pump must be shut-down for 5-10 minutes to allow residual water to gravity drain through media and collect at the bottom of the adsorption tank.

Leave the bottom ball valve of each adsorption tank in the open position with a pail placed underneath the valve to catch any residual water dripping out of the tanks (empty as necessary). Open the lid on the top of each media vessel and allow the media to dry for a 2-3 days. If weather is cold, turn heaters on in the OWS unit or use a frost fighter to expedite the drying process.

To drain the API tank, setup a tub underneath the drain port on the outside of the OWS unit. Open the lowest ball valve on the drain port to allow the water in the API tank to gravity drain into the tub. Transfer contaminated water from the tub to the facility's containment berm.

Double-check that all valves and drain ports are opened and drained to ensure ALL residual water has been removed. It is absolutely critical that all lines, pipes, tanks and vessels have been completely drained of any water prior to freeze up.

5.7 OWS Discharge Log, Results Dissemination and Approval for Discharge

All the monitoring documentation to be completed during the operation of the OWS unit is located in the OWS Discharge Log file on the Mine Site Environmental Server at FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators. This file contains the Summary Sheet, the External Results Sheet and the Daily Log Forms presented in Appendix G, Appendix F and Appendix D, respectively.

The External Results Sheet presented in Appendix F must be updated upon receipt of any external sample results, including preliminary results. The Environmental Coordinator or his/her designate will provide the results to the Environment Superintendent and/or Manager who will assess the results and determine whether the effluent quality is acceptable for discharge or will assign instructions for additional treatment.

The Daily Log (refer to Appendix D) must be updated to include all internal samples and weekly external samples (if applicable) throughout the treatment process. End-of-shift cumulative discharge values and additional notes must also be recorded on the Daily Log.

The Summary Sheet (refer to Appendix G) must be filled out after all wastewater has been treated for a specific facility (i.e. Bulk Fuel Storage Facility, Landfarm Facility, etc.).

All documentation must be added to the appropriate site server location (FINAL File System\2.0 ENV MANAGEMENT, MONITORING PLANS (BIM INTERNAL)\2.08 Oily Water Separators). Upon the completion of wastewater treatment at a facility, the completed OWS Discharge Log must be provided to the Environmental Coordinator, Superintendent and Manager.

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6 REFERENCES

AMEC FW, (2014). Baffinland Iron Mines field notes OWS. July, 2014

Water Licence No: 2AM-MRY1325 – Amendment No. 1, Nunavut Water Board (July 21, 2015)

Newterra, (2013), Process Treatment System Project # 102140. Operation and Maintenance Manual

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APPENDIX A -

NEWTERRA OWS O&M MANUAL

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1.0 Start Up Procedure
Commissioning Checklist

Test Records
Packing List

2.0 Mechanical Drawings

3.0 Electrical Drawings

4.0 Control Panel Module

5.0 Components

6.0 Specs

7.0 Manuals

8.0 System Maintenance, Troubleshooting

An Esselte Corporation

RTS - 151
150 GPM WATER TREATMENT SYSTEM
STARTUP PROCEDURE

- If the system is being started for the first time then work your way through the commissioning checklist in the installation guide or system manual before starting the system.
- If kill switch on panel (red mushroom shaped button) is pulled out then push it in to confirm that system is off.
- Pull kill button out in process room so the system can start at the appropriate time.
- Walk through process piping and check the position of all process valves.
- Check that there are no obstructions over any moving parts.
- Check that main disconnect is on.
- Put all hand/off/auto switches in auto.
- Pull the kill Button (red button on panel) out to start the process.
- Push the reset button on the operator interface to reset all alarms.
- Push the start button on the Operator Interface.
- If an alarm occurred on startup, then review the alarm descriptions and troubleshooting guide in the installation guide or manual for guidance on how to troubleshoot the problem. Fix the alarm condition and restart the system with the above procedure.

RTS - 151 150 GPM

Mech Eng:		Control:	Tester #1:	Warren, Kevin
Mechanical Team:	Electrical Team:	Panel Team:	Tester #2:	
-Select One-	-Select One-	-Select One-		
			Start Date:	8/20/2013
			End Date:	8/27/2013

SECTION A - PRE-TEST FLOW RATES AND POWER DETAILS

P-VLS		B-STRIP	
B-SVE		P-STRIP	
P-OWS		C-SPRG	
OTHER:		OTHER:	

System Certifications	Panel Standard	System Standard	SETPOINTS
Building #1 / Room #1:	UL 698A	MET us, Classified	
Building #2 / Room #2:	N/A	N/A	
Site Power Requirements			
Voltage:	208 Vac	3-Phase , 3-Wire	
Amperage:	125 Amps		

Notes:

SECTION B - WALK AROUND	OK / NA	INITIALS
Check That Walk Through Issues Have Been Resolved, Review Shop Aids	OK	KW
Lay Down Electrical Safety Mat and Set Up Testing Cart	OK	KW
Ensure That Testing Tote Is Connected and That Hoses Are Secure	OK	KW
Ensure That Carbon Vessels Are Bypassed	OK	KW
Verify That Exhaust Mufflers and Elbows are Installed (SVE/Sparge/Compressed Air)	OK	KW
Make Sure That Building Fan and Louvre Shipping Braces Have Been Removed	OK	KW

SECTION C - WALK THROUGH	OK / NA	INITIALS
Inspect Valves and Process Lines	OK	KW
Check Transmitter / Magnehelic Lines for Low Lying Spots Where Moisture can Collect	N/A	KW
Check That Floor Vents Have Been Installed	N/A	KW
Record Process Equipment Model and Serial Numbers* and Motor Nameplates	OK	KW
Notify Project Manager and Production Staff of Any Outstanding Issues	OK	KW

* This includes motors, blowers, compressors, oxygen/ozone generators, pumps, etc.

SECTION D - PANEL OFF INSPECTION	OK / NA	INITIALS
Check for Dielectric Test Label	OK	KW
Check for Auto Re-Start Label, Check for Ground, L1, L2, L3 and High Leg Labels	OK	KW
Check for IS Wiring Warning Stickers in Panel and on Lines From Panel	OK	KW
Ensure Neutral Wire is Connected To Terminal Block	OK	KW
Inspect 24Vdc and 120Vac Relays for Proper Connections	OK	KW
Check That Spare IS Input Wires Are Pulled	OK	KW
Cross Check Fuses, Circuit Breakers and Starters with Fuse Schedule	OK	KW
Determine Service Factor Amps and Set Motor Overloads	OK	KW

SECTION E - PANEL ON INSPECTION	OK / NA	INITIALS
Record Test Supply Voltages		
Primary: L1/L2 213, L2/L3 213, L3/L1 213 Vac; L1/N 124, L2/N 124, L3/N 124 Vac — **Secondary:** L1/L2 245, L2/L3 124, L3/L1 Vac; L3/N Vac		
Record 24Vdc Supply Voltage 24 Vdc	OK	KW
Test GFI and non GFI Outlets	OK	KW
Check "Push To Test" Panel Indicators	OK	KW
	N/A	KW

SECTION F - INITIAL SYSTEM SETUP AND TESTING	OK / NA	INITIALS
Archive Pre-Test Program Revisions and Create New Revision	N/A	KW
Check E-mail Configuration Through ECOM Card on PLC	N/A	KW
Record H0-ECOM100 Firmware Revision v.	N/A	KW
Update PLC Firmware and Record Revision: v.	OK	KW
Initialize Scratch Pad of Automation Direct PLCs	OK	KW
Upload PLC Program	OK	KW
Set PLC Clock and Calendar	OK	KW
Check Functionality of All Discrete Inputs	OK	KW
Check Functionality of All Discrete Outputs	OK	KW
Check Functionality of All Analog Inputs and Outputs	OK	KW
Switch System Outputs to AUTO Mode	OK	KW
Set and Test All Setpoints	OK	KW

SECTION G - OPERATOR INTERFACE (PANEL DOOR / TOUCHSCREEN)	OK / NA	INITIALS
Type of Operator Interface: -Select One-		
Update Display Screen Firmware, Record Revision v.	OK	KW
Upload Panel Program	OK	KW
Test Panel Menu Hierarchy	OK	KW
Check PLC to Panel Communication, Remove Ground Jumper if Necessary	OK	KW
Verify Value, Scale, Significant Digits and Units of Analogue Signals	N/A	KW
Check Functionality of All Discrete Inputs	OK	KW
Check Functionality of All Discrete Outputs	OK	KW
Test All User-Adjustable Setpoints	OK	KW
Verify Correct Hourmeter Values, Ensure Proper Time is Kept	OK	KW

SECTION H - VFD / SOFT START DEVICES	OK / NA	INITIALS
Drive Type and Application: N/A N/A		
Verify Drive Parameter Settings Match Electrical Drawings	N/A	KW
Test Frequency Control	N/A	KW
Check VFD Noise on Analog Signals / Adjust Carrier Frequency Accordingly	N/A	KW
Save VFD Set-up Variables From PowerSuite / Record VFD Settings	N/A	KW
Verify Integrity of RS-485 Communications, Record Settings	N/A	KW
BAUD: N/A PARITY: N/A STOP BITS: N/A CARRIER: N/A		

SECTION I - ANALOG SIGNALS	INITIALS
PLC Card Slot #1: N/A - Not Installed	KW
PLC Card Slot #2: N/A - Not Installed	KW
PLC Card Slot #3: N/A - Not Installed	KW
PLC Card Slot #4: N/A - Not Installed	KW

Check mA Signals at Different Operating Points for Device Hysterisis and Calibration	N/A	KW
Check Conversion Math and Square Root Functions in PLC Logic	N/A	KW

SECTION J - SYSTEM OPERATION	OK / NA	INITIALS
Check Building Fan(s) and/or Heater(s) Operation	OK	KW
Test All Kill Buttons	OK	KW
Bump Motors and Check For Excessive or Abnormal Current Draw	OK	KW
Ensure that LSL Switches are Above Pump Intakes	OK	KW
Set and Test Pressure and Vacuum Relief Valves According to P&ID	N/A	KW
Thoroughly Test Control Logic	OK	KW
Check Functionality of Oxidizer Interlocks	N/A	KW
Run System In Full Automatic	OK	KW
Simulate All Alarms, Check That Non-Critical Alarms Do Not Shut Down System	N/A	KW
Check Magnehelic Gauges for Accuracy, Verify Air Flows Using Hot Wire Anemometer	N/A	KW
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Measured CFM: @ PSI/"Hg/"WC		
Verify Logic and Flow For All Solenoid Valves, Including Auto-Oilers	N/A	KW
Run System With Doors Closed and Monitor Ventilation	N/A	KW
Verify Auto Restart Functionality of Whole System (Including VFD)	OK	KW
Check for Water / Compressed Air (Bubble Test) Leaks	OK	KW

SECTION K - PLC FINAL CHECK	OK / NA	INITIALS
Check Hour Meter Variable Memory Locations and Minute Counters	N/A	KW
Force Datalogging	N/A	KW
Update PLC Program Revision(and Operator Interface if Applicable)	OK	KW
Final Program Revision # : v. 2.0		

SECTION L - TELEMETRY	√OK/ NA	INITIALS
Select Communication Type:		
Confirm Remote Access, Record Method	N/A	KW
Check Modem Auto-Reboot Feature	N/A	KW
Test System Operation Using Offsite Package, Review Datalog Files	N/A	KW
Test System Email Out	N/A	KW
Configure Autodialer (Set Sensaphone Passwords to "2000" and "s2000")	N/A	KW
Test Autodialer Alarm Dial-out and Report	N/A	KW

SECTION M - FINAL SYSTEM TESTING / AS BUILT	OK/ NA	INITIALS
Record Max Noise Level dBA @ ft.	N/A	KW
Record Motor Voltages, Currents and Operating Conditions	OK	KW
Add Flow Charts, Piping Labels (Hot**, Directional), Oxygen / Ozone Generator Labels	OK	KW
Pump Water Out Of System	OK	KW
Turn Off All Breakers and HOA Switches	OK	KW
Take System Pictures	OK	KW
Email Project Manager and Production Staff	OK	KW
Update System Approval Data Plates, Fuse Schedule and Startup Procedure	OK	KW
Ensure appropriate approval labels are obtained (GP, Haz). **Rentals require US and CAN.**	OK	KW
Attach System Approval Stickers, Fuse Schedule and Startup Procedure	OK	KW
Take Panel Pictures and Transfer All Pictures to Project Folder	OK	KW
Check Off "Testing" as Being Complete in APES	N/A	KW
Make Changes to the IO and Alarms Tables Are Captured in the Markups	OK	KW
Update Project Software Folder	OK	KW

Copy Completed Test Sheets to Electrical As-Builts Directory with DWG Files and Bill of Materials
Check Off "As-Builts" Box in APES
** Hot Labels to be Applied to Any Piping >/= 140 DegF as Determined by IR Readings

MECHANICAL TEST RECORD

Device Name:	**P-4901**	Manufacturer:	**GOULDS**
Device Model #:	**4SH2K52COW**	Device Serial #:	**F1200054**
Motor Manufacturer:	**WEG**	Area Classification Tag Checked:	
Motor Model #:	**JM007402**	Motor Serial #:	**1014500858**
HP:	**7.50**	Voltage: **208**	Frame: **184JM** RPM: **3480**
Phase:	**3**	Current: **20.70**	SF: **1.15** ENCL.: **TEFC**

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
20.9	**20.6**	**21.4**	Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
213	**213**	**213**	Vac				Vac

Device Name:	**P-4001**	Manufacturer:	**GOULDS**
Device Model #:	**WS15112BHF**	Device Serial #:	**RC-061**
Motor Manufacturer:	**GOULDS**	Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	**1.50**	Voltage: **230**	Frame: RPM: **3450**
Phase:		Current: **18.00**	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
17.1			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
213			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:		Voltage:	Frame: RPM:
Phase:		Current:	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:		Voltage:	Frame: RPM:
Phase:		Current:	SF: ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

MECHANICAL TEST RECORD

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	
			Vac				Vac

MECHANICAL TEST RECORD

Device Name:		Manufacturer:	
Device Model #:		Device Serial #:	
Motor Manufacturer:		Area Classification Tag Checked:	
Motor Model #:		Motor Serial #:	
HP:	Voltage:	Frame:	RPM:
Phase:	Current:	SF:	ENCL.:

Factory Test:				Field Test:			
L1	L2	L3		L1	L2	L3	
			Amps				Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1	

Vac	Vac

Device Name:			Manufacturer:		
Device Model #:			Device Serial #:		
Motor Manufacturer:			Area Classification Tag Checked:		
Motor Model #:			Motor Serial #:		
HP:		Voltage:	Frame:		RPM:
Phase:		Current:	SF:		ENCL.:
Factory Test:			Field Test:		
L1	L2	L3	L1	L2	L3
		Amps			Amps
L1/L2	L2/L3	L3/L1	L1/L2	L2/L3	L3/L1
		Vac			Vac

Device Name:			Manufacturer:		
Device Model #:			Device Serial #:		
Motor Manufacturer:			Area Classification Tag Checked:		
Motor Model #:			Motor Serial #:		
HP:		Voltage:	Frame:		RPM:
Phase:		Current:	SF:		ENCL.:
Factory Test:			Field Test:		
L1	L2	L3	L1	L2	L3
		Amps			Amps
L1/L2	L2/L3	L3/L1	L1/L2	L2/L3	L3/L1
		Vac			Vac

Device Name:			Manufacturer:		
Device Model #:			Device Serial #:		
Motor Manufacturer:			Area Classification Tag Checked:		
Motor Model #:			Motor Serial #:		
HP:		Voltage:	Frame:		RPM:
Phase:		Current:	SF:		ENCL.:
Factory Test:			Field Test:		
L1	L2	L3	L1	L2	L3
		Amps			Amps
L1/L2	L2/L3	L3/L1	L1/L2	L2/L3	L3/L1
		Vac			Vac

Pre-commissioning Checklist

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Please return copy of completed form to newterra prior to startup Project number and name:
The purpose of this report is that the customer is prepared for startup.
Please send us the completed Pre-Commissioning Checklist 5 days prior to our site visit.
Return to Shane Henderson at shenderson@newterra.com or Fax 613-345-7633
Checked by: Date:

Checklist	Ck
Verify site power is correctly installed to the control panel and necessary electrical approvals have been completed.	
Verify that all input wiring is completed and wired into the control panel according to the installation guide.	
Verify that all power wiring is completed and wired into the control panel according to the installation guide.	
Verify that Compressed air will be connected to system (if required).	
Verify that Fresh Water supply is installed to system (if required).	
Verify that all process piping will be installed and completed.	
Verify that the required approvals are in place to allow the system to discharge air and water as designed.	
Verify that system has been installed on a level pad.	
Verify that all field piping will be completed and wells will be connected to the operating system.	
Verify that phone line is installed and activated if required.	
Additional Checklist Items related to Oxidizers	
Verify that all necessary wiring is completed between the oxidizer and the main control system.	
Verify that all piping between oxidizer and treatment system is completed.	
Verify that Power is connected to oxidizer and necessary electrical approvals have been completed.	
Verify that the required approvals are in place to allow the oxidizer to discharge air to the atmosphere.	
Verify that Gas is connected to the oxidizer and activated to allow for testing of the oxidizer. Note: Please ensure that the gas supply valves are not locked out by the local gas installer at time of commissioning.	
If local gas approval is required for oxidizer, ensure that this is completed or planned to occur during the commissioning.	

******All Tasks will be completed No Later Than 5 Business days prior to newterra Technicians arrival onsite.***
Please note if newterra arrives onsite and items have not been completed there will be a charge associated.
Site Address: _____
_____
_____

Onsite Contact Name & Number: _____
_____
Customer Sign-off Date

System Field Test Checklist

This purpose of this report is to test the functionality of electrical, control, and mechanical components to ensure the system operates as originally designed. This testing is then documented so it can be referenced at a later date if needed.

The following field test records must be completed by the startup technician on site before operating the process system. This is the last quality check ensuring the process equipment is ready for continuous operation.

newterra™ highly recommends that the system is started by a newterra factory trained startup technician to ensure the long term success of your project. We understand that this may not always be feasible in which case we would require a highly skilled technician capable of troubleshooting both mechanical and electrical aspects of a process treatment system and be familiar with our manual, equipment and capable of training the operator on operating and maintenance requirements of the treatment system.

This checklist must be sent back to Product Support department at newterra to validate your equipment warranty which begins on the date of shipment from the factory. It can be sent back in one of the following methods:

Email: service@newterra.com

Fax: Att: Product Support
(613) 345 7633
If you choose to fax the document then, please follow up with an email explaining that a fax was sent so we can ensure that we received the fax and properly validated the equipment warranty.

Project number: _____
Project name: _____

Tested By: _____
Company: _____
Date Tested: _____

System Field Test Checklist

Minimum Tools Required:

Clamp style amp meter	Socket Set
Multi meter for AC/DC Volts and ma signals	Wire Cutters
Instrumentation Screw Driver	Wire Strippers
Screw Driver Set	Channel Locks
Wrench Set	Pipe Wrenches
Straight Edge for Aligning couplings and belts	

Testing Checklist	Ck	Initial	Date
Verify site power per system design criteria			
Verify building process flow and instrumentation matches P +ID drawing, check off drawing components against actual (preferably with the customer present)			
Ensure all unions are tight, as some are loosened to prevent stress in shipping.			
Walk through system and open all valves that are required to run the system in automatic			
Check panel for lose wiring			
Tighten all terminals where wires are terminated			
Check alignment of motors			
Check field wiring and piping as per drawings			
Check all motor belt tensions			
Turn power on. Measure site voltage. L1/L2_____ L2/L3_____ L3/L1_____ L1/GRD_____ L2/GRD_____ L3/GRD_____			
Test that incoming power has correct phase sequence. Bump a safe 3 phase motor to test rotation.			
Check voltage on AC step down transformer			
Check voltage on DC transformer			
Check rotation of all motors that were field wired.			
Check that PLC Run light is on and the stop/term/run switch is in term			
Manually test inputs as per input table			

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System Field Test Checklist

Check connections of all field wiring to ensure it was completed per the electrical drawings and per the NEC.			
Manually test control logic for each output			
Manually test all shut down alarms			
Manually test that non-critical alarms do not shut down SVE			
Run through complete logic and alarm sequence with customer and make allowable changes.			
Note name of individual and company with whom logic was reviewed:			
Check overload settings for all motors			
Check/Install filter bag in bag filters			
Test analogue inputs			
Run system in full automatic			
Fill out mechanical test record on each motor and check amperage and voltage. Document amperage on the System test records in the operating manual in the Field test load section.			
Wet test all control inputs and outputs			
Wet test all shut down alarms			
Check systems for leaks (liquid and vapor)			
Test position of ball float switches for proper start/stop level			
Test vacuum and pressure relief valve			
Test air stripper and discharge pump operating sequence			
Check flow rate on all pulse meters such that digital and analogue reading increment at the same rate			
Test operation of building exhaust fan			
Test operation of building heater			
Install louver hoods on system			
Test remote access			

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System Field Test Checklist

Test operation of Auto dialer and program if necessary.			
Note newterra modem offsite web address			
Check flow rate discharging from VLS, should maximize flow to prevent a high level shutdown. If you have a centrifugal pump ensure flow rate is low enough to prevent cavitation on the inlet under vacuum.			
Check the skimmer on the oil water separator should be ½" above water level when water is flowing at full speed. Adjust if necessary.			
If Kaeser Compressor Present – Confirm warranty validation has been completed and submitted to Kaeser for warranty			
Check water flow rate into stripper, should be set to minimum flow to keep up with incoming water to maximize contact time in the air stripper. Adjust flow rate if necessary.			
Check flow rate exiting the air stripper, if there is no carbon filters down stream then allow pump to discharge at maximum flow rate. If carbon vessels are installed, then set pump flow rate to the designed system flow rate			

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System Field Test Checklist

Customer Training Checklist			
Review the operating manual with the customer explaining the various components of the manual and sources of information.			
Review the startup and shutdown procedure with operator.			
Review operation of treatment system and describe the maintenance required for each piece of equipment.			
Describe operation of panel and panel components.			
Train customer to troubleshoot alarms based on input conditions to the PLC or relays in the panel.			
Discuss the operating logic with the customer so they understand how the system is configured to work.			

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System Field Test Checklist

Operating Data and Records

The following table is a guideline to document the operating conditions of the system when running in automatic mode. The startup technician should document the operating conditions at all the locations in the system. This information can be used at a later date to troubleshoot problems that can arise.

Location of Record Description	Recorded Value
Air Vacuum readings:	
Air Pressure Readings	
Water Pressure Readings	
Water Flow Rates	
Air Flow Rates	
Operating Temperatures:	

System Field Test Checklist

Site Contractor Information: It is important that we capture the site contractor's information who was involved in the mechanical and electrical installation of equipment on site. We may be required to contact these companies during the project life to provide services at a later date.

Electrical Contractor:

Company Name: _____

Contact: _____

Phone Number: _____

Mechanical Contractor:

Company Name:

Contact: _____

Phone Number:

Quality Issues Identified during startup: The intension in this section is to list any problems, deficiencies or quality issues that were identified during startup. If the problem was solved during startup, please indicate. If MLE is required to follow up then please indicate.

Issue 1: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

Issue 2: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

Issue 3: Identified:

_____

_____

_____

Check box that applies: newterra Follow up Required ☐ Sorted out on Startup ☐

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System Field Test Checklist

Customer Feedback: newterra is committed to the success of our customers'. Please take a moment and provide any suggestions you may have for our quality and product support teams. We appreciate your comments and look forward to working with you again in the near future.

Please list one item you like about the system you have received:

Please indicate if there are items we could improve upon:

System Field Test Checklist

MECHANICAL TEST RECORD							
Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:	Frame:			RPM:	
Phase:		Current:	SF:			ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:	Frame:			RPM:	
Phase:		Current:	SF:			ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:	Frame:			RPM:	
Phase:		Current:	SF:			ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

Device Name:				Manufacturer:			
Device Model #:				Device Serial #:			
Motor Manufacturer:							
Motor Model #:				Motor Serial #:			
HP:		Voltage:	Frame:			RPM:	
Phase:		Current:	SF:			ENCL.:	
Factory Test:				Field Test:			
L1	L2	L3	Amps	L1	L2	L3	Amps
L1/L2	L2/L3	L3/L1	Vac	L1/L2	L2/L3	L3/L1	Vac

System Field Test Checklist

MECHANICAL TEST RECORD								
Device Name:				Manufacturer:				
Device Model #:				Device Serial #:				
Motor Manufacturer:								
Motor Model #:				Motor Serial #:				
HP:		Voltage:	Frame:			RPM:		
Phase:		Current:	SF:			ENCL.:		
Factory Test:				Field Test:				
L1	L2	L3		L1	L2	L3		
			Amps					Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1		
			Vac					Vac

Device Name:				Manufacturer:				
Device Model #:				Device Serial #:				
Motor Manufacturer:								
Motor Model #:				Motor Serial #:				
HP:		Voltage:	Frame:			RPM:		
Phase:		Current:	SF:			ENCL.:		
Factory Test:				Field Test:				
L1	L2	L3		L1	L2	L3		
			Amps					Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1		
			Vac					Vac

Device Name:				Manufacturer:				
Device Model #:				Device Serial #:				
Motor Manufacturer:								
Motor Model #:				Motor Serial #:				
HP:		Voltage:	Frame:			RPM:		
Phase:		Current:	SF:			ENCL.:		
Factory Test:				Field Test:				
L1	L2	L3		L1	L2	L3		
			Amps					Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1		
			Vac					Vac

Device Name:				Manufacturer:				
Device Model #:				Device Serial #:				
Motor Manufacturer:								
Motor Model #:				Motor Serial #:				
HP:		Voltage:	Frame:			RPM:		
Phase:		Current:	SF:			ENCL.:		
Factory Test:				Field Test:				
L1	L2	L3		L1	L2	L3		
			Amps					Amps
L1/L2	L2/L3	L3/L1		L1/L2	L2/L3	L3/L1		
			Vac					Vac

Project Packing List

PMProjNum **102140**

SOLD - USED RTS151 - Baffinland 150GPM W

PM_ShippingNotes:

Tag	Part Number	Part Description	Req / Rec	PO # / Line	EngMemo
2	18661	Hose, Assembly, J300, 3"	2	-	
Inlet & Outl	ea	Green Hose	0		
Type: G		-3" x 50' Hose assembly with camlocks		0	
2	10541	Camlock Fitting, Aluminum, 3", Part "F"	4		Male Camlocks
Inlet & Outl	ea	Male Adapter x Male Thread Cam Lock Fitting	4		
Type: F		-	102140-003	2	
2	M1108	Switch, Level, Mech Float, Wide Angle, N.O.,	1	---	
LSH-4001	ea	Tilt Float Level Switch 90deg, w 40' cable	1		
Type: I		13A, SPST, N/O ---	102140-011	9	
2	17149	Manual, System, Hard Copy	2	---	
Manual	ea		0		
Type: P		---		0	
2	9999	Misc Part, See Details	1	---	
OWS VEN	ea	As per detailed specification below	0		
Type: P		2IN. X 4FT. PVC OWS VENT STACK		0	
2	RC061	Pump, Sump, Goulds, 100GPM @ 40'	1	---	
P-4001	month	WS1512BHF, w/ switch	0		
Type: R		230V 1 Ph, 1-1/2 HP ---		0	
2	RTS151	WTS, 150 gpm, OWS-24, Carbon, 40' Contair	1	---	
System	month	208/120V, 3ph, Cl1 Div 2	0		
Type: R		Max Water 150gpm @ 40psi ---		0	
5200	M1272	Camlock Fitting, Aluminum, 2", Part "F"	1	---	
5200-Stack	ea	Male Adapter x Male Thread Cam Lock Fitting	0		
Type: F		---		0	
5200	M1137	Drum, Black, Steel, 45 gal, 2 hole lid, bottom ;	1	-	
PST-5201	ea	including palletization	1		
Type: I		-	102140-011	4	
5200	9999	Misc Part, See Details	1	---	
PST-5201	ea	As per detailed specification below	0		
Type: P		2IN. X 5 FT. TANK TRUCK HOSE ASSEMBLY WITH CAMLOCK, TYPE C AND TYPE F		0	
5200	9999	Misc Part, See Details	1	---	
PST-5201	ea	As per detailed specification below	0		
Type: P		2IN. X 4FT. PVC PST VENT STACK		0	

Tag	Part Number	Part Description	Req	PO #		EngMemo
			Rec	Line		
7900	10908	Lock, Passage, 107188, Taymor	2		---	
7900	ea	107188	0			
	Type: I	---			0	
7900	10909	Lock, Deadbolt, 289648, Taymor, 1 cyl, S/S	2		---	
7900	ea	keyed alike #289648	0			
	Type: I	---			0	
7900	24662	Hood, Fan, 27" - on use up	2		---	
F-7901	ea	Fits 24" Fan	2			
	Type: I	---	102140-011		6	
7900	23989	Hood, 15"	2		---	
F-7902	ea	Fits 12" Fan & Louver	2			
	Type: I	---	102140-011		5	

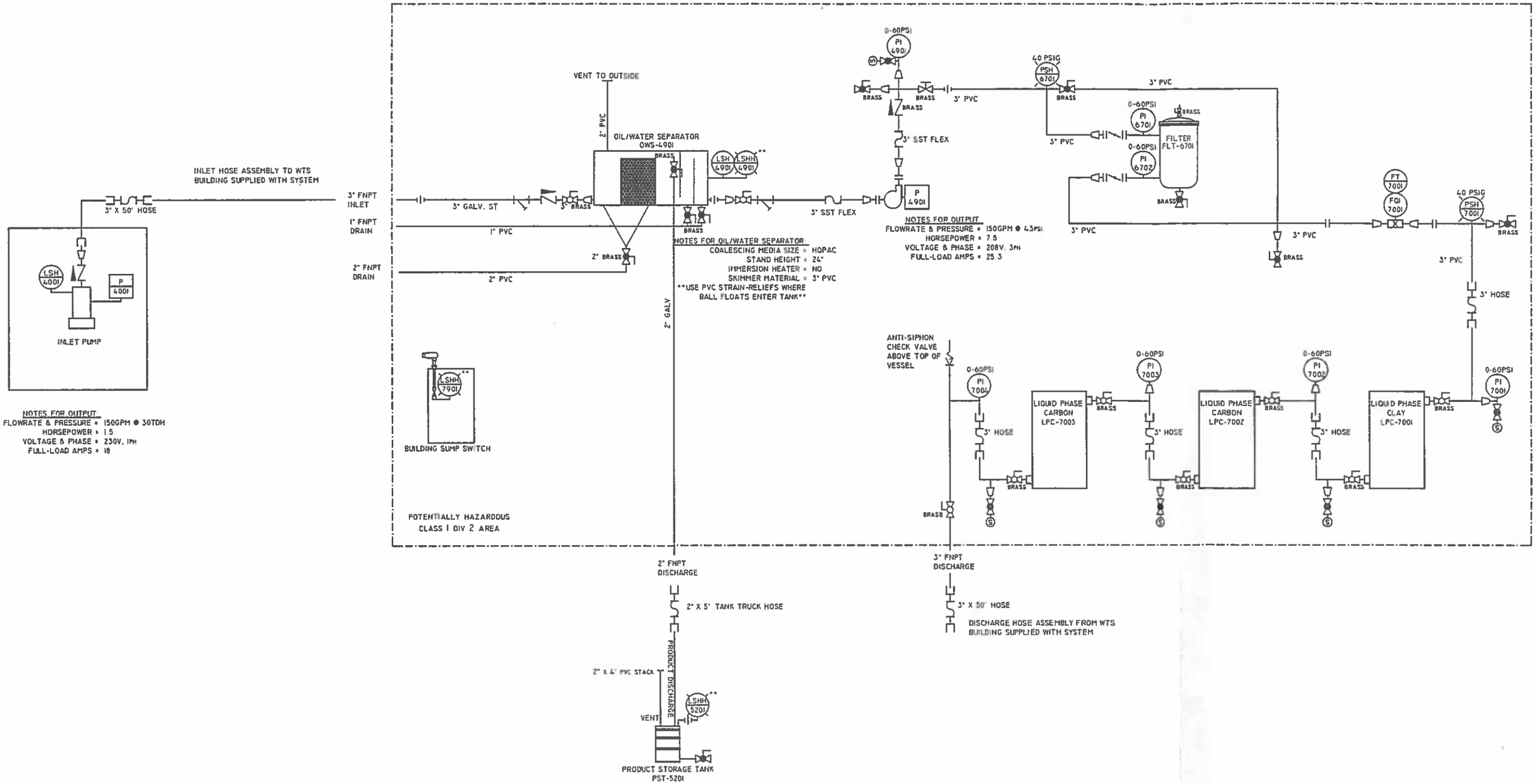
Project Packing List

PMProjNum **102140A**

Baffinland 20' Container for Loose Components

PM_ShippingNotes:

Tag	Part Number	Part Description	Req / Rec	PO # / Line	EngMemo
1	11686	Filter, Bag, FOS P2P, 7" x 32"	120		---
EXTRA	ea	Oil Absorbing Bags, Sub-micron, Plastic Ring	0		
	Type: P	Box Quantity, 20 per box ---		0	
1	25263-T	Melt-Blown Spaghetti Media	15		---
EXTRA	ea	Filter Bag Insert, Oil-Absorbing, Polypropylene	0		
	Type: I	25 lbs/bag ---		0	
1	11214	Media, Clay, TM100	5000		---
EXTRA	lb	(stocked and ordered in lbs)	0		
	Type: I	---		0	
1	20220	Media, Carbon, Liquid, Virgin, 8 x 30 Coconut	6000		---
EXTRA	lb	Sold in 1100 lb (500 Kg) sacks per pound	0		
	Type: I	---		0	
1	9999	Misc Part, See Details	2		---
EXTRA	ea	As per detailed specification below	0		
	Type: P	O-ringsm 4155-1490-B (V6427)		0	
1	21891	Gasket, Flange, Tetrasolv AF Series	6		---
EXTRA	ea	18" Hatch Gasket	0		
	Type: P	Fits, AF250, AF500, AF1000, AF2000, AF300 ---		0	
1	22353	Pump, Part, SSH, Mechanical Seal Kit	2		---
EXTRA	ea	P/N: RPKSSHS	0		
	Type: P	---		0	
1	21605-T	Media, Coal, Anthracite, .9 to .95mm	20		---
EXTRA	lb	52 lbs/bag; sold in lbs.	0		
	Type: I	---		0	
1	11610	Container, 8' x 20' x 8'6"	1		---
EXTRA PA	ea	5-8 yr	0		
	Type: P	---		0	



BUILDING EQUIPMENT AND CONTROL PANEL

BORDER DEFINES THE LIMITS OF THE ENCLOSURE

CONTROL PANEL

TO BE LOCATED ON BUILDING. PANEL TO BE A MINIMUM OF 36" FROM ANY HAZARDOUS PROCESS EQUIPMENT, AND A MINIMUM OF 36" ABOVE GRADE.

TSL 7901, TSL 7902, TSH 7901, TSH 7902, H 7901, H 7902, H 7903, F 7901, F 7902, LSHH 7901**, KILL 7901**

WIRING TO BE CLASS I DIVISION 2, AS PER THE CEC.

IS INPUT WIRING TO BE WIRED FOR INDOORS, ACCORDING CEC FOR HAZARDOUS LOCATIONS.

PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
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- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE. USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI. USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

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C	2013-08-20	DM	AS BUILT
B	2013-08-06	DAM	FOR PRODUCTION

DWG. NO: 102140-01 (PAGE 1 OF 2)

TITLE: PROCESS & INSTRUMENTATION DRAWING

CUSTOMER: MARY RIVER PROJECT BAFFINLAND

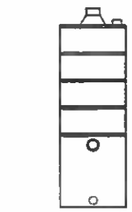
newterra LTD.

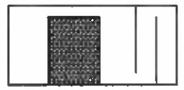
VALVES AND PIPING

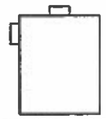
NO NC

- BALL VALVE -
- GATE VALVE -
- GLOBE VALVE -
- NEEDLE VALVE -
- SLIDE VALVE -
- SOLENOID VALVE -
- BUTTERFLY VALVE -
- SWING CHECK VALVE -
- WAFER CHECK VALVE -
- SPRING CHECK VALVE -
- WYE STRAINER -
- SAMPLE PORT -
- PRESSURE RELIEF VALVE -
- VACUUM RELIEF VALVE -
- CAMLOCK CONNECTION -
- FERNCO CONNECTION - (FERNCO)
- FLEXIBLE CONNECTION -
- FLANGED CONNECTION -
- REDUCER -
- UNION -
- ADSORBENT FILTER - (A, DRAIN)
- COALESCING FILTER - (DRAIN)
- PARTICULATE FILTER - (DRAIN)
- FILTER, SILENCER -
- PRESSURE REGULATOR -
- REGULATOR W/ FILTER -

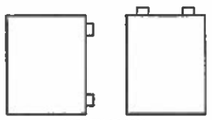
EQUIPMENT

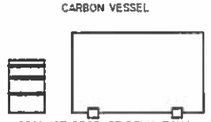

AIR STRIPPER

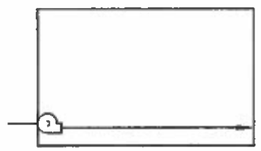

OIL/WATER SEPARATOR


VAPOR/LIQUID, SEAL FLUID SEPARATOR

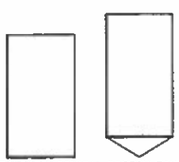
BAG FILTER


CARBON VESSEL


PRODUCT STORAGE DRUM, TANK


OXIDIZER

CHEMICAL DRUM


STANDARD, CONICAL-BOTTOM TANK

EQUIPMENT

- CENTRIFUGAL PUMP -
- PROGRESSIVE-CAVITY PUMP -
- CHEMICAL-INJECTION PUMP -
- CENTRIFUGAL, REGENERATIVE BLOWER -
- POSITIVE-DISPLACEMENT BLOWER -
- ROTARY-CLAW BLOWER -
- LIQUID-RING PUMP -
- ROTARY-VANE COMPRESSOR -
- RECIPROCATING COMPRESSOR -
- HEAT EXCHANGER -
- PASSIVE COOLING FINS -

EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL

FLOW MEASUREMENT

- AVERAGING PITOT TUBE - (RANGE, PDI 101, H, L)
- VENTURI - (RANGE, PDI 101, H)
- ROTOMETER - (RANGE, FI 101)
- WATER FLOW METER - (FQI 101)

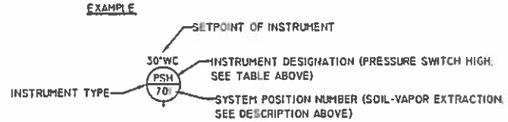
INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A			ALARM				A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE				G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O							O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION

- INDICATING INSTRUMENT
- DIGITAL INPUT TO CONTROL PANEL
- DIGITAL INPUT CAUSING ALARM
- ** DIGITAL INPUT CAUSING SYSTEM SHUTDOWN ALARM
- ANALOG INPUT TO CONTROL PANEL
- ANALOG OUTPUT FROM CONTROL PANEL

EXAMPLE



SYSTEM POSITION DESIGNATION

100 - VACUUM INLET MANIFOLD
300 - INLET HEAT EXCHANGER
400 - VAPOR/LIQUID SEPARATOR
500 - VAPOR/LIQUID SEPARATOR - 2
700 - SOIL-VAPOR EXTRACTION
1000 - LIQUID-RING PUMP
1300 - SVE HEAT EXCHANGER
1600 - VAPOR-PHASE CARBON
1900 - OXIDIZER
2200 - AIR SPARGE
2500 - SPARGE HEAT EXCHANGER
2800 - SPARGE OUTLET MANIFOLD
3100 - AIR COMPRESSOR
3400 - COMPRESSED-AIR OUTLET MANIFOLD
3700 - PNEUMATIC WELL PUMPS
4000 - SUBMERSIBLE WELL PUMPS
4300 - SURFACE-MOUNT WELL PUMPS
4600 - GROUNDWATER INLET MANIFOLD
4900 - OIL/WATER SEPARATOR
5200 - PRODUCT STORAGE TANK
5500 - INLET TANK
5800 - UPSTREAM BAG FILTER
6100 - CHEMICAL INJECTION
6400 - AIR STRIPPER
6700 - PRE-CARBON BAG FILTER
7000 - LIQUID-PHASE CARBON
7100 - PRE-MEDIA BAG FILTER
7200 - ACTIVATED ALUMINA
7300 - DISCHARGE TANK
7400 - POST-TREATMENT BAG FILTER
7600 - REINJECTION
7900 - BUILDING, TRAILER OR SKID
8200 - CONTROL PANEL
8500 - ELECTRICAL PARTS
9900 - EXTRAS

PIPING DETAILS
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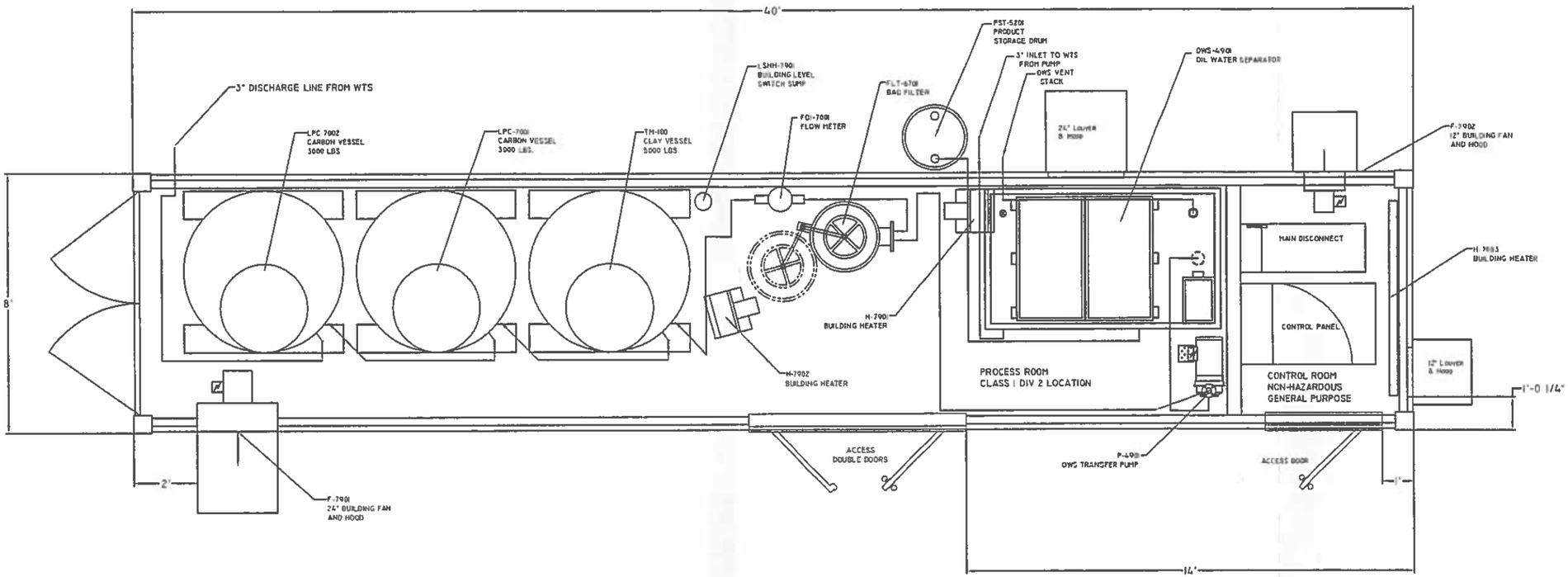
B	2013-08-06	DAM	FOR PRODUCTION	

DWG. NO: 102140-01 (PAGE 2 OF 2)
TITLE: PROCESS & INSTRUMENTATION DRWG LEGEND
CUSTOMER: MARY RIVER PROJECT BAFFINLAND

SCALE BAR, EACH BLOCK IS 12" LONG



PLEASE NOTE: THIS BUILDING IS SHIPPING ON A BOAT AND MUST NOT BE MORE THE 96" IN WIDTH. THIS INCLUDES ALL EQUIPMENT AND CONNECTIONS THAT PROTRUDE THROUGH THE ENCLOSURE.

** CIVIL CONSTRUCTION NOTES **

- BUILDING TO BE PAINTED WITH HEMPATEX HI BUILD 46410 BLUE. HEMPEL COLOUR CODE 33930
- DOOR COLOUR TO BE THE SAME AS BUILDING
- FLOOR TO BE GATOR GUARDED
- PROVIDE WOOD LIP AROUND PERIMETER TO ALLOW SUMP SWITCH TO TRIP
- INSTALL GRATING BETWEEN BUILDING FANS AND OUTSIDE LOUVERS.
- THERMAL INSULATION ON WALLS AND CEILING

**MECH /ELECT ASS'Y NOTES **

- MAXIMUM WIDTH FOR SHIPPING IS 96" THIS INCLUDES ALL CONNECTIONS THAT PROTRUDE THROUGH THE SIDES OF THE ENCLOSURE
- PLUG AND SEAL (WITH WASHERS) ANY HOLES IN THE FLOOR TO CONTAIN WATER SPILLS.
- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- LOCATE HEATING THERMOSTAT AT FLOOR LEVEL.

*** COMMISSIONING NOTES ***

- NEWTERRA RECOMMENDS PAD BE AT LEAST 12" LARGER THAN ENCLOSURE IN ALL DIRECTIONS LOCAL CODES MAY REQUIRE ALTERNATE DIMENSIONS.
- BUILDINGS NEED TO BE SHIMMED ON SITE TO ALLOW DOORS TO OPEN FREELY. PLEASE HAVE SHIMMING MATERIAL READY DURING BUILDING INSTALLATION
- FOR BUILDINGS IN COLD WEATHER CLIMATES WHERE THE BUILDING IS ELEVATED, A SKIRT MUST BE BUILT AROUND THE BASE TO PREVENT THE FLOOR FROM FREEZING.
- [illegible] AND LOUVER HOODS NEED TO BE INSTALLED [illegible]. CANNOT SHIP WITH HOODS ATTACHED

*** DIMENSION INFORMATION ***

DESCRIPTION	DIM (L X W X H)	WEIGHT
40' CONTAINER	8' X 42' X 9.5'	?????

FLOW DIRECTION
ELECTRICAL CONNECTION
FLOW INTO THE PAGE
FLOW OUT OF THE PAGE
THIS AREA REPRESENTS SERVICE SPACE REQUIRED

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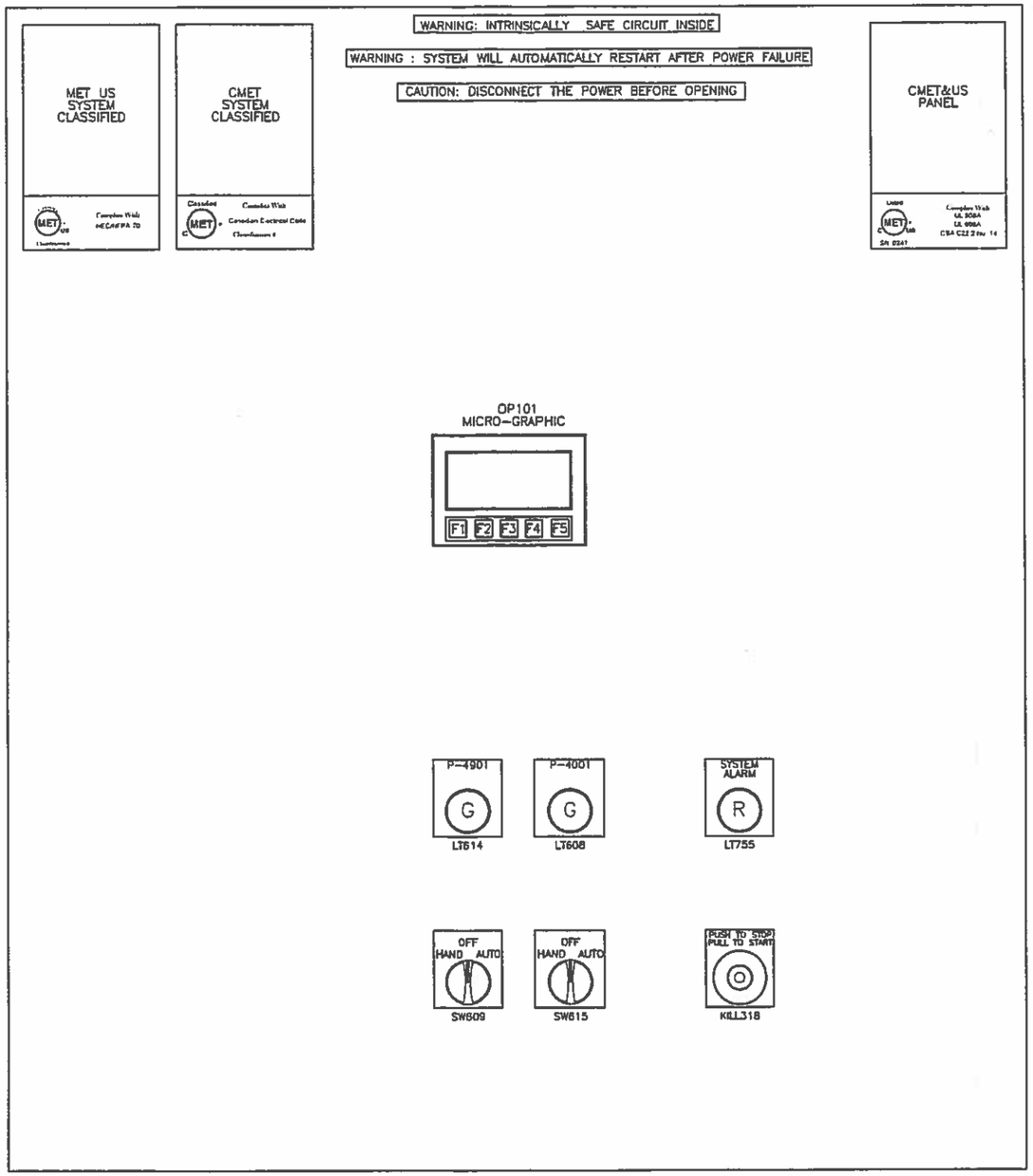
LEVEL	DATE:	BY	REVISION:
F	2013-08-20	DM	AS BUILT FOR 102140
F2	2013-08-07	DM	PRODUCTION RELEASE FOR 102140

DWG NO: 102140 - 02
TITLE: SYSTEM LAYOUT
CUSTOMER: BAFFINLAND MARY RIVER PROJECT
newterra LTD.



DS201

MAIN DISCONNECT

200 AMP
125A FUSES
208V 3PH
108 FLA

NOTE 1: NEMA 3R LOCKABLE PANEL(S)

NOTE 2: LIGHTS & SWITCHES MOUNTED ON INNER SWING PANEL DOOR

15A GFI

WIRE LEGEND

BLACK:	POWER
RED:	CONTROL
WHITE:	NEUTRAL
BLUE:	+24VDC & I.S.(Intrinsically Safe)
BL/WH:	0VDC
YELLOW:	INTERLOCKS

NOTES:

MET US CERTIFIED, CONTROL ROOM BUILT TO NEC GENERAL PURPOSE STANDARDS, PROCESS ROOM BUILT TO NEC CLASS 1 DIV 2 STANDARDS, ALL WIRING COMPLETE AND ALL EQUIPMENT PRE-PIPED, FACTORY TESTED AND MOUNTED IN ENCLOSURE.

REV	DATE(mm/dd/yy)	BY	DESCRIPTION
E	08/14/13	dbeliste	FOR PROJECT 102140

	NAME	DATE(mm/dd/yy)
DRAWN	PR	JUN18/07
CKD		
APPR		

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1325 CALIFORNIA AVE.
BROCKVILLE, ONTARIO
CANADA
K6V 5Y6
www.newterra.com

PROJECT:
RTS151 / 150GPM OWS
Baffinland Iron Mines Corp
Mary River Project/ PM 005

DRAWING-NO:

JOB-NO:
102140

PAGE DESCRIPTION
PANEL VIEW

PAGE:
1 OF 8

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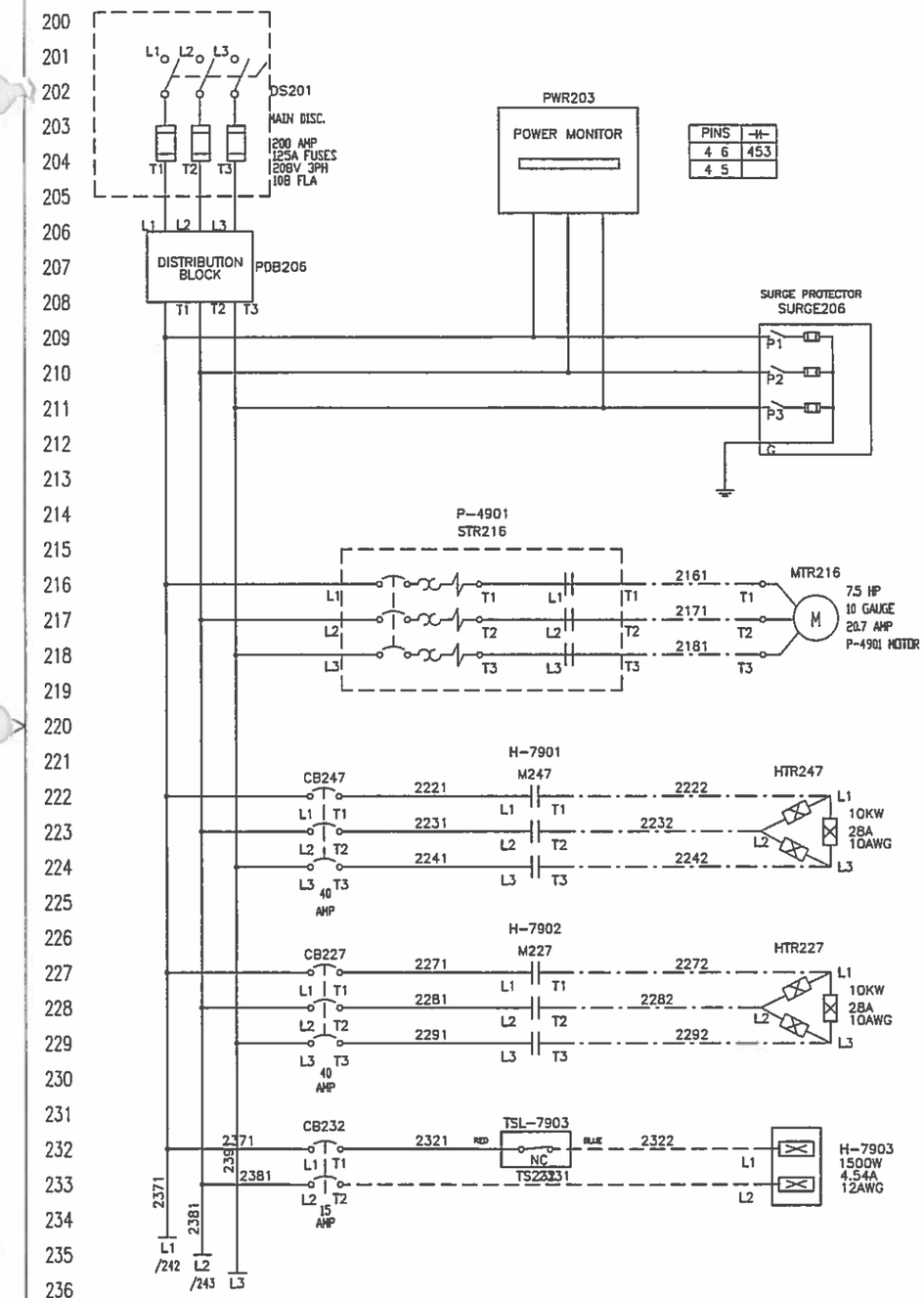

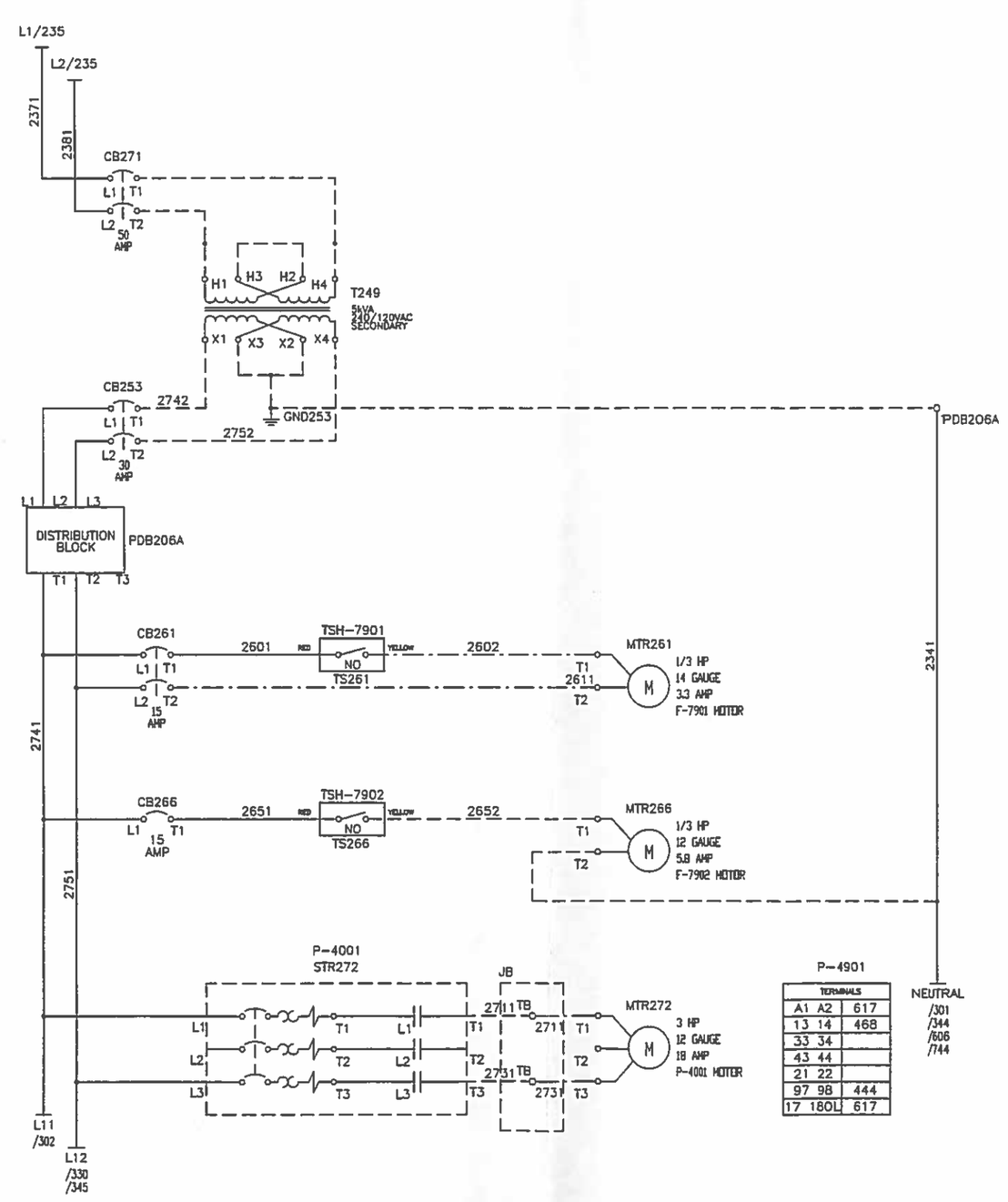

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BL/WH: 0VDC
YELLOW: INTERLOCKS

NOTES:

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REV	DATE(mm/dd/yy)	BY	DESCRIPTION
E	08/14/13	dbelisle	FOR PROJECT 102140

	NAME	DATE(mm/dd/yy)
DRAWN	PR	JUN18/07
CKD		
APPR		

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PROJECT: RTS151 / 150GPM OWS
Baffinland Iron Mines Corp
Mary River Project/ PM 005

DRAWING-NO:

JOB-NO: 102140

PAGE DESCRIPTION: MOTORS

PAGE: 2 OF 8

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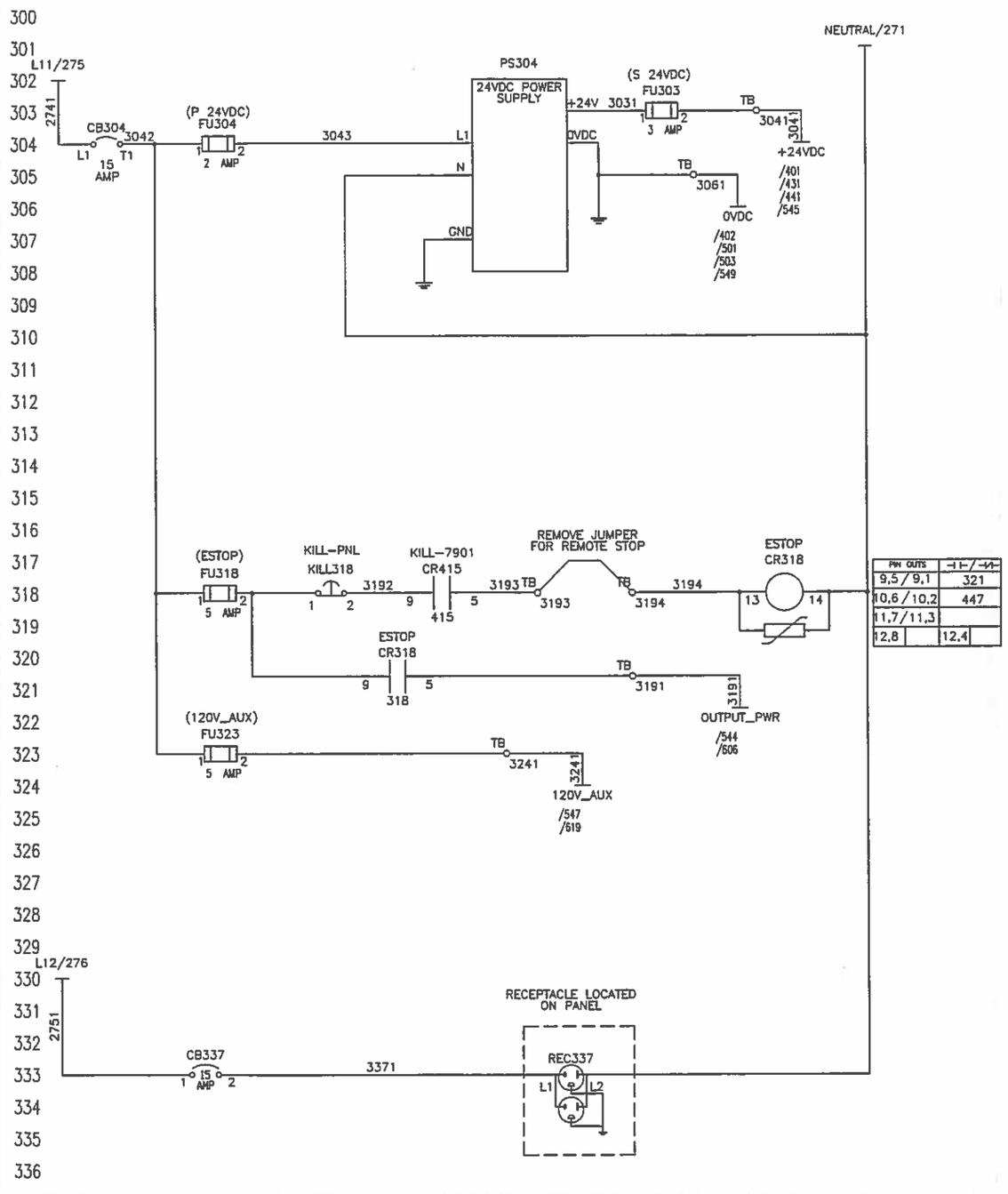
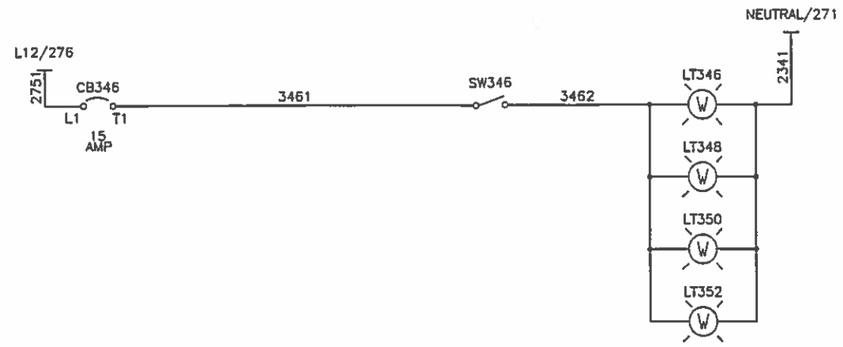
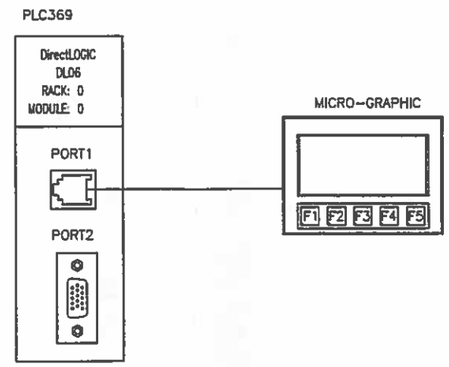


PIN OUTS	
9,5/9,1	321
10,6/10,2	447
11,7/11,3	
12,8	12,4





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REV	DATE(mm/dd/yy)	BY	DESCRIPTION
E	08/14/13	dbelisle	FOR PROJECT 102140

	NAME	DATE(mm/dd/yy)
DRAWN	PR	JUN18/07
CKD		
APPR		

newterra

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PROJECT: RTS151/ 150GPM OWS
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Mary River Project/ PM005

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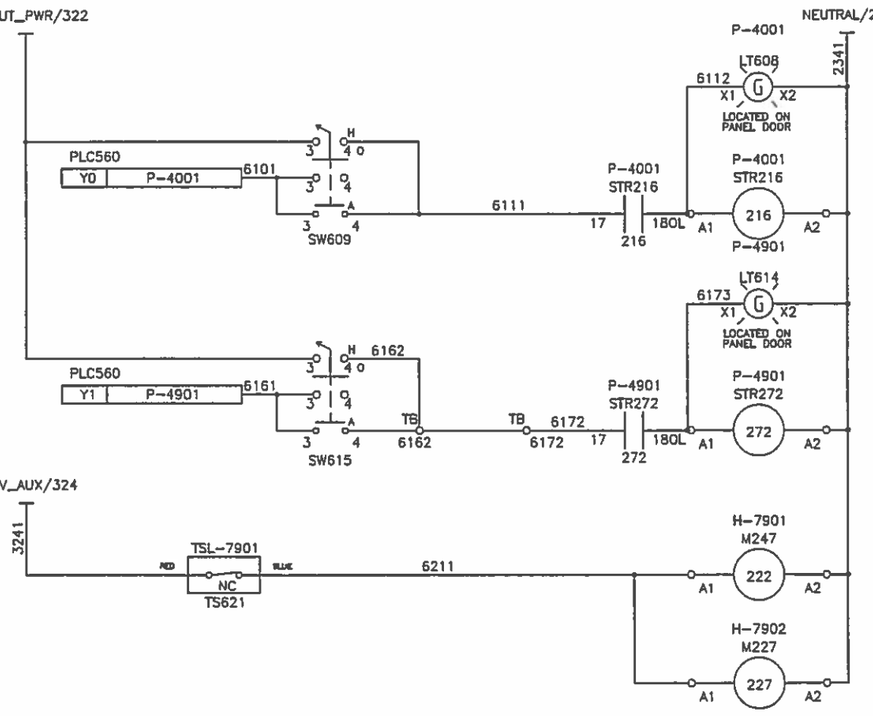

WIRE LEGEND

BLACK: POWER
RED: CONTROL
WHITE: NEUTRAL
BLUE: +24VDC & I.S.(Intrinsically Safe)
BL/WH: 0VDC
YELLOW: INTERLOCKS

NOTES:

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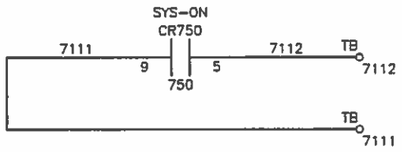

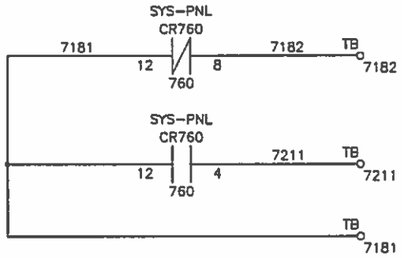

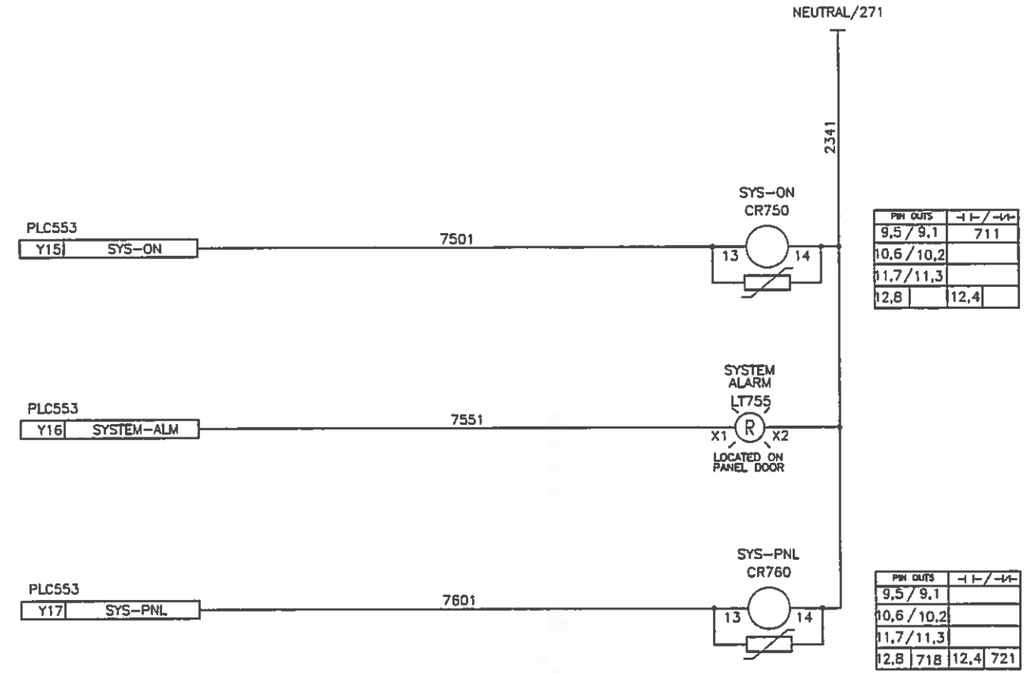

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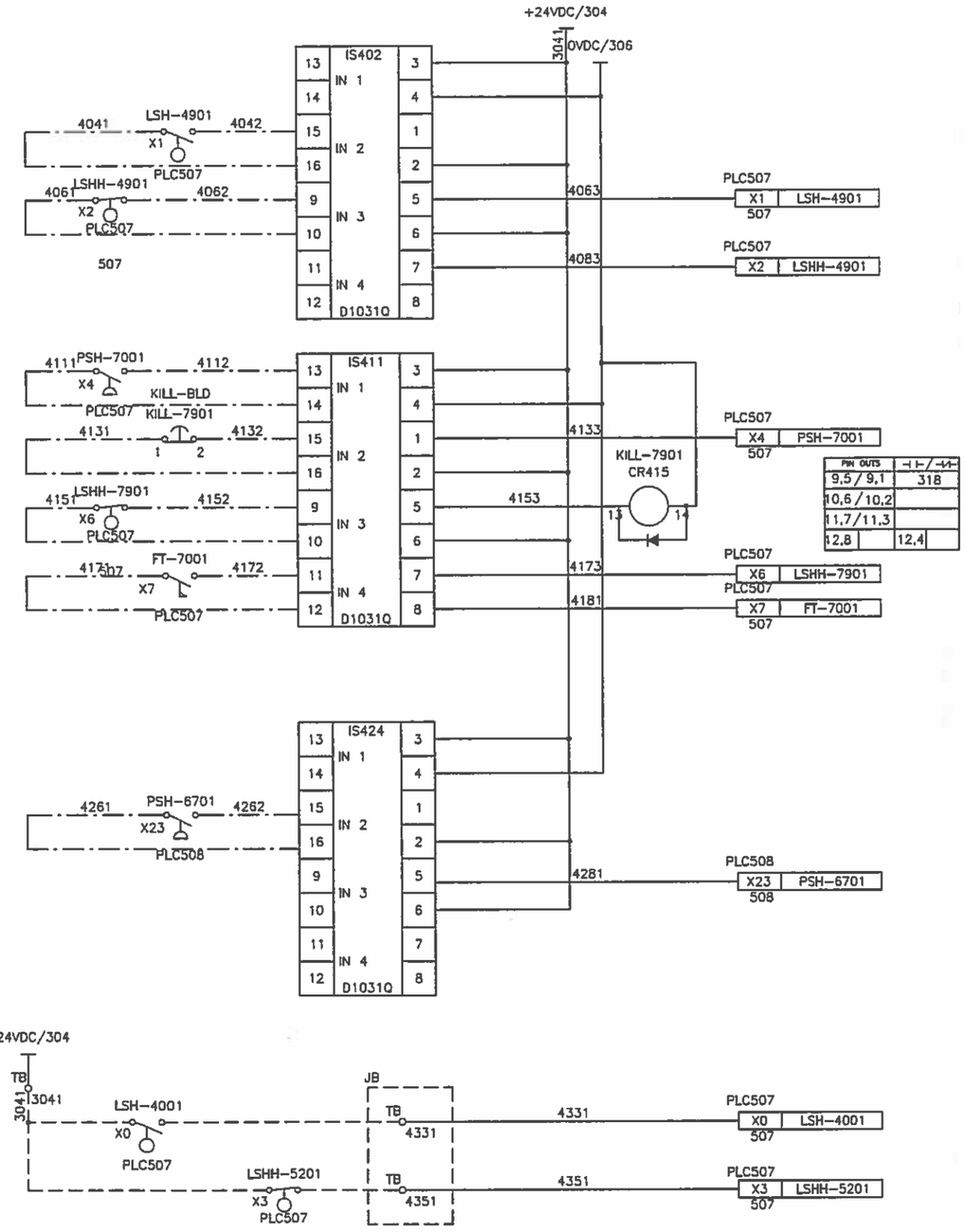

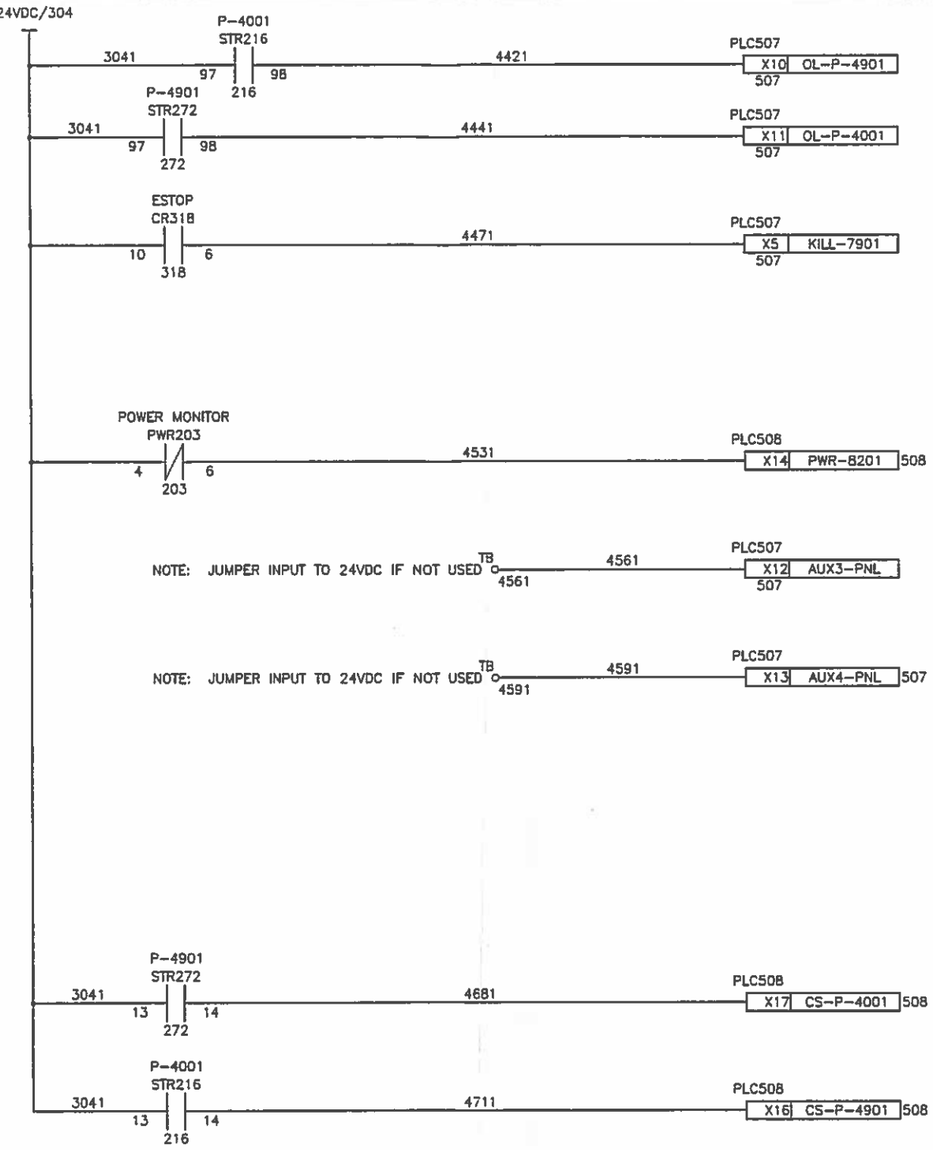

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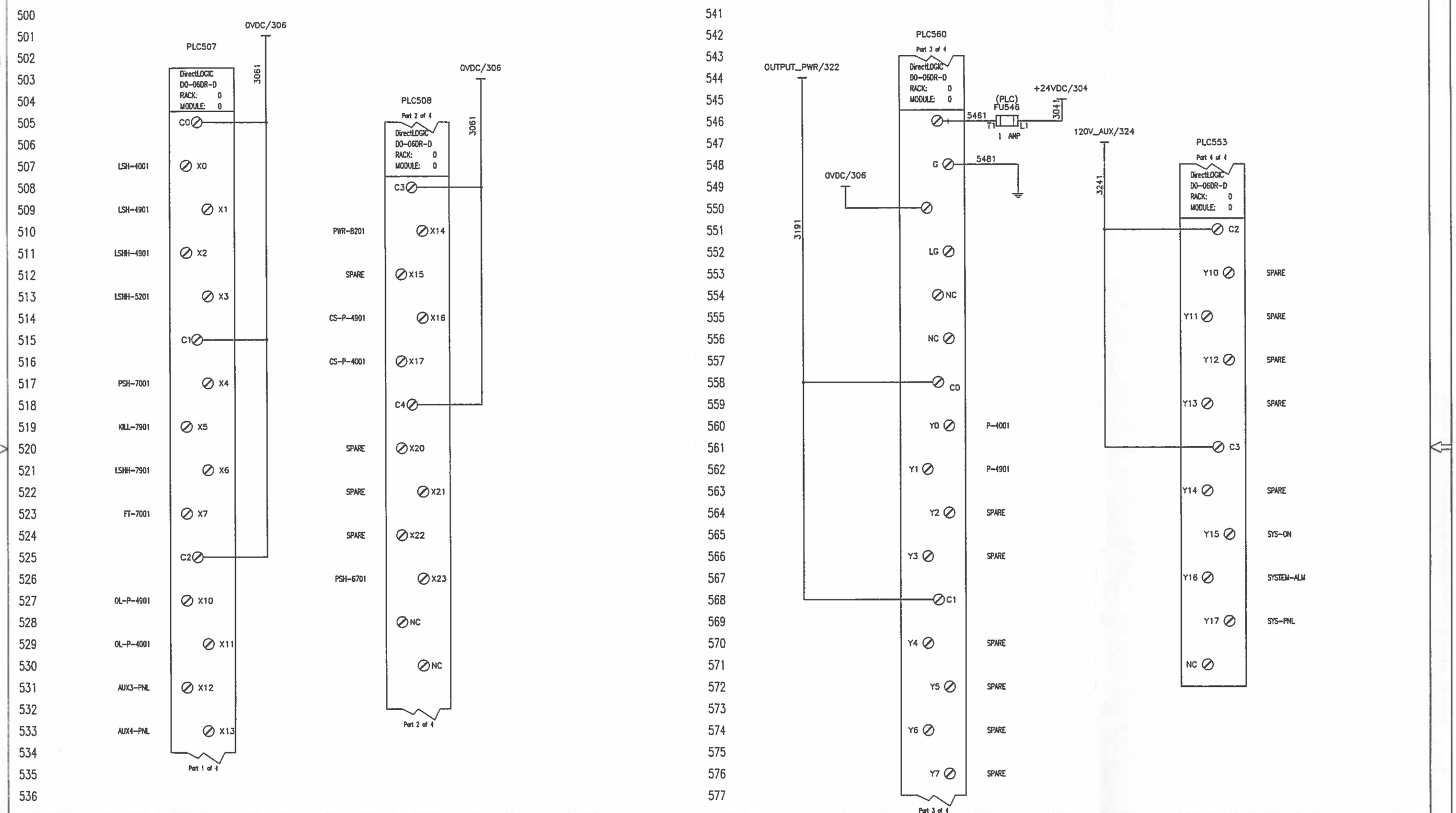

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PLC LAYOUT

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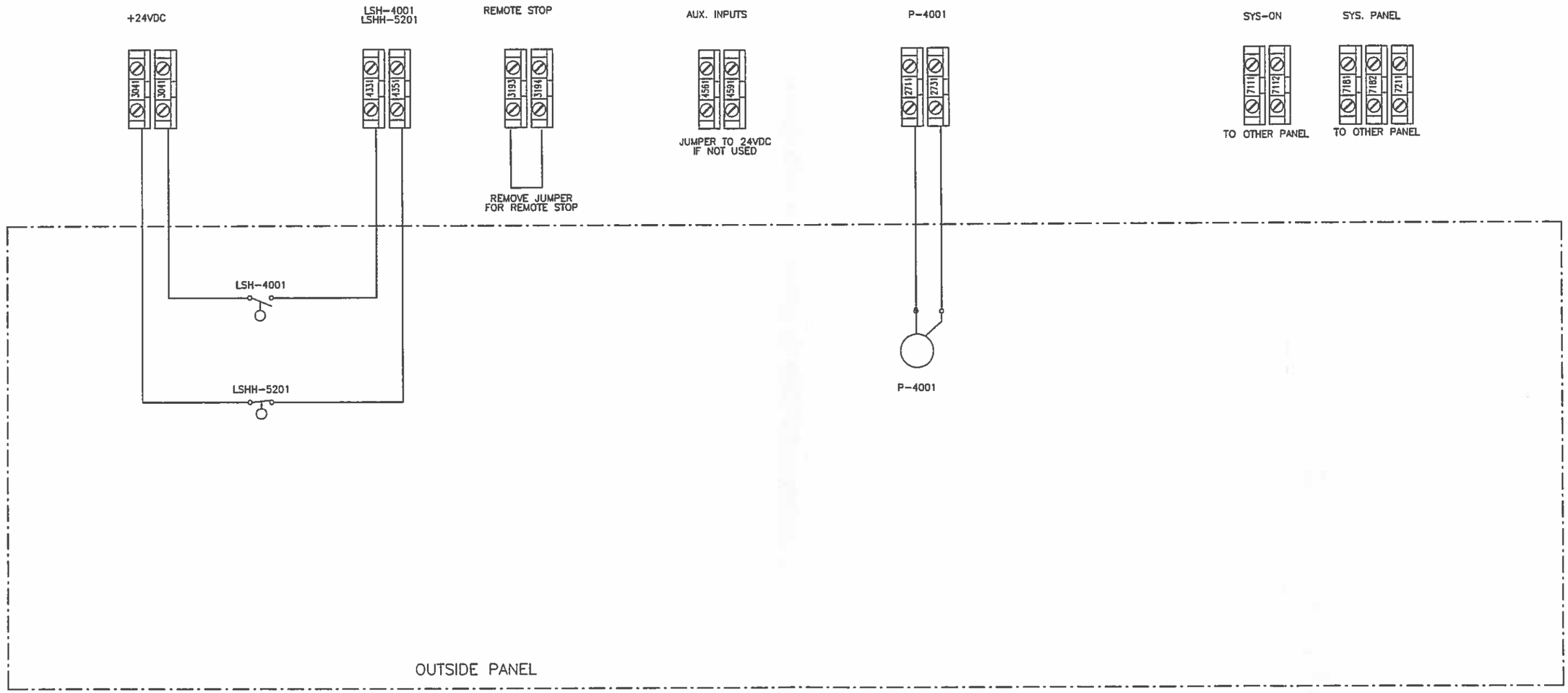
TERMINAL PLAN



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Inputs and Setpoints — *Project: RTS151 WTS, 150gpm, OWS-24, Carbon, 4*

Input Summary	
Digital PLC Inputs:	15
Digital PLC Frequency:	1
Analog(4-20) Inputs:	0
Analog(5V) Inputs:	0
Analog(10V) Inputs:	0

IS Barrier Summary	
Analog IS:	0
Digital IS :	9

Legend for Class

ISA : Intrinsically Safe Analog
ISD: Intrinsically Safe Digital
GP: Wire General Purpose
D1: Wire as DI/1
D2: Wire as DI/2

				PLC		Signal						Datalogger (DLO6)	
Tag	Name	Type	Class	Input	Value	State	Low	High	Units	SQRT	Fctr	Offsite_Col	Note	Main	Monthly (Daily for 30 days)
Digital_PLC															
4000 Submersible Pump															
LSH-4001	Level Switch Hi Well Pump 4001	Digital_PLC	ISD	X000		NormOpen	0	0		☐	0			☐ 0	☐ 0
CS-P-4001	P-4001 Status	Digital_PLC	GP	X017		NormOpen	0	0		☐	0			☐ 0	☐ 0
4900 Oil/Water Separator															
LSH-4901	Level Switch High - Oil Water Separato	Digital_PLC	ISD	X001		NormOpen	0	0		☐	0			☐ 0	☐ 0
LSHH-4901	Level Switch High High - Oil Water Sep	Digital_PLC	ISD	X002		NormClose	0	0		☐	0			☐ 0	☐ 0
CS-P-4901	P-4901 Status	Digital_PLC	GP	X016		NormOpen	0	0		☐	0			☐ 0	☐ 0
5200 Product Storage Tank															
LSHH-5201	Level Switch High High - Product Stora	Digital_PLC	ISD	X003		NormClose	0	0		☐	0			☐ 0	☐ 0
6700 Bag Filter															
PSH-6701	Pressure Switch High Bag Filter 6701	Digital_PLC	ISD	X023		NormOpen	0	0		☐	0			☐ 0	☐ 0
7000 Liquid Phase Carbon															
PSH-7001	High Pressure Switch	Digital_PLC	ISD	X004		NormClose	0	0		☐	0			☐ 0	☐ 0
7900 Building, Trailer or Skid															
KILL-7901	Kill Switch 1 - Building	Digital_PLC	ISD	X005		NormClose	0	0		☐	0			☐ 0	☐ 0
LSHH-7901	Level Switch High High - Building	Digital_PLC	ISD	X006		NormClose	0	0		☐	0			☐ 0	☐ 0
8200 Main Control Panel															
OL-P-4901	P-4901 Overload	Digital_PLC	GP	X010		NormOpen	0	0		☐	0			☐ 0	☐ 0
OL-P-4001	P-4001 Overload	Digital_PLC	GP	X011		NormOpen	0	0		☐	0			☐ 0	☐ 0
AUX-8201	Auxiliary Contact - Control Panel	Digital_PLC	GP	X012		NormClose	0	0		☐	0			☐ 0	☐ 0
AUX-8202	Auxiliary Contact - Control Panel	Digital_PLC		X013		NormClose	0	0		☐	0			☐ 0	☐ 0
PWR-8201	Power/Phase Monitor Panel	Digital_PLC		X014		NormClose	0	0		☐	0			☐ 0	☐ 0
Digital_PLC_Freq															
7000 Liquid Phase Carbon															
FT-7001	Flow Transmitter - Liquid Phase Carbo	Digital_PLC_	ISD	X007		NormOpen	0	0		☐	0			☐ 0	☐ 0
Direct															
7900 Building, Trailer or Skid															
TSH-7901	Temperature Switch High - Room #1	Direct				NormOpen	0	0		☐	0			☐ 0	☐ 0
TSH-7902	Temperature Switch High - Room #2	Direct				NormOpen	0	0		☐	0			☐ 0	☐ 0
TSL-7901	Temp Switch Low - Room #1	Direct				NormClose	0	0		☐	0			☐ 0	☐ 0

				PLC		Signal							Datalogger (DLO6)	
Tag	Name	Type	Class	Input	Value	State	Low	High	Units	SQRT	Fctr	Offsite_Col	Note	Main	Monthly (Daily for 30 days)
TSL-7902	Temp Switch Low - Room #2	Direct				NormClose	0	0		☐	0			☐ 0	☐ 0

Outputs Project RTS151 WTS, 150gpm, OWS-24, Carbon, 40

Largest Motor	7.5

575V-3ph:	0
460V-3ph:	0
230V-3ph:	0
208V-3ph:	20.46

230V-1ph	11.43
208V-1ph	0
115V-1ph	12

230V/115-3ph	0

Tag	PLC Loc	Device	Voltage	Watts	HP	Amps	Switches: At Device	Switches: On Panel	Panel Setup: Hourmeter	Panel Setup: Ammeter	Analog Setup: Signal_Low	Analog Setup: Signal_High	Offsite Communication Package: Offsite_Switch	Offsite_Color	Offsite_Name	Hourmeter	Ammeter	Datalog: Monthly	Datalog: Mai
							Logic												
Digital PLC																			
4000 Submersible Pump																			
P-4001	Y000	Motor Cntr	230V-1ph		1.5	7.83	None	Hand/Off/Auto	Display Only	None						☐	☐	☐ 0	☐ 0
Well Pump 4001							PUMPS FEEDING OWS PUMP START: SYSTEM IN RUN AND LAHH-4901 OFF PUMP STOP: SYSTEM NOT IN RUN OR LAHH-4901 ON												
4900 Oil/Water Separator																			
P-4901	Y001	Motor Cntr	208V-3ph		7.5	20.46	None	Hand/Off/Auto	Display Only	None						☐	☐	☐ 0	☐ 0
Pump - Oil Water Separator							PUMP START: SYSTEM IN RUN AND LSH-4901 ON PUMP STOP: SYSTEM NOT IN RUN OR LSH-4901 OFF												
8200 Main Control Panel																			
AL-8201	Y016	Light	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
Alarm Light							LIGHT ON: SYSTEM IN ALARM. LIGHT OFF: SYSTEM NOT IN ALARM.												
AR-8201	Y017	Relay(110)	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
Alarm Relay							RELAY ON: SYSTEM IN SHUTDOWN ALARM. RELAY OFF: SYSTEM NOT IN SHUTDOWN ALARM.												
SYS ON	Y015	Relay(110)	115V-1ph				None	None	None	None						☐	☐	☐ 0	☐ 0
System On Relay							RELAY ON: SYSTEM IN RUN AND KILL SWITCH NOT PRESSED RELAY OFF: SYSTEM NOT IN RUN OR KILL SWTICH PRESSED												
Power																			
7900 Building, Trailer or Skid																			
F-7901		Fan	230V-1ph		0.33	3.6	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Fan - Process Room							FAN START: TSH-7901 ON FAN STOP: TSH-7901 OFF												
F-7902		Fan	115V-1ph	0	0.25	2	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Fan - Control Room							FAN START: TSH-7902 ON FAN STOP: TSH-7902 OFF												
H-7901		Heater	208V/120V-3	10000	0	28	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Process Room #1							HEATER START: TSL-7901 OFF HEATER STOP: TSL-7901 ON												
H-7902		Heater	208V/120V-3	10000		28	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Process Room #2							HEATER START: TSL-7901 OFF HEATER STOP: TSL-7901 ON												
H-7903		Heater	208V/120V-3	1500	0	4.1	None	None	None	None	0	0				☐	☐	☐ 0	☐ 0
Heater - Control Room							HEATER START: TSL-7902 OFF HEATER STOP: TSL-7902 ON												
Lights		Light	115V-1ph	600		5	None	None	None	None						☐	☐	☐ 0	☐ 0
Inside Lights							LIGHTS ON: LIGHT SWITCH ON LIGHTS OFF: LIGHT SWITCH OFF												

Tag	PLC Loc	Device	Voltage	Watts	HP	Amps	Switches: At Device	Switches: On Panel	Panel Setup: Hourmeter	Panel Setup: Ammeter	Analog Setup: Signal_Low	Analog Setup: Signal_High	Offsite Communication Package: Offsite_Switch	Offsite_Color	Offsite_Name	Hourmeter	Datalog: Ammeter	Datalog: Monthly	Datalog: Mai
							Logic												
1200	Main Control Panel																		
	120V CB	Control Powe	115V-1ph	600		5	None	None	None	None						☐	☐	☐ 0	☐ 0
	120V Control Power																		

Alarms Project RTS151 WTS, 150gpm, OWS-24, Carbon, 40' Contai

Tag		PLC Loc / Logic	Alarm Type	Delay(sec)	Alarms On..	Alarm Setting / Comment
Type: Alarm_PLC						
4900 Oil/Water Separator						
LAHH-4901	**High High Level Alarm - Oil Water Separator**	C103	Recovers	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND LSHH-4901 OPEN FOR DELAY SHOWN ALARM STOP: SYSTEM RESET				
5200 Product Storage Tank						
LAHH-5201	**High High Level Alarm - Product Storage Tank**	C104	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND LSHH-5201 DEACTIVATED FOR DELAY SHOWN (see table) ALARM STOP: SYSTEM RESET				
5800 Bag Filter						
PAH-6701	**High Pressure Alarm Bag Filter 6701**	C110	Light_Only	5	Open	0
		SOFT ALARM: ALARM START: SYSTEM IN RUN AND PSH-6701 ACTIVATED FOR 5 SECONDS ALARM STOP: SYSTEM RESET				
7000 Liquid Phase Carbon						
PAH-7001	**Pressure Alarm High**	C106	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM ON AND PSH-7001 OPEN FOR DELAY SHOWN (see table) ALARM STOP: SYSTEM RESET				
7900 Building, Trailer or Skid						
KILLA-7901	**Kill Switch Alarm 1 - Building**	C102	Sys_Shutdown	0	Open	0
		SYSTEM SHUTDOWN: ALARM START: ANY KILL INPUT OPEN ALARM STOP: SYSTEM RESET				
LAHH-7901	**Level Alarm High High - Building**	C105	Sys_Shutdown	5	Open	0
		STANDARD LOGIC SYSTEM SHUTDOWN: ALARM START: LSHH-7901 OPEN FOR DELAY SHOWN ALARM STOP: SYSTEM RESET				
8200 Main Control Panel						
OLA-P-4901	**Overload Alarm OWS Discharge Pump**	C111	Sys_Shutdown	1	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND OL-P-4901 ACTIVATED ALARM STOP: SYSTEM RESET				

Tag		PLC Loc	Alarm Type	Delay(sec)	Alarms On..	Alarm Setting
		Logic				Comment
OLA-P-4001	**Overload Alarm Inlet Discharge Pump**	C112	Sys_Shutdown	1	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND OL-P-4001 ACTIVATED ALARM STOP: SYSTEM RESET				
AUXA-8201	**Auxiliary Alarm - Control Panel**	C113	Sys_Shutdown	5	Open	0
		STANDARD LOGIC SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND AUX-8201 DEACTIVATED ALARM STOP: SYSTEM RESET				
AUXA-8202	**Auxiliary Alarm - Control Panel**	C113	Sys_Shutdown	5	Open	0
		SYSTEM SHUTDOWN: ALARM START: SYSTEM IN RUN AND AUX-8202 DEACTIVATED ALARM STOP: SYSTEM RESET				
PWRA-8201	**Panel Power Alarm**	C114	Sys_Shutdown	0	Open	0
		SYSTEM SHUTDOWN: ALARM START: POWER LOSS OR INCOMING VOLTAGE FAULT ALARM STOP: SYSTEM RESET AND INCOMING POWER IS WITHIN LIMITS Note. Power limits and tolerance, as well as recovery time is all set locally on device.				

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1 Using the newterra Site-Link: Remote Offsite Telemetry

1.1 Document purpose

This document details the various features and functionality of and procedure for logging in to and using the **newterra** Site-Link: Remote Offsite Telemetry portal.

Revision control

Revision	Author	Date
Rev 1. Original draft.	T Coates/ W Moulton	11 April 2012

2 Table of Contents

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3 Overview

The **newterra** Site-Link: Remote Offsite Telemetry is a customized software program and hardware configuration which provides a real-time link to a process control system via cellular modem using our secure Site-Link Server.

Site-Link does not require any additional software to be downloaded or installed and simply uses your favourite internet browser* to view your system from anywhere you can get internet and is Operating System independent (ie Windows/ MAC). This means that you have access to your system via your internet browser enabled computer, smart phone or similar device. To access your system simply type the following address into your browser: https://sitelink.newterra.com.

** **newterra** recommends Internet Explorer 8.0® or higher for best performance with 800x600 resolution or higher.*

Site-Link comes with the following features:

- Customized P&ID layout with System Status
- Start/ Stop/ Reset of System
- Manual Control of most system components†
- Data and Alarm logging exports in .csv format
- Alarm History including Current Alarm Status
- Hour Meters for Equipment††
- Customization of all system set points†

† certain restrictions apply.
†† only applies when hour meters are quoted with system.

Multiple users can have access to Site-Link, each with their own unique login details. Users can have read and write privileges for monitoring and control, or read only privileges for monitoring only. For customers with multiple systems with Site-Link capability, all those systems will be available via the one login account.

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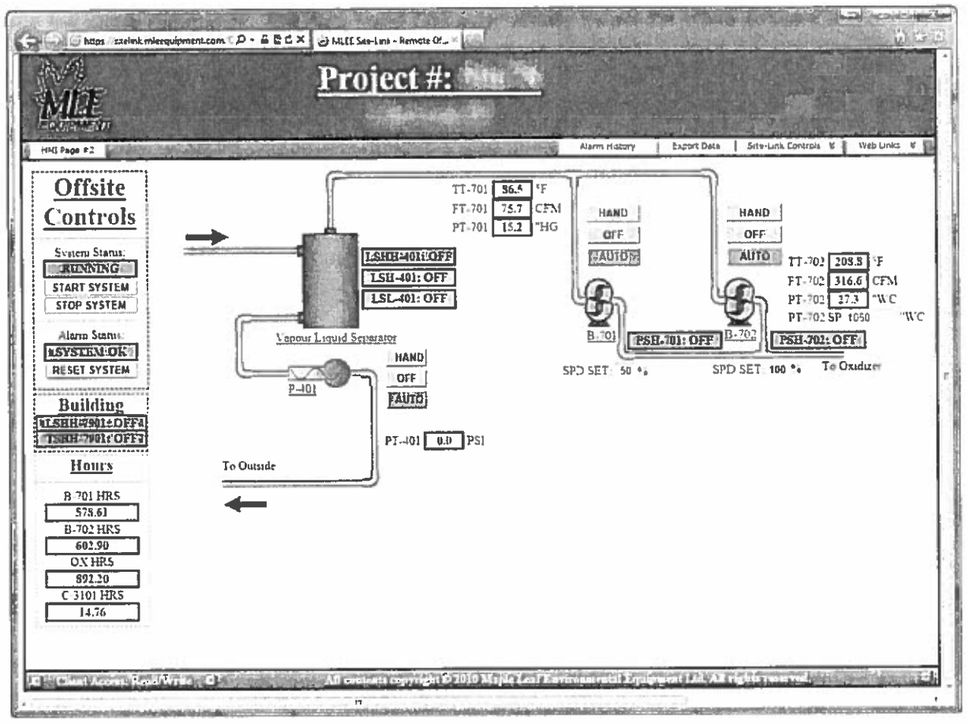
4 P&ID Page 1

P&ID page 1 typically includes system status dialog box (Shutdown/ Running). Start and Stop buttons. Reset button to reset alarms. Alarm status box (System OK/ Alarm). Soft HOA switches for motors/ valves etc. Visual indicators for level switches, active pumps/ motors/ valves etc.
Depending on the components used in the system; instantaneous flow, total flow, analog transmitters and SetPoints.
Tabs for P&ID page 2 (if applicable), alarm history and export data.

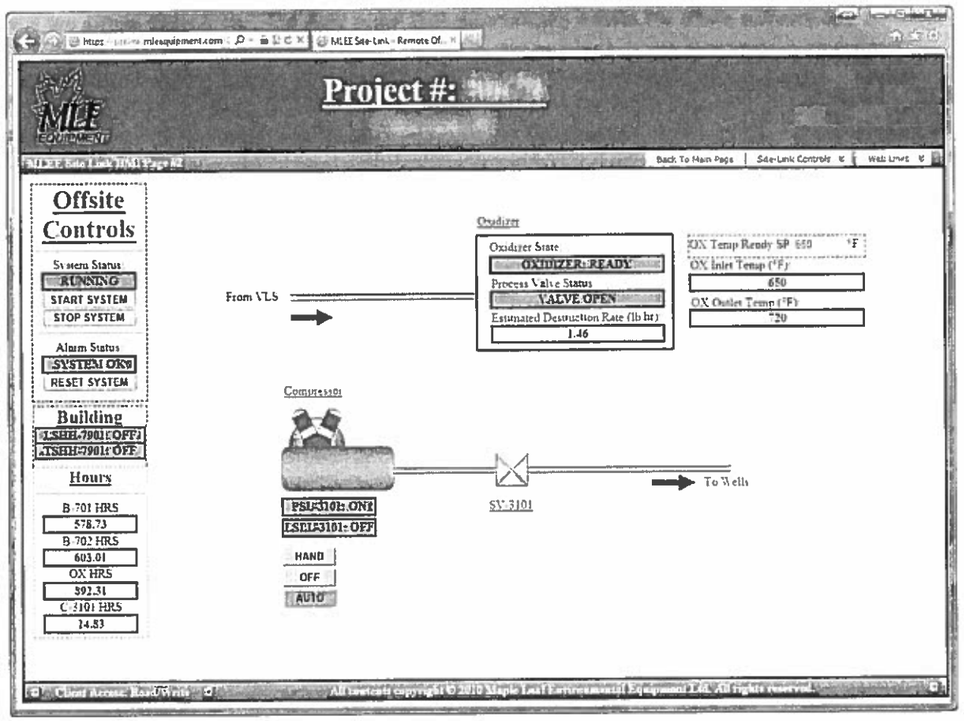


Display refresh rate is once per minute unless a Site-Link button is pressed, in which case the display refresh will be approximately 5 seconds.

To change analog SetPoints simply type into the text box provided and then press the enter key on your computer keyboard.

5 P&ID Page 2

P&ID page 2 is typically used for larger systems and includes many or all of the same features as mentioned above, depending on the system.



6 Datalogging

Analog values and flow data (if present on the system) and hour meters are logged automatically. If the system only has hour meters the standard logging rate is once per day. If the system has analog values and/ or flow data the standard logging rate is once every 10 minutes.

Note: Data is only retained on the server for 90 days before the oldest data starts to be overwritten by the newest data. Therefore it is recommended that downloads are performed every 2 months (see Export Data section below).

7 Yellow/ orange boxes with ?????

Yellow/ orange boxes with ????? instead of the usual red/ green boxes means the Site-Link server is unable to pull any data from the PLC on site. This typically means there is no power to the control panel or possibly an issue with the wireless signal or modem. If symptoms persist please call **newterra**.

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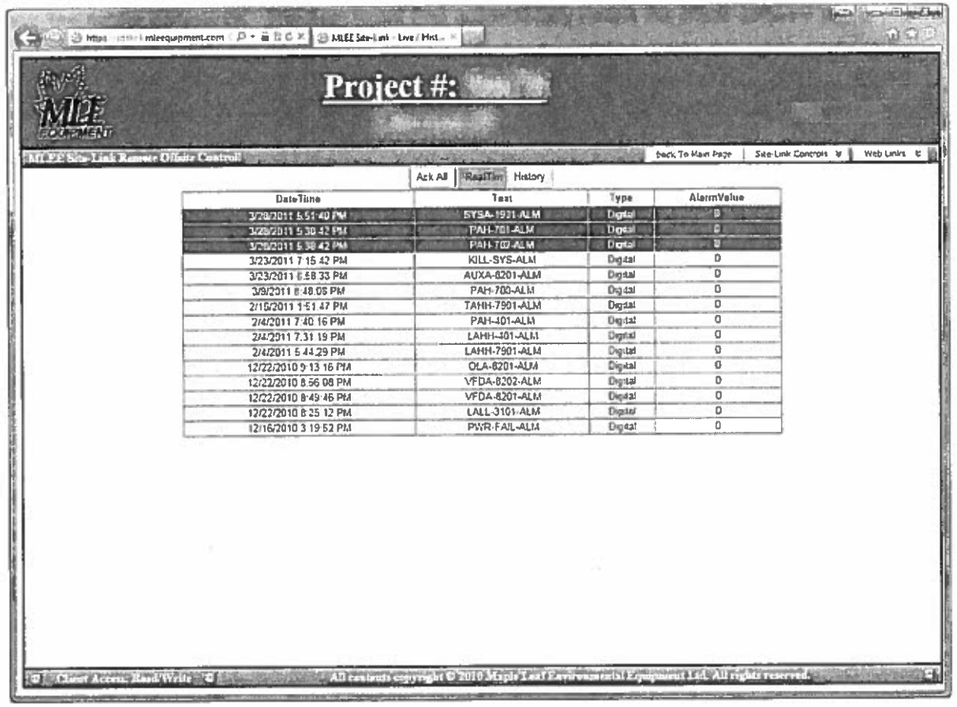
8 Alarm History

This is a list of all the alarms the system is capable of generating, in the order that the alarm status last changed. It details the last date/ time that alarm changed state. For more detailed alarm history the alarm export data download can be performed.



DateTime: Date and time the alarm status changes. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).
Text: Short form alarm code. Please refer to O&M manual for more detailed description.
Type: This will always display Digital.
AlarmValue: 0 indicates that the alarm is inactive. 1 indicates that the alarm is active.
Colour: Yellow indicates alarm statuses that have been acknowledged, even if the alarm is still active. Red indicates alarm statuses that have not been acknowledged since it last changed state, even if the alarm is no longer active (so red does not necessarily mean the alarm is active, just that it has changed state since it was last acknowledged).
Ack All: This will acknowledge all the alarms in the table and turn all the lines yellow, whether the alarm is active or inactive. Please note that this does not physically cancel or reset any alarms on the subject system. An active alarm that has been acknowledged and is displayed on a yellow line will change to a red line once the alarm deactivates, as the alarm has changed state.
History: Provides limited alarm history, it is recommended to use the alarm Export Data download outlined in the next section.

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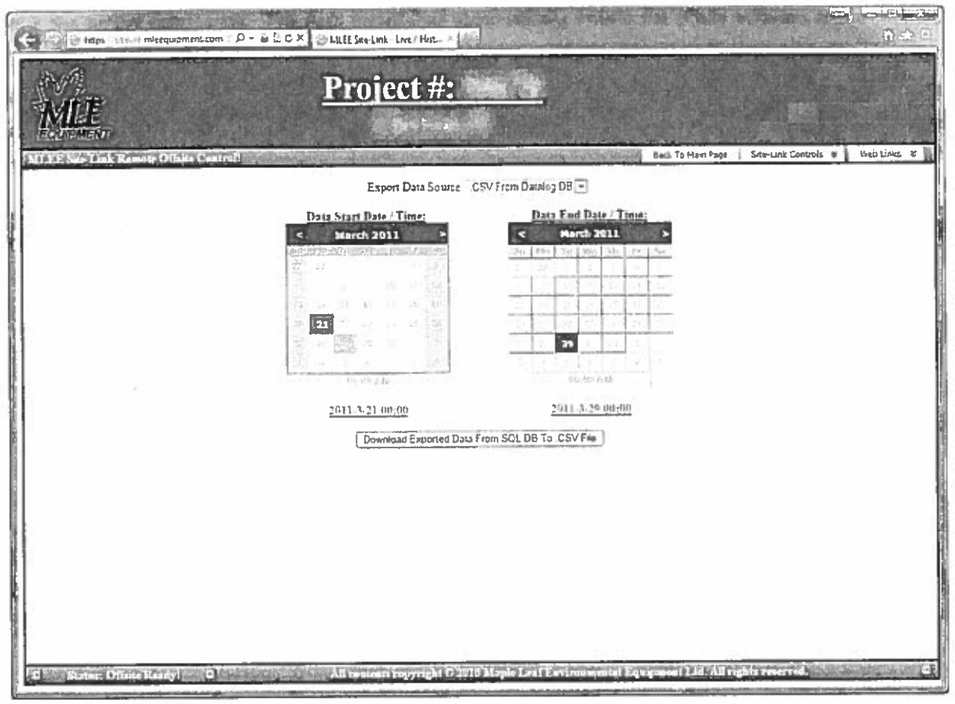
9 Export Data

Data and/ or alarm logs can be downloaded for recording, reporting or trending purposes. **Note:** Data is only retained on the server for 90 days before oldest data starts to be overwritten by the newest data. Therefore it is recommended that downloads are performed every 2 months.



Select data source: Select the data export source from the drop down box, either Datalog DB or Alarm DB.

Select Start Date/ Time: Select the start date by navigating the Data Start Date/ Time calendar to the desired year/ month and click on the day. Set the desired start time in the box below the calendar. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).

Select End Date/ Time: Select the end date by navigating the Data End Date/ Time calendar to the desired year/ month and click on the day. (**Note:** You have to click on the day even if it is today's date, as today's date will always be highlighted and it looks like it is highlighted but it is not). Set the desired start time in the box below the calendar. (**Note:** All times are taken from the Site-Link server clock which is Eastern Time, EST or EDT depending on the time of year).

Download Data: Click on the 'Download Exported Data From SQL DB To .CSV File' button. When prompted by the File Download dialog box click on the Save button to save the .csv file and then navigate to the location you want to save the file to.

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10 Sample Data Download snap shot

Copy and paste from a data download .csv file from a system with only hour meters.

DateAndTime	V_STATUS	C3101_HRS	C3201_HRS	P4901_HRS	B6401_HRS	P6401_HRS
3/13/2012 12:00:00 AM	2	73	159	6	0	0
3/14/2012 12:00:00 AM	2	76	165	6	0	0
3/15/2012 12:00:00 AM	2	81	173	6	0	0
3/16/2012 12:00:00 AM	2	86	180	6	0	0
3/17/2012 12:00:00 AM	2	90	187	7	0	0
3/18/2012 12:00:00 AM	2	95	195	7	0	0
3/19/2012 12:00:00 AM	2	99	202	7	0	0
3/20/2012 12:00:00 AM	2	103	209	7	0	0
3/21/2012 12:00:00 AM	2	109	217	7	0	0
3/22/2012 12:00:00 AM	102	112	220	7	0	0
3/23/2012 12:00:00 AM	114	113	221	7	0	0
3/24/2012 12:00:00 AM	1	116	225	8	0	0
3/25/2012 12:00:00 AM						
3/26/2012 12:00:00 AM	1	116	225	8	0	0
3/27/2012 12:00:00 AM	2	119	228	9	0	0
3/28/2012 12:00:00 AM	2	126	235	12	0	0
3/29/2012 12:00:00 AM	2	132	242	15	0	0
3/30/2012 12:00:00 AM	2	139	249	18	0	0
3/31/2012 12:00:00 AM	2	145	254	20	0	0
04/01/2012 0:00	2	151	261	23	0	0
04/02/2012 0:00	2	158	268	26	0	0
04/03/2012 0:00	2	164	275	29	0	0
04/04/2012 0:00	2	170	282	32	0	0
04/05/2012 0:00	105	177	288	35	0	0
04/06/2012 0:00	105	183	294	37	0	0
04/07/2012 0:00	105	189	301	40	0	0
04/08/2012 0:00	105	196	307	42	0	0
04/09/2012 0:00	105	202	313	43	0	0

DateAndTime: Date and time data log was taken (Eastern Time). If there are no values for a particular data log date/ time then the server was unable to connect to the system (eg power outage at the system).
V_STATUS: Internal PLC status bit used by Site-Link to determine whether the system is running (2), stopped (1) or in alarm (other value).
C3101_HRS: Accumulated run time hours for component.

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11 Sample Alarm Download snap shot

Cut and paste from alarm download .csv file.

AlarmID	AlarmType	AlarmGroup	Priority	AlarmText	Active	Acked	TimeDelay	AlarmValue	ClearedValue	AlarmDateTime
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	1		3/21/2012 10:02:22 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	0		3/22/2012 5:13:44 PM
200213.C-CGA-3101-ALM_Dig	Digital	ALM200213	0	CGA-3101-ALM	TRUE	FALSE	0	1		3/22/2012 7:26:07 PM
200213.C-CGA-3101-ALM_Dig	Digital	ALM200213	0	CGA-3101-ALM	TRUE	FALSE	0	0		3/23/2012 8:16:04 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	1		3/23/2012 8:25:28 AM
200213.C-SYSTEM-KILL-ALM_Dig	Digital	ALM200213	0	SYSTEM-KILL-ALM	TRUE	FALSE	0	0		3/23/2012 8:25:41 AM
200213.C-LALL-3101-ALM_Dig	Digital	ALM200213	0	LALL-3101-ALM	TRUE	FALSE	0	1		3/23/2012 10:36:42 AM
200213.C-LALL-3101-ALM_Dig	Digital	ALM200213	0	LALL-3101-ALM	TRUE	FALSE	0	0		3/23/2012 11:03:57 AM
200213.C-LAHH-4901-ALM_Dig	Digital	ALM200213	0	LAHH-4901-ALM	TRUE	FALSE	0	1		3/23/2012 11:04:03 AM

AlarmID: Short form alarm code. Please refer to O&M manual for more detailed description.
AlarmType: Will always will report Digital. Unable to suppress column.
AlarmGroup: Will always report ALMxxxxxx. Unable to suppress column.
Priority: Will always report zero. Unable to suppress column.
AlarmText: Short form alarm code. Please refer to O&M manual for more detailed description.
Active: Will always report True. Unable to suppress column.
Acked: Will always report False. Unable to suppress column.
TimeDelay: Will always report zero. Unable to suppress column.
AlarmValue: 1 means alarm is/ became active. 0 means alarm is/ became inactive.
ClearedValue: Will always be blank. Unable to suppress column.
AlarmDateTime: Date and time at which alarm changed state (became active and/ or inactive)

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12 PLC Program Changes

Wireless telemetry also enables **newterra** to perform remote PLC program/ system troubleshooting and upload PLC program modifications remotely.

13 Logging in

Each user is added to the Site-Link database and set up with an account by an Administrator at **newterra**. Once this has been done the user will receive an automated Email similar to the one shown below.

From: MLEE Site-Link Admin <sitelink@newterra.com>
Date: 12 April 2012 08:11
Subject: Re: New User Account Created For: jsmith
To: jsmith <jsmith@email.com>

Site-Link Account Information

Project # / Username: jsmith
Contact E-Mail Address: jsmith@email.com

New Random Password: 96a35b

Please feel free to return to https://sitelink.newterra.com to change your password at any time

----
*Thank You Very Much For Using The **newterra** Site-Link Offsite Software,*

~The Site-Link Administrator

Multiple users can have access to Site-Link, each with their own unique login details. Users can have read and write privileges, for monitoring and control, or read only privileges for monitoring only. For customers with multiple systems with Site-Link capability, all those systems will be available with the one login.

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14 E-Alarm

An instant Email or Email to cell phone text is optionally available as a separate service. Personnel on the call out list will receive an automated Email or text similar to the one shown below.

From: 200000 - ABC Air Sparge [mailto:plc@newterra.com]
Sent: April 13, 2012 8:33 AM
To: plc201217
Subject: ALARM! 200000 - ABC Airsparge

C103 - PAH-2401 SPG1
04/13/12,12:32PM
Help: http://goo.gl/upNS6

14.1 E-Alarm Re-Email

Any alarm condition will re-Email every 2 hours (unless specified otherwise by the customer) until the alarm either self clears (if it is recoverable) or is reset via the Site-Link P&ID page.

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15 E-Monitor

A daily system status Email is optionally available as a separate service. Personnel on the call out list will receive a daily automated Email similar to the ones shown below, the more complex the system the more detailed the report.

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Site-Link E-Monitor

Daily Report for

Start: 3-19-2012 EST Stop: 3-19-2012 EST

SYSTEM STATUS: **ALARM**

Date-Time (EST)	Status	System (hours)	B-6401 (hours)	P-4901 (hours)	P-6401 (hours)	P-7301 (hours)	Total Water Discharge FT-7301 (gal)	Total Product Discharge FT-5201 (gal)	Total Inlet Fluids FT-4601 (gal)	pH	DWS LT-4901 (%)	PT-4901 (psi)	PDT-6401 ("WC)	PDT-6402 ("WC)	PT-6401 ("WC)
3-19-2012 2:22:00 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	48	78	0.8	15.4	59
3-19-2012 2:22:30 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	47	78	0.7	15.3	59
3-19-2012 2:23:00 PM	RUNNING	1159	1121	68	92	35	327690	0	0	79	49	78	0.7	15.3	59
3-19-2012 2:23:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	51	78	0.7	15.3	59
3-19-2012 2:24:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	52	78	0.7	15.3	59
3-19-2012 2:24:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	54	78	0.8	15.3	59
3-19-2012 2:25:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	55	78	0.8	15.3	59
3-19-2012 2:25:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	53	78	0.8	15.3	59
3-19-2012 2:26:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	57	78	0.7	15	59
3-19-2012 2:26:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	58	78	0.7	15	59
3-19-2012 2:27:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	59	78	0.7	15	59
3-19-2012 2:27:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	56	78	0.8	15.0	59
3-19-2012 2:28:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	38	78	0.8	15.0	59
3-19-2012 2:28:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	20	78	0.7	14.7	59
3-19-2012 2:29:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	18	78	0.7	14.7	59
3-19-2012 2:29:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	16	78	0.6	15.0	59
3-19-2012 2:30:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	19	78	0.6	15.0	59
3-19-2012 2:30:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	21	78	0.7	15.0	59
3-19-2012 2:31:00 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	21	78	0.7	15.0	59
3-19-2012 2:31:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	20	78	0.6	14.9	59
3-19-2012 2:31:59 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	22	78	0.6	14.9	59
3-19-2012 2:32:17 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	25	78	0.7	14.9	59
3-19-2012 2:32:45 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	31	78	0.7	14.9	59
3-19-2012 2:33:05 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	32	78	0.7	14.9	59
3-19-2012 2:33:30 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	33	78	0.7	14.9	59
3-19-2012 2:33:55 PM	RUNNING	1159	1122	68	92	35	327690	0	0	79	35	78	0.7	14.9	59

Printed at 3-20-2012 EST

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Site-Link E-Monitor

Daily Report for

Start: 3/22/2012 9:50:00 AM
Stop: 3/23/2012 9:20:00 AM

SYSTEM STATUS: **RUNNING**

Analogs:

	VT-LRP
MIN:	16.200000762939
MAX:	17.8999996
AVERAGE:	17.3577464

ALARM STATUS

Last Alarm	Active
KILL-SYS-ALM 3/13/2012 2:42:10 PM	NO

HOUR METERS:

DP-PS	2272
VP-LRP	3043
DP-OWS	505
AB-STRP	1406
DP-STRP	423

3/23/2012 9:22:52 AM

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Project As-Built Document

27-Aug-13

RTS151 **WTS, 150gpm, OWS-24, Carbo**

Customer: newterra ltd.

System Site Specifications

Elevation:	0 ft
Max Temp	0 deg F
Min Temp:	0 deg F
Noise Target:	
Gas Required:	
Water Required:	
Telephone Reqd:	
Building:	

System Electrical Specifications

Voltage:	208V/120V-3ph
Main Disconnect	100amp
Panel Approval:	MET1604(CL Class CL1DIV2
System Approval:	Class CL1DIV2
Panel Type:	PLC-DL06
Telemetry:	
Autodialer:	
EMonitor:	Server:

System SVE (First Blower)

0 @ 0

Blower Disch Temp:	0 deg F
Inlet Legs:	0
Disch Press:	0 in wc
Water Flowrate:	0 gpm
Heat xchg Disch:	0 deg F

System SVE (Second Blower)

0 @ 0

Blower Disch Temp:	0 deg F
Inlet Legs:	0
Disch Press:	0 in wc
Water Flowrate:	0 gpm
Heat xchg Disch:	0 deg F

Air Sparge

0 @ 0 psi

Sparge Disch Temp:	0 deg F
Disch Legs:	0
Heat xchg Disch:	0 deg F

Other Specifications

Other Inlet Liquid Flow:	0 gpm
Disch Flow:	150 gpm @ 40 psi
AirTreatment:	None
Water_Treatment:	Carbon
Stripper Airflow:	0 cfm
Stripper Dsn Flow:	0 gpm
OWS_Dsn_Flow:	150 gpm

Contaminants

Other Information May be Presented Below

Connection Info:

Shipping Information

Parts

Module Code: 0

Insulation, Foil Back Foam, 1", R, Thinsulate, 4x8	Part:	10636
	Qty:	34
	Mfg:	
	Mfg Part:	356075
Lumber, Spruce, Dry, 2" x 4" x 10'	Part:	10912
818011	Qty:	96
	Mfg:	
	Mfg Part:	818011
Lumber, Plywood, Spr, STD, 4 x 8 x 3/8"	Part:	14463
620295	Qty:	34
	Mfg:	
	Mfg Part:	620295
Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	2
	Mfg:	Johnson Controls
	Mfg Part:	
Breaker, Techna, JTEC4892C40	Part:	17700
240V 40 AMP 2P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
	Mfg Part:	JTEC4892C40
Combination Starter, SQT LUCC32FU	Part:	19434
TeSysU 1 Phase Control Unit 8-32A	Qty:	1
110/120VAC coil	Mfg:	Telemecanique
	Mfg Part:	SQT LUCC32FU
Wire, Stranded, T90, #1 AWG, Black	Part:	25152
	Qty:	10
	Mfg:	
	Mfg Part:	T901BLK

FLT-6701

Filter, Bag, Dewatering, Assembly, Four (4)	Part:	RC036
	Qty:	1
	Mfg:	
---	Mfg Part:	---

PI-6701

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	8
	Mfg:	
---	Mfg Part:	P16K2-FG-60

PSH-6701

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Rental Components

Module Code: 2

RCHOSE DISCH

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	50
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

RCHOSE-INLET

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	50
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

Submersible Pump

Module Code: 4000

LSH-4001

Switch, Level, Mech Float, Wide Angle, N.O., Red	Part:	M1108
Tilt Float Level Switch 90deg, w 40' cable	Qty:	1
13A, SPST, N/O	Mfg:	Warrick Controls
---	Mfg Part:	GR20W4000

P-4001

Pump, Sump, Goulds, 160GPM @ 40'	Part:	RC073
WS2038BHF, 200V, 3 Ph, 2 HP, w/o switch	Qty:	1
3" Type F Camlock Fitting	Mfg:	Goulds
---	Mfg Part:	

Oil/Water Separator

Module Code: 4900

LSHH-4901

Switch, Level, Mech Float, Narrow Angle, N.C., YEL	Part:	19279
N/C, Yellow float	Qty:	1
	Mfg:	
---	Mfg Part:	PY2CW4000

OWS-4901

Media, Coalescing, HD Q-PAC	Part:	13959
0.25" spacing, 132 sqft/cuft	Qty:	24
	Mfg:	
---	Mfg Part:	HD Q-PAC

Oil Water Separator, OWS-24, Stainless	Part:	16263
24 cubic feet of packing, 304SS	Qty:	1
Note: Build up price from Price Sheet	Mfg:	Maple Leaf Environmental Equipment
To be removed from RTS-148, SVE, WTS returning fron Veron,TX. Purchased used equipment, 50430 Jerry Wood #2 project.	Mfg Part:	

Strain Relief, Connector, PVC, 1/2"	Part:	16884
TSRC10	Qty:	2
	Mfg:	
None	Mfg Part:	TSRC10

Oil Water Separator, Assembly, OWS-24	Part:	17535
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

Switch, Level, Mech Float, Wide Angle, N.O., Red	Part:	m1108
Tilt Float Level Switch 90deg, w 40" cable	Qty:	1
13A, SPST, N/O	Mfg:	Warrick Controls
None	Mfg Part:	GR20W4000

Valve, Ball, Brass, 2", 150#	Part:	p1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
None	Mfg Part:	601-2

Valve, Ball, Brass, 2", 150#	Part:	p1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
None	Mfg Part:	601-2

Valve, Ball, Brass, 1", 150#	Part:	p1067
NPT, Teflon seats, 600 PSI WOG	Qty:	3
	Mfg:	Kitz
None	Mfg Part:	601-1

Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	3
	Mfg:	
---	Mfg Part:	601-3

P-4901

Valve, Gate, Brass, 3"	Part:	10167
	Qty:	1
	Mfg:	
None	Mfg Part:	514T10
Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	Part:	16203
SS, brass internals, Glyc. Filled, bottom mount	Qty:	1
	Mfg:	Indumart
None	Mfg Part.	
Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	1
	Mfg:	
---	Mfg Part:	835-030SR
Pump, Piping, Centrifugal, 3" x 3", 170gpm	Part:	17316
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Pump, Suction, Goulds, SSH Series, 4SH2K52C0	Part:	21028
7.5hp, 3ph, 208-230/460V, TEFC	Qty:	1
C Impeller	Mfg:	Goulds
---	Mfg Part:	---
Hose, Braided, SS, 3", MNPT fittings, 12" long	Part:	21971
5680K2	Qty:	2
304SS	Mfg:	
None	Mfg Part:	5680K2
Strainer, Wye, Brass, 3"	Part:	M1523
threaded	Qty:	1
	Mfg:	
None	Mfg Part:	145T10
Valve, Check, Swing, Brass, 3"	Part:	M1524
	Qty:	1
	Mfg:	
None	Mfg Part:	521T10
Valve, Check, Swing, Brass, 3"	Part:	M1524
	Qty:	1
	Mfg:	
None	Mfg Part:	521T10
Union, Galv, 3"	Part:	M1530
	Qty:	2
	Mfg:	
None	Mfg Part:	3GLU
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
-	Mfg Part:	601-3

Product Storage Tank

Module Code: 5200

LSHH-5201

Switch, Level, Almeg, Vertical, ATB3-48B	Part:	12351
1/4NPT	Qty:	1
	Mfg:	Almeg
---	Mfg Part:	ATB3-48B
Reducer, Bushing, Galv, 2" x 1/2"	Part:	P1021
Hex	Qty:	1
	Mfg:	
—	Mfg Part:	2X12GZB
Union, Galv, 2"	Part:	P1093
	Qty:	1
	Mfg:	
—	Mfg Part:	2GZU

PST-5201

Tee, Galv, 2"	Part:	10136
1	Qty:	1
	Mfg:	
—	Mfg Part:	2GZT
Drum, Black, Steel, 45 gal, 2 hole lid, bottom 2" port	Part:	M1137
including palletization	Qty:	1
	Mfg:	
—	Mfg Part:	SOH00733
Elbow, 90deg, Galv, 2"	Part:	P1058
	Qty:	4
	Mfg:	
—	Mfg Part:	2GZE9
Valve, Ball, Brass, 2", 150#	Part:	P1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
---	Mfg Part:	601-2
Nipple, Galv, 2" x Short	Part:	P1192
	Qty:	5
	Mfg:	
—	Mfg Part:	2xSHGZN

Bag Filter

Module Code: 5800

FLT-5801

O-Ring, Buna-N, 8-3/8" OD, 3/16" Thick A70 Hardness * Fits most Filter Innovation EB112 series ---	Part: Qty: Mfg: Mfg Part:	21619 25 369 BUNA
Filter, Bag, Dewatering, Assembly, Four (4) ---	Part: Qty: Mfg: Mfg Part:	RC033 1 ---

FLT-5802

Reducer, Bushing, Galv, 3" x 2" Hex ---	Part: Qty: Mfg: Mfg Part:	10019 4 3X2GZB
Tee, Galv, 2" 1 ---	Part: Qty: Mfg: Mfg Part:	10136 2 2GZT
Nipple, Galv, 2" x Close ---	Part: Qty: Mfg: Mfg Part:	10222 14 2XCLGZN
Tee, Galv, 3" ---	Part: Qty: Mfg: Mfg Part:	10302 2 3GZT
Valve, Ball, Brass, 1/2", 150# NPT, Teflon seats, 600 PSI WOG ---	Part: Qty: Mfg: Mfg Part:	10538 2 601-1/2
Nipple, Galv, 1/2" x Close ---	Part: Qty: Mfg: Mfg Part:	10619 2 12CLGZN
Skid, 2ft x 4ft ---	Part: Qty: Mfg: Mfg Part:	15152 1 Maple Leaf Environmental Equipment
Sample Port Assembly, 1/4" -	Part: Qty: Mfg: Mfg Part:	18682 2 Maple Leaf Environmental Equipment -
Filter, Bag, Housing, #2, Carbon Steel SS Basket, CS legs ---	Part: Qty: Mfg: Mfg Part:	19117 2

Reducer, Bushing, Galv, 2" x 1/2"	Part:	P1021
Hex	Qty:	2
	Mfg:	
---	Mfg Part:	2X12GZB
Valve, Ball, Brass, 2", 150#	Part:	P1065
NPT, Teflon seats, 600 PSI WOG	Qty:	4
	Mfg:	Kitz
---	Mfg Part:	601-2
Union, Galv, 2"	Part:	P1093
	Qty:	4
	Mfg:	
---	Mfg Part:	2GZU

PI-5801

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	12
	Mfg:	
---	Mfg Part:	P16K2-FG-60

PSH-5801

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Bag Filter

Module Code: 6700

FLT-6701

Nipple, Galv, 3" x Close	Part:	11220
	Qty:	6
	Mfg:	
—	Mfg Part:	3CLGZN
Flange, Companion, Galv, 6"	Part:	12572
threaded	Qty:	2
	Mfg:	
—	Mfg Part:	6GZCIF / 12.0905
Valve, Butterfly, Wafer, Ductile Iron, 6"	Part:	15019
316SS disc & stem, BUNA, 10 position lever	Qty:	2
	Mfg:	
—	Mfg Part:	CIWB-SBL 6" CO
Reducer, Bushing, Galv, 6" x 3"	Part:	19681
Hex	Qty:	2
	Mfg:	
—	Mfg Part:	
Tee, PVC 40, 3", SxSxS, 401-030G	Part:	22578
	Qty:	2
	Mfg:	
—	Mfg Part:	
Elbow, 90deg, PVC 40, 3", SxS, 406-030G	Part:	22619
	Qty:	8
	Mfg:	
—	Mfg Part:	406-030G
Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	1
	Mfg:	
Pricing from Steve Hughes, Aug. 7th,2013 e-mail	Mfg Part:	Qo8L100RB9
V6427-A, Muilti-Bag Filter Housing - 7 Bag Model - 304 Stainless		
Vessel A - Inlet and Outlet are on the right hand side of the unit when looking at the label.		
Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	2
	Mfg:	
4155-1490-B, O-rings for V6427-A Bag Filter Housing	Mfg Part:	Qo8L100RB9
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
—	Mfg Part:	601-3
Elbow, 90deg, Galv, 3"	Part:	P1220
	Qty:	1
	Mfg:	
—	Mfg Part:	3GZE9

FT-6701

Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	4
	Mfg:	
---	Mfg Part:	835-030SR

PSH-6701

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
---	Mfg Part:	

Liquid Phase Carbon

Module Code: 7000

7000

Nipple, Galv, 3" x Close	Part:	11220
	Qty:	2
	Mfg:	
---	Mfg Part:	3CLGZN
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	
---	Mfg Part:	601-3
Adapter, PVC 80, Female, 3", SxT, 835-030G	Part:	P1153
	Qty:	2
	Mfg:	
---	Mfg Part:	835-030

FQI,FT-7001

Meter, Water, 2", US Gal, w/ pulse, Turbine, DLJ	Part:	15499
Flange	Qty:	1
	Mfg:	Daniel L. Jerman Co.
---	Mfg Part:	DLJ200TC

LPC-7001

Reducer, Bushing, Galv, 3" x 2"	Part:	10019
Hex	Qty:	5
	Mfg:	
---	Mfg Part:	3X2GZB
Tee, Galv, 3"	Part:	10302
	Qty:	5
	Mfg:	
---	Mfg Part:	3GZT
Nipple, Galv, 3" x Short (3")	Part:	10445
	Qty:	4
	Mfg:	
---	Mfg Part:	3SHGZN
Camlock Fitting, Aluminum, 3", Part "F"	Part:	10541
Male Adapter x Male Thread Cam Lock Fitting	Qty:	6
	Mfg:	Bayco Industries
-	Mfg Part:	BAL-300F
Camlock Fitting, Aluminum, 3", Part "C"	Part:	10542
Female Adapter x Hose Shank Cam Lock Fitting	Qty:	6
	Mfg:	Bayco Industries
-	Mfg Part:	BAL-300C
Hose, Suction, PVC, Green, 3", J300	Part:	12043
TigerFlex, 65psi@70F, 40psi@100F	Qty:	30
PVC,150F, (min 100ft order)	Mfg:	Kuriyama
-	Mfg Part:	J300
Reinforced, Adapter, PVC 80, Female, 3", SxSS	Part:	17055
Fitting, transition, socket x SS	Qty:	6
	Mfg:	
---	Mfg Part:	835-030SR

Hose, Assembly, J300, 3"	Part:	18661
Green Hose	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Sample Port Assembly, 1/4"	Part:	18682
	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Valve, Check, Spring, Brass, 2"	Part:	M1529
	Qty:	1
	Mfg:	
—	Mfg Part:	2BPUCV
Clamp, Hose, SS, 3", HAS48	Part:	P1044
	Qty:	12
	Mfg:	
None	Mfg Part:	HAS48
Valve, Ball, Brass, 3", 150#	Part:	P1104
NPT, Teflon seats, 600 PSI WOG	Qty:	4
	Mfg:	
—	Mfg Part:	601-3
Reducer, Bushing, Galv, 2" x 1/4"	Part:	P1219
Hex	Qty:	5
	Mfg:	
—	Mfg Part:	2x14GZB

PI-7001

Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	Part:	16203
SS, brass internals, Glyc. Filled, bottom mount	Qty:	2
	Mfg:	Indumart
—	Mfg Part:	

PI-7004

Gauge, Pressure, 0-60psi, Indumart, P16K2-FG-60 (back)	Part:	19393
SS, brass internals, Glyc. Filled, back mount	Qty:	1
	Mfg:	
—	Mfg Part:	P16K2-FG-60

PSH-7001

Switch, Pressure, A1F-0-SS-1-2	Part:	20589
4-75 PSI Range	Qty:	1
Deadband at Min Range 4 - Max Range 15	Mfg:	Dwyer
—	Mfg Part:	

Building, Trailer or Skid

Module Code: 7900

7900

Door, Single, 36", Steel slab/no brick moulding, No sill ext	Part:	10822
1103A,wooden frame,open out,RH	Qty:	1
to be pre drilled for passage and deadbolt	Mfg:	
-	Mfg Part:	1103-Dalmen
Lock, Passage, 107188, Taymor	Part:	10908
107188	Qty:	1
	Mfg:	
None	Mfg Part:	
Lock, Deadbolt, 289648, Taymor, 1 cyl, S/S	Part:	10909
keyed alike #289648	Qty:	1
	Mfg:	
None	Mfg Part:	
Container, Painting, 40ft exterior/interior	Part:	12063
	Qty:	1
	Mfg:	
Building exterior, to be painted our standard white finish.	Mfg Part:	
Container, Shipping, Tilt load	Part:	13593
	Qty:	1
	Mfg:	
---	Mfg Part:	
Container, 8' x 40' x High Cube	Part:	15512
	Qty:	1
	Mfg:	
---	Mfg Part:	
Container, Modification	Part:	15513
As per specification below or drawing provided.	Qty:	1
	Mfg:	
---	Mfg Part:	
Door, Assembly, 72", Double	Part:	19012
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-
Door, Assembly, 36", Single	Part:	19014
	Qty:	1
	Mfg:	Maple Leaf Environmental Equipment
-	Mfg Part:	-

Access Cover

Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	3
	Mfg:	
As per attached drawing, For 36"x36" Carbon Access Cover	Mfg Part:	---

F-7901

Fan, Building, 24", 1/3hp, 1625rpm, 120/230V, 1ph, XPF	Part:	10329
SD24-XPF, OSHA Guard,Turnout Box	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	SD24-XPF-OSHA

Fan Shutter Assembly,KD,24",KDS24-SS - Use 23082	Part:	10330
	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	KD24-SS
Fan, Hood, White,24",HFPW-24	Part:	M1411
	Qty:	2
	Mfg:	Canarm
---	Mfg Part:	HFPW-24

F-7903

Fan, Shutter, Backdraft damper, 12"x12"	Part:	23080
Non-Motorized	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	SR3212X12
Hood, 15"	Part:	23989
Fits 12" Fan & Louver	Qty:	2
	Mfg:	
---	Mfg Part:	
Fan, Building, 12", 1/4hp, 1750rpm, 120V, 1ph, TEFC	Part:	M1072
CSA Approved, S12-E1	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	SD120311

H-7901

Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	2
	Mfg:	Johnson Controls
-	Mfg Part:	-

H-7903

Heater, Baseboard, Ouellet, 1.5kW, OFM1508	Part:	22314
208V, 66" long	Qty:	1
	Mfg:	Ouellet
---	Mfg Part:	OFM1508

TSH-7903

Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	
Switch, Temperature, Probe, WEL 14A-602R	Part:	15653
Bulb, Well for Temperature Switch, Brass	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	WEL 14A-602R
Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	1
	Mfg:	Johnson Controls
-	Mfg Part:	-

TSL-7903

Switch, Temperature, Probe, A19ABC-24D	Part:	15651
range -30/100F	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	

Switch, Temperature, Probe, WEL 14A-602R	Part:	15653
Bulb, Well for Temperature Switch, Brass	Qty:	1
	Mfg:	Johnson Controls
-30 - 100 F option	Mfg Part:	WEL 14A-602R
Switch, Temperature, Johnson Controls, Assembly	Part:	18985
	Qty:	1
	Mfg:	Johnson Controls
-	Mfg Part:	-

Main Control Panel

Module Code: 8200

8200

Contactor, SQD LC1D32G7	Part:	10520
32A, 10/10/20/25HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D32G7
Disconnect, 3ph, D324N	Part:	11163
200A, UL.240V,Nema 1,fusible disconnect	Qty:	1
	Mfg:	Square D
---	Mfg Part:	SQD D324N
Contactor, SQD LC1D09G7	Part:	12547
9A, 2/2/5/7.5HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D09G7
Contactor, SQD LC1D50AG7	Part:	12548
50A, 15/15/40/40HP	Qty:	1
120VAC coil	Mfg:	Square D
---	Mfg Part:	SQD LC1D50G7
Modem, Antenna, Airlink GPRS, N-Female	Part:	13723
120-110-2107	Qty:	1
MAX-BMLPVDB800/1900 Antenna & MAX-MTPM-800 Hardwar	Mfg:	
---	Mfg Part:	120-110-2107
PLC, EA1-S3ML	Part:	17233
C-more micro graphic user interface	Qty:	1
	Mfg:	Automation Direct
---	Mfg Part:	EA1-S3ML
PLC, DV-1000CBL	Part:	17234
2m Cable RJ12 to RJ12	Qty:	1
C-more Micro to DL05/06/205	Mfg:	Automation Direct
---	Mfg Part:	DV-1000CBL
Breaker, Techna, JTEC4892C30	Part:	17543
480/277V 30 AMP 2P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4892C30
Breaker, Techna, JTEC4893C06	Part:	17709
480/277V 6 AMP 3P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C06
Breaker, Techna, JTEC4893C40	Part:	17717
240V 40 AMP 3P C Trip Cuve	Qty:	2
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C40
Breaker, Techna, JTEC4893C50	Part:	17718
240V 50 AMP 3P C Trip Curve	Qty:	1
10k SCCR	Mfg:	Fusetek
---	Mfg Part:	JTEC4893C50

Breaker, Techna, JTEC4891C15 240V 15A, 1P C Trip Curve 10k SCCR ---	Part: Qty: Mfg: Mfg Part:	18359 1 Fusetek JTEC4891C15
Motor Saver, 460 w/Diagnostic 3ph Finger Safe, DIN Rail Mountable ---	Part: Qty: Mfg: Mfg Part:	18396 1 Symcom 460
Combination Starter, SQT LUB12 TeSysU Power Base 12A 3HP@208/240, 7.5HP@480, 10HP@600 ---	Part: Qty: Mfg: Mfg Part:	19264 1 Telemecanique SQT LUB12
Combination Starter, SQT LUA1C20 TeSysU Aux Contact Module 1NO Ready 1NO Fault ---	Part: Qty: Mfg: Mfg Part:	19269 2 Telemecanique LUA1C20
Combination Starter, SQT LU9SP0 TeSysU UL508 Type E Phase Barrier ---	Part: Qty: Mfg: Mfg Part:	19270 2 Telemecanique SQT LU9SP0
Combination Starter, SQT LUB32 TeSysU Power Base 32A 10HP@208/240, 20HP@480, 25HP@600 ---	Part: Qty: Mfg: Mfg Part:	19273 1 Telemecanique SQT LUB 32
Combination Starter, SQT LUCA32FU TeSysU Standard Control Unit 8-32A 110/120VAC coil ---	Part: Qty: Mfg: Mfg Part:	19274 1 Telemecanique SQT LUCA32FU
Combination Starter, SQT LUCC12FU TeSysU 1 Phase Control Unit 3-12 110/120VAC coil ---	Part: Qty: Mfg: Mfg Part:	19456 1 Telemecanique LUCC12FU
Transformer, Hammond, HAT Q005YEKF 208V to 240V,5KVA,UL/CSA,3R,1ph ---	Part: Qty: Mfg: Mfg Part:	19999 1 Hammond Power Solutions HAT Q005BECF
Modem, Cable, RF, N-Male to SMA-Male, 15' Length GW195-180-SM-NM Use with Raven XE ---	Part: Qty: Mfg: Mfg Part:	20569 1 GW195-180-SM-N
Relay, SQT RXM4AB1F7 Miniature Relay 4PDT 120 V AC ---	Part: Qty: Mfg: Mfg Part:	21887 1 Telemecanique SQT RXM4AB1F
Relay, SQT RXM4AB1BD Miniature Relay 4PDT 24 V DC ---	Part: Qty: Mfg: Mfg Part:	21888 1 Telemecanique SQT RXM4AB1B

Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Relay, SQT RXZE2S114M	Part:	21889
Base/Socket for RXM4 4P Relays	Qty:	1
	Mfg:	Telemecanique
---	Mfg Part:	SQT RXZE2S114
Modem, Bracket, Mounting, Airlink Raven XE	Part:	22143
100-170-1015	Qty:	1
Use with Raven XE	Mfg:	
---	Mfg Part:	100-170-1015
Modem, Airlink Raven, XE V2228E-SA w/AC Pwr Adapter, Sprint	Part:	22170
V2228E-SA	Qty:	1
Requires mounting bracket MLE# 22143	Mfg:	Airlink_Communications
---	Mfg Part:	V2221E-SA
Fuse, GLD GDL3	Part:	E1187
3A 250V Time Delay	Qty:	1
Miniature 1/4"x1-1/4"	Mfg:	Ferraz Shawmut
---	Mfg Part:	GLD GDL3
Fuse, GLD TR125R	Part:	E1206
125A 240V Time Delay	Qty:	3
Class R	Mfg:	Ferraz Shawmut
---	Mfg Part:	GLD TR125R

Panel

Misc Part, See Details	Part:	9999
As per detailed specification below	Qty:	1
	Mfg:	
Use and modify the old RTS070 PLC Control panel and Disconnect in the rental tent.	Mfg Part:	---

Bill of Material

Project RTS151
Description Baffinland Iron Mines Corp^Mary River Project/ PM
Ordernumber 102140
Drawing Number

1325 CALIFORNIA AVE.
BROCKVILLE. ONTARIO
CANADA
K6V 5Y6

Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
1	CB227		1	17717	Breaker, Techna, JTE	Breaker, Techna, JTEC4893C40 , 240V 40 AMP 3P C Trip Cuve	
2	CB232		1	17397	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C15 , 480/277V 15 AMP 2P C Trip Curve	
3	CB247		1	17717	Breaker, Techna, JTE	Breaker, Techna, JTEC4893C40 , 240V 40 AMP 3P C Trip Cuve	
4	CB253		1	17698	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C20 , 480/277V 20 AMP 2P C Trip Curve	
5	CB261		1	17397	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C15 , 480/277V 15 AMP 2P C Trip Curve	
6	CB266		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
7	CB271		1	17701	Breaker, Techna, JTE	Breaker, Techna, JTEC4892C50 , 240V 50 AMP 2P C Trip Curve	
8	CB304		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
9	CB337		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
10	CB346		1	18359	Breaker, Techna, JTE	Breaker, Techna, JTEC4891C15 , 240V 15A, 1P C Trip Curve	Fusetek
11	CR318	ESTOP	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
12	CR318	ESTOP	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
13	CR415	KILL-7901	1	21888	Relay, SQT RXM4AB1BD	Relay, SQT RXM4AB1BD , Miniature Relay 4PDT 24 V DC	Telemechanique
14	CR415	KILL-7901	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
15	CR750	SYS-ON	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
16	CR750	SYS-ON	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
17	CR760	SYS-PNL	1	21887	Relay, SQT RXM4AB1F7	Relay, SQT RXM4AB1F7 , Miniature Relay 4PDT 120 V AC	Telemechanique
18	CR760	SYS-PNL	1	21889	Relay, SQT RXZE2S114	Relay, SQT RXZE2S114M , Base/Socket for RXM4 4P Relays	Telemechanique
19	DS201	200 AMP	1	11163	Disconnect, 3ph, D32	Disconnect, 3ph, D324N , 200A, UL,240V,Nema 1,fusible disconnect	SQD
20	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould
21	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould

Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
22	DS201	200 AMP	1	E1206	Fuse, GLD TR125R	Fuse, GLD TR125R , 125A 240V Time Delay	Gould
23	FU303		1	E1187	Fuse, GLD GDL3	Fuse, GLD GDL3 , 3A 250V Time Delay	Gould
24	FU303		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
25	FU304		1	E1186	Fuse, GLD GDL2	Fuse, GLD GDL2 , 2A 250V Time Delay	Gould
26	FU304		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
27	FU318		1	E1188	Fuse, GLD GDL5	Fuse, GLD GDL5 , 5A 250V Time Delay	Gould
28	FU318		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
29	FU323		1	E1188	Fuse, GLD GDL5	Fuse, GLD GDL5 , 5A 250V Time Delay	Gould
30	FU323		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
31	FU546		1	E1190	Fuse, GLD GGC1	Fuse, GLD GGC1 , 1A 250V Fast Acting	Gould
32	FU546		1	19077	Fuse, Holder, PHX 30	Fuse, Holder, PHX 3004171 , 1P 10A 250V	Phoenix
33	IS402		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
34	IS411		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
35	IS424		1	12475	Barriers, IS, D1031Q	Barriers, IS, D1031Q , Must be marked with UL Approval	GMI
36	KILL318		1	14607	Button, E-Stop, ZB5	Button, E-Stop, ZB5 AT4 , E-Stop Button	SQD
37	KILL318		1	14607	Button, E-Stop, ZB5	Button, E-Stop, ZB5 AT4 , E-Stop Button	SQD
38	KILL318		1	14609	Button, ZB5 AZ105	Collar with 1-N/0 and 1-N/C Contact Block	SQD
39	KILL318		1	14609	Button, ZB5 AZ105	Collar with 1-N/0 and 1-N/C Contact Block	SQD
40	KILL318		1	23054	Label, Emergency Sto	Label, Emergency Stop, SQT ZBY9330 ,	
41	KILL318		1	23054	Label, Emergency Sto	Label, Emergency Stop, SQT ZBY9330 ,	
42	LT608	P-4001	1	18625	Button, XB7EV03GP	Button, XB7EV03GP , Green LED Pilot Light 120VAC	Square D
43	LT614	P-4901	1	18625	Button, XB7EV03GP	Button, XB7EV03GP , Green LED Pilot Light 120VAC	Square D
44	LT755	SYSTEM	1	18626	Button, XB7EV04GP	Button, XB7EV04GP , Red LED Pilot Light 120VAC	Square D
45	M227	H-7902	1	10520	Contactor, SQD LC1D3	Contactor, SQD LC1D32G7 , 32A, 10/10/20/25HP	SQD
46	M247	H-7901	1	10520	Contactor, SQD LC1D3	Contactor, SQD LC1D32G7 , 32A, 10/10/20/25HP	SQD
47	OP367	MICRO-GRAPHIC	1	17233	PLC, EA1-S3ML	PLC, EA1-S3ML , C-more micro graphic user interface	
48	OP367	MICRO-GRAPHIC	1	17234	PLC, DV-1000CBL	PLC, DV-1000CBL , 2m Cable RJ12 to RJ12	
49	PDB206		1	E1217	Power Block, GLD 675	Power Block, GLD 67583 , 175A 1Pri 8Sec Aluminum	Gould
50	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
51	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
52	PDB206		1	16071	Power Block, GLD 857	Power Block, GLD 8570 , safety cover	Gould
53	PDB206A		1	E1215	Power Block, GLD 631	Power Block, GLD 63163 , 90A 1Pri 4Sec Aluminum 3P	Gould

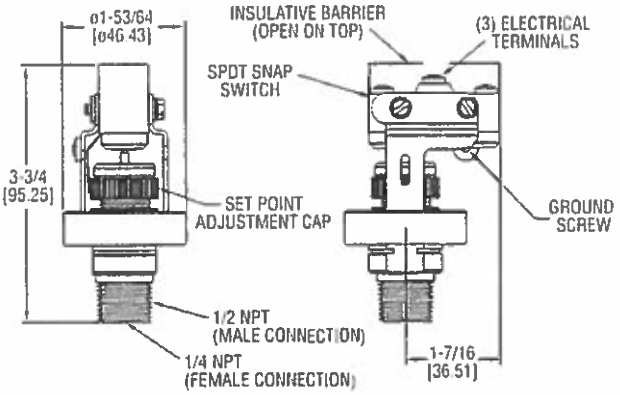
Installation

No.	Device Id	Function Text	Quantity	Partnumber	Description	Technical Des	Manufacturer
54	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
55	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
56	PDB206A		1	16010	Power Block, GLD 853	Power Block, GLD 8530 , safety cover	Gould
57	PLC369		1	DLO6			
58	PLC507		1	12752	PLC, D0-06DR-D	PLC, D0-06DR-D , 20PT 24VDC Input 16PT Relay Output Base Unit DL06	Koyo
59	PLC507		1	E1024	PLC, D2-Bat-1	PLC, D2-Bat-1 , Battery for PLC DL05/06/205	
60	PLC508		1	D0-06DR-D			
61	PS304		1	20780	Power supply, Teleme	Power supply, Telemecanique ABL7 RM24025 , In 100-240VAC Out 24VDC 2.5A	Telemechanique
62	PWR203		1	18396	Motor Saver, 460 w/D	Motor Saver, 460 w/Diagnostic 3ph , Finger Safe, DIN Rail Mountable	
63	REC337		1	GFI-15			
64	STR216	P-4001	1	19274	Combination Starter,	Combination Starter, SQT LUCA32FU , TeSysU Standard Control Unit 8-32A	
65	STR216	P-4001	1	19273	Combination Starter,	Combination Starter, SQT LUB32 , TeSysU Power Base 32A	
66	STR216	P-4001	1	19269	Combination Starter,	Combination Starter, SQT LUA1C20 , TeSysU Aux Contact Module	Telemechanique
67	STR216	P-4001	1	19270	Combination Starter,	Combination Starter, SQT LU9SP0 , TeSysU UL508 Type E Phase Barrier	
68	STR272	P-4901	1	20669	Combination Starter,	Combination Starter, SQT LUCC18FU , TeSysU 1 Phase Control Unit 4.5-18	
69	STR272	P-4901	1	19273	Combination Starter,	Combination Starter, SQT LUB32 , TeSysU Power Base 32A	
70	STR272	P-4901	1	19269	Combination Starter,	Combination Starter, SQT LUA1C20 , TeSysU Aux Contact Module	Telemechanique
71	STR272	P-4901	1	19270	Combination Starter,	Combination Starter, SQT LU9SP0 , TeSysU UL508 Type E Phase Barrier	
72	SW609		1	14660	Button, ZB5 AD3	Button, ZB5 AD3 , 3 Pos. Switch, Maintained	SQD
73	SW609		1	14610	Button, ZB5 AZ103	Button, ZB5 AZ103 , 3	SQD
74	SW615		1	14660	Button, ZB5 AD3	Button, ZB5 AD3 , 3 Pos. Switch, Maintained	SQD
75	SW615		1	14610	Button, ZB5 AZ103	Button, ZB5 AZ103 , 3	SQD
76	T249		1	19999	Transformer, Hammond	Transformer, Hammond, HAT Q005YEKF , 208V to 240V,5KVA,UL/CSA,3R,1ph	

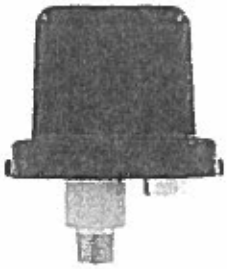
Mercoid® Series A1F Compact OEM Pressure Switch

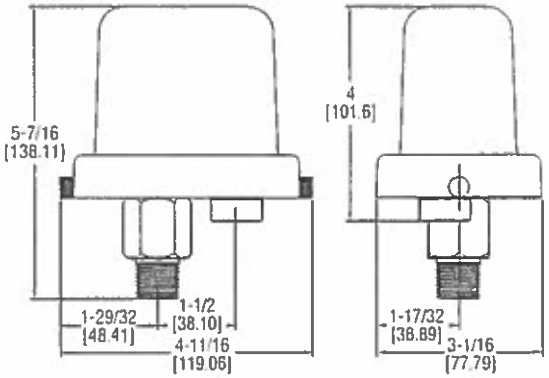
Specifications - Installation and Operating Instructions

A1F



A1F with A-447





The Series A1F Compact OEM Pressure Switch is ideal for panel mounting wherever a high-quality, economical open-case or weatherproof control is required.

INSTALLATION

1. Location: Select a location where the temperature limits of -40 to 180°F (-40 to 82°C) will not be exceeded. Locate the switch as close as possible to the pressure source. Long lengths of piping will not affect accuracy of the actuation point but will slightly add to response time.

2. Mounting and Processing Connection: Avoid mounting surfaces with excess vibration which could cause false actuation when pressure is near setpoint. The switch should be mounted within 20° of vertical for proper operation. Mount the switch by connecting it to the process piping using either 1/4" NPT female or 1/2" male connection. Pipe joint compound or TFE thread tape should be used to prevent leakage.

3. Electrical Connections: The SPDT snap switch includes normally open, normally closed and common connections. The common and normally open contacts will close and the common and normally closed contacts will open when pressure increases to the setpoint. The actions will reverse when pressure decreases below the setpoint minus the deadband. A green grounding screw is provided on the switch bracket. All wiring should be in accordance with local codes.

SETPOINT ADJUSTMENT

1. Determine the setpoint pressure. The approximate actuation point can be set by turning the adjustment cap up or down, aligning the top of the O-ring, located above the cap, with the appropriate scale graduation.
2. Connect tubing or piping from the pressure port on bottom of switch to one leg of a tee. Connect the second leg to a pressure test gage of known accuracy and in an appropriate range. The third leg should be connected to a controllable source of pressure.
3. Connect a volt/ohm meter or other circuit tester to the snap action terminals to indicate when switching occurs.
4. Slowly apply pressure to the system and note the pressure at which switching occurs.
5. Operate the switch through several cycles to confirm proper actuation point.
6. Remove test apparatus and attach switch to pressure source and control circuit wiring. Place switch in service.

SPECIFICATIONS

Service: Compatible liquids and gases.
Wetted Materials:
Pressure Chamber: 316 SS.
Diaphragm: Fluorocarbon.
Temperature Limit: -40 to 175°F (-40 to 80°C).
Pressure Limits: 750 psig (51 bar).
Enclosure Rating: No rating for open construction. Installed properly within an optional A-447 enclosure meets NEMA 4X standards.
Switch Type: SPDT snap switch.
Electrical Rating: 15A @ 120/240/480 VAC, 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC.
Electrical Connection: Screw terminals.
Process Connection: 1/4" female NPT and 1/2" male NPT.
Mounting Orientation: Within 20° of vertical.
Set Point Adjustment: Knurled screw cap with indicating scale.
Deadband: Fixed, See deadband chart.
Weight: 10.5 oz (297 g).

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 www.dwyer-inst.com
Fax: 219/872-9057 e-mail: info@dwyer-inst.com

Example of how to order:

A1F	-	O	-	SS	-	1	-	4
1		2		3		4		5

1. Diaphragm Designation:
   F - Fluorocarbon
2. Enclosure Designation:
   O - Open Construction No Enclosure
3. Housing Material Designation:
   SS - 316SS
4. Switch Designation:
   1 - SPDT Snap Action Switch
5. Operating Pressure Range Designation:
   1 - 2 to 15 psig
   2 - 4 to 75 psig
   3 - 8 to 225 psig
   4 - 16 to 450 psig

Series A1F Deadband Chart-psig (bar)

Range	Deadband at Minimum Range	Deadband at Maximum Range
2 to 15 (0.14 to 1.03)	2 (0.14)	3 (0.21)
4 to 75 (0.28 to 5.17)	4 (0.27)	15 (1.0)
8 to 225 (0.55 to 15.5)	8 (0.55)	25 (1.7)
16 to 450 (1.1 to 31.0)	15 (1.0)	50 (3.5)

MAINTENANCE

Upon final installation of the Series A1F Compact OEM Pressure Switch, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series A1F is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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DWYER INSTRUMENTS, INC.
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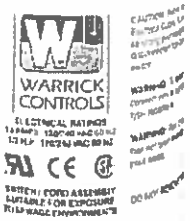
Series M
Mechanical Tilt Float Level Switch

- Non-Mercury Switch
- Sealed Cable
- Impact & Corrosion Resistant ABS Shell
- N.O., N.C., SPDT Contacts
- Various Cable Lengths
- Color Coded Body

Designed for level control and alarm applications in difficult liquids such as sewage and waste water. Series M mechanical tilt floats are ideal for applications where the presence of mercury is a concern. Series M Switches have impact resistant ABS shell and neoprene jacketed cable.



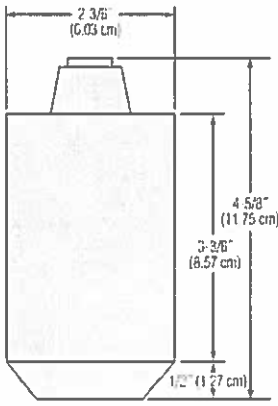
Specifications

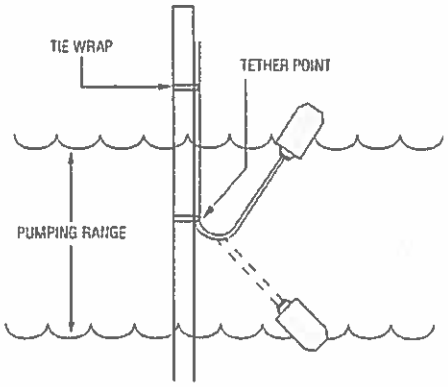
Cord	2 or 3 conductor 16 AWG wire SJOW Oil Resistant CPE
Contact Rating	13 amp @ 120/240 VAC 1/2 hp
Contact Design	SPST, Normally Open or Normally Closed Common with N.O. & N.C. (form C)
Temperature Rating	
Dry	32°F to 194°F (0°C to 90°C)
Water Resistant	32°F to 140°F (0°C to 60°C)
Overall Weight	1.0 lbs. (not including weight)
Tether Method	Tie-wrap nylon, weight: 2.5 lbs.
Approvals	U.L. Recognized, CSA Cert.

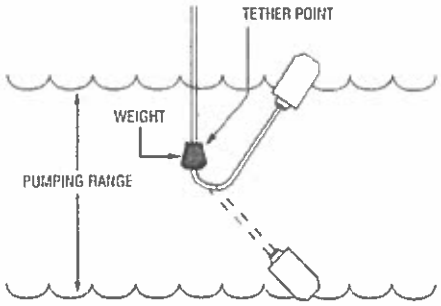
Applications

- Level Control
- Alarms
- Sewage Lift Systems
- Slurries
- Drainage Sumps
- Wastewater Treatment
- Holding Tanks

Dimensions







How to Order

Use the **Bold** characters from the chart below to construct a product code.

M XXX XX X

Series
M

Contact Configuration
BLU – SPST, Normally Open, narrow angle[1]
YEL – SPST, Normally Closed, narrow angle[1]
RED – SPST, Normally Open, wide angle[2]
WHI – SPST, Normally Closed, wide angle[2]
GRE – SPDT, Form C, wide angle[2]

Length
40 – 40 feet (12.19 m)

Tether Method
T – Tie
W – Weight

Tether Method	Part Number
Tie Wrap	7762360
Weight	7762381

Notes:
1. Narrow angle pumping range approximately 2 in. to 8 in.
2. Wide angle pumping range approximately 5 in. to 18 in.

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OIL WATER SEPARATORS – OWS SERIES

Application:

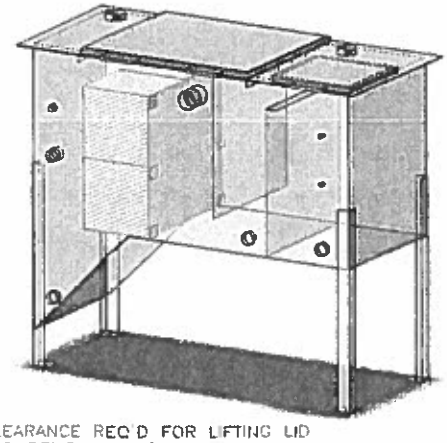
newterra Oil Water Separators are designed to remove oil from a liquid phase inlet stream. As the oil/water mixture is passed through the coalescing oil/water separator, larger oil droplets migrate to the surface to be collected and skimmed off. The media collects the smaller droplets until they are large and buoyant enough to float to the surface.

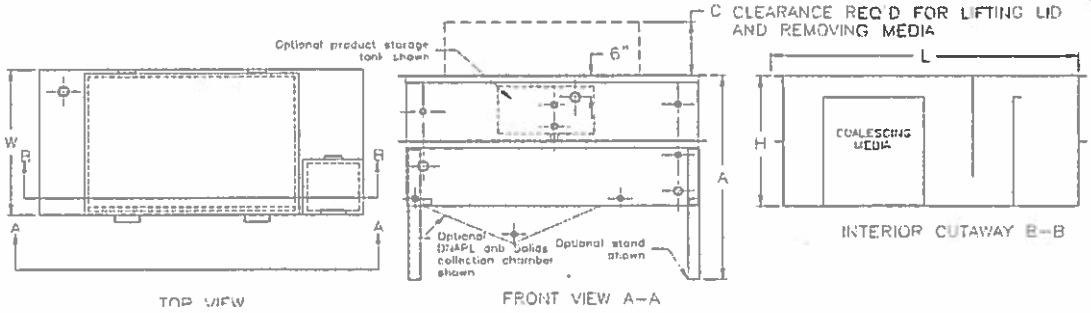
Construction:

The standard OWS Series are fabricated from carbon steel. For corrosion resistance, the interior is epoxy coated and the exterior is painted. Optional stainless steel construction is also available. A large lid allows access to the coalescing media and oil skimmer while a small lid allows access to the pump-out tank.

Standard Features:

- Standard finish: Interior is epoxy coated. Exterior is painted **newterra** blue over zinc primer (except stainless steel option)
- Sacrificial anode to prevent corrosion of tank.
- 11 AWG carbon steel construction
- Sludge containment section
- Adjustable oil skimmer
- Water underflow/overflow weir design
- Easy removal of coalescing media for cleaning
- High Alarm Level Coupling and Pump High/Low Level Coupling in the pump-out chamber





Dimension Chart:

Part Number	Width "W"	Standard Height "H"	Standard Overall Length	Length with Extended Pump-out	Height with Elevated Pump-out "A"	Overhead Clearance "C"	Standard Pump-out Volume	Extended Pump-out Volume	Elevated Pump-out Volume	Product Tank Volume
OWS-2	16"	30"	64"	76"	n/a	14"	23 Gal	41 Gal	n/a	8.1 Gal
OWS-4	28"	30"	64"	76"	n/a	26"	46 Gal	81 Gal	n/a	8.1 Gal
OWS-8	28"	30"	76"	88"	n/a	26"	46 Gal	81 Gal	n/a	8.1 Gal
OWS-12	40"	30"	76"	88"	n/a	38"	70 Gal	122 Gal	n/a	8.1 Gal
OWS-18	40"	30"	88"	n/a	60"	24"	70 Gal	n/a	130 Gal	12.2 Gal
OWS-24	52"	30"	88"	n/a	60"	24"	93 Gal	n/a	173 Gal	12.2 Gal
OWS-36	52"	42"	88"	n/a	72"	24"	133 Gal	n/a	212 Gal	17.8 Gal
OWS-45	64"	42"	88"	n/a	72"	24"	166 Gal	n/a	265 Gal	17.8 Gal
OWS-72	100"	42"	88"	n/a	72"	24"	266 Gal	n/a	425 Gal	17.8 Gal

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OIL WATER SEPARATORS – OWS SERIES

Specification Chart:

Part Number	HQ PAC		½" Packing		¾" Packing		1¼" Packing		Slant Plate	
	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)	Oil (0.9)	Gas (0.72)
OWS-2	9.7	27.0	5.0	14.1	3.5	9.8	2.3	6.3	0.9	2.5
OWS-4	19.3	54.0	10.1	28.2	7.0	19.7	4.5	12.7	1.8	4.9
OWS-8	38.6	108.1	20.2	56.5	14.0	39.3	*9.1*	*25.4*	*3.5*	*9.8*
OWS-12	57.9	162.1	30.3	84.7	21.1	59.0	13.6	38.1	5.3	14.7
OWS-18	86.9	243.2	45.4	127.1	31.6	88.4	20.4	57.1	7.9	22.1
OWS-24	115.8	324.2	60.5	169.5	42.1	117.9	27.2	76.1	10.5	29.5
OWS-36	159.2	445.8	68.1	190.7	47.4	132.6	30.6	85.7	11.8	33.2
OWS-45	199.0	557.3	85.1	238.4	59.2	165.8	38.2	107.1	14.8	41.5
OWS-72	318.5	891.7	136.2	381.4	94.7	265.3	61.2	171.3	23.7	66.3

Rated US GPM (Based on 25 micron particles at 65 deg F and design safety factor of 1.25)
Larger spaced packing will not plug as quickly as closely spaced packing allowing longer intervals between maintenance requirements. The coalescing slant plate should be used in applications with heavy sludge loads because it does not foul quickly.

Options Table:

Option	Description
Stand	The separator will be elevated above ground to assist in gravity discharge or to provide room underneath the separator for blowers and pumps. This replaces the standard foot mounts. The maximum stand height for 8' clearance is 36" for OWS-18 and OWS-24 and 24" for OWS-36 and larger.
Oversize Pump-out (Extended)	OWS-2, OWS-4, OWS-8 and OWS-12 only. The final section of the separator can be oversized to allow a greater water pump-out volume. For the OWS-2, OWS-4, OWS-8 and OWS-12 the oversized pump-out will be an extended length of the final section of the separator.
Oversize Pump-out (Elevated)	OWS-18, OWS-24, OWS-36 and OWS-45 only. The final section of the separator can be oversized to allow a greater water pump-out volume. For the OWS-18, OWS-24, OWS-36 and OWS-45 the separator will be raised on a stand and the final section will extend to the ground to give the oversized volume.
Top Inlet	A top mounted option is available to allow for pre-separation of air and liquid at the inlet to the separator.
Product Storage Tank	A tank may be mounted on the front of the separator to collect the oil from the skimmer. The volume of the product storage tank is: OWS-2, OWS-4, OWS-8 and OWS-12: 8.1 US Gal OWS-18, OWS-24 12.2 US Gal OWS-36, OWS-45 17.8 US Gal
Telerette Basket	A telerette basket may be added to allow for a high surface area polishing media for final hydrocarbon removal.
Oversize Inlet and Outlet	The inlet and outlet couplings may be increased by one size to allow for higher flow through the separator.
Stainless Steel	Each separator can be purchased with Stainless Steel construction instead of the standard Carbon Steel.
Main Tank Low Coupling	Additional couplings may be added to allow for the installation of a low level switch in the main separator tank. NOTE: This option covers only the cost of installing the coupling, the switches must be purchased separately.
Main Tank High High Coupling	Additional couplings may be added to allow for the installation of a high high level switch in the main separator tank. NOTE: This option covers only the cost of installing the coupling, the switches must be purchased separately.
Custom Size	A custom sized separator can be designed to meet specific project needs.
Media	Custom media available for contaminants other than oil/BTEX such as chlorinated solvents and other DNAPL products.
DNAPL Separation	The separator can be supplied with a DNAPL sump to capture heavy fluids and solids and allow collection below the media of the oil water separator.

Sample Ordering Format:

OWS-4 with ½" Packing
SG: 0.9
Temp: 65 deg F
Minimum Micron Size: 25
Design Safety Factor: 1.25
Options:
Oversize Pumpout (Extended)
Product Storage Tank
Stand: 24"

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ATB 3 and ATS3 Series Spec Sheet
Level Switch - Small Size - Heavy Duty

The ATB3 is designed for high or low level alarm or switch point applications in rugged situations similar to oil tank reservoirs or industry vessels that require a more robust level switch. Notice the larger brass one piece machined hex to get a wrench on - this model also has an optional brass set screw locking collar in place of the clip.

Internal reed switch selection is the same Almeg quality standard but we've beefed up the external part as well as fully encapsulated the reed switch to maintain a complete moisture free environment. The leads are wire wrapped (not clipped) soldered and heat shrink sealed to the reed switch before encapsulating.

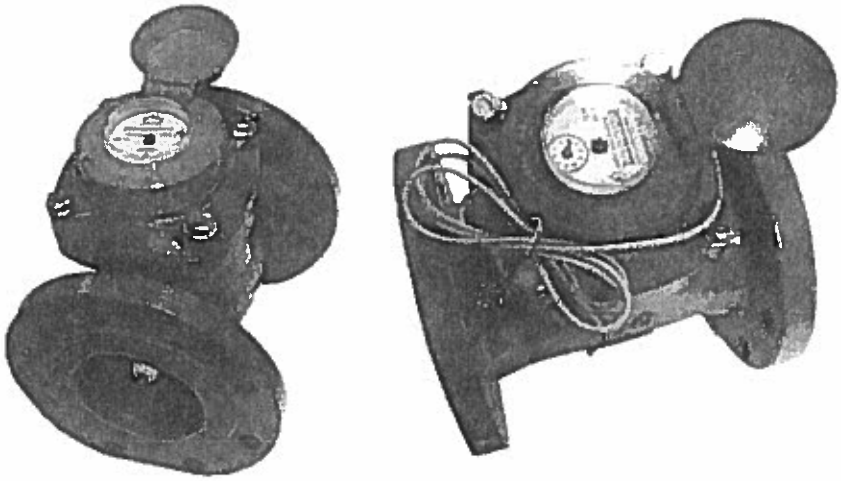
The TRUE closed cell Buna float will not swell or take on moisture - even if cut or drilled. It is designed like a tight bee hive or honey comb construction.

100% of our controls are tested before shipping.

The ATB3 is available in a single order or OEM applications.

DLJ Epoxy Coated Cast Iron Turbine Meters

200T, 250T, 300T, 400T, 600T, 800T



Description

Operation DLJ Turbine Meters are horizontal Woltman type water meters designed for installation where occasional low and moderate to high sustained flows are demanded. Water flow drives a vertical impeller in direct proportion to the quantity of water passing through the meter. Impeller revolutions are transferred to the register assembly through a reduction gear and magnetic drive.

Compliance The DLJ Turbine Meters comply with AWWA C701 and ISO 4064 Class B standards.

Installation The meter must be installed in a clean pipeline, free of any foreign materials. Install the meter with direction of flow as indicated by the arrow cast into the meter body. You can install the meter vertically or horizontally and the registers are fully revolvable for ease of reading. It is recommended to strain the incoming water to prevent foreign debris damage and to reduce the effects of water turbulence.

Application The DLJ Cold Water Turbine Meters are for use only with cold water up to 120 degrees F (50 degrees C)

Construction The meter consists of a fully epoxy coated cast iron main case with the flow direction cast into it and a removable measuring element for easy maintenance.

	Specifications					
Characteristics	**DLJ 200T 2"**	**DLJ 250T 2 1/2"**	**DLJ 300T 3"**	**DLJ 400T 4"**	**DLJ 600T 6"**	**DLJ 800T 8"**
Flow Rating (gpm)	325	395	495	1250	2500	3450
Continuous Flow (gpm)	250	300	375	1000	2000	2800
Low Flow (gpm)	4	5	6	9	32	38
Maximum Pressure (psi)	175	175	175	175	175	175
Maximum Temperature (°F)	120	120	120	120	120	120
Sweep Hand Registers (Gallons)	10/100	10/100	10/100	10/100	10/100	10/100
Register Capacity (Millions of Gallons)	1000	1000	1000	1000	1000	1000

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DLJ Meter

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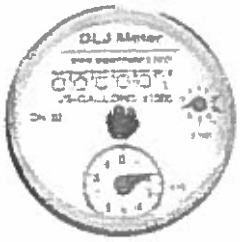
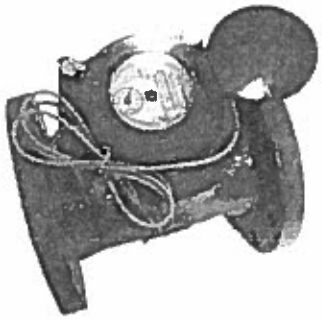
DLJ Epoxy Coated Cast Iron Turbine Meters

200T, 250T, 300T, 400T, 600T, 800T

Direct Read Register The register is contained in a hermetically sealed nylon casing with a 5mm tempered glass lens. The totalizer wheels are large and easy to read and the sweep hands are offset on seperate 10 gallon and 100 gallon register wheels. The large black spinning trickle indicator is excellent for leak detection. Each register clearly show's it's applicable meter size.



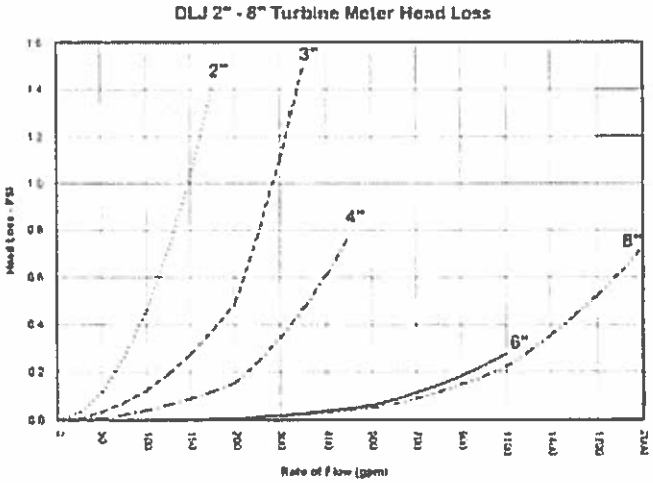
Pulse Output The DLJ line is available with a dry contact reed switch pulse output. This requires external DC power, 4 watts, 30VDC maximum. Contact closure is 1 pulse per 100 gallons on the 2 - 3" Turbines and 1 pulse per 1000 gallons on the 4 - 8" Turbines



Magnetic Drive The magnetic drive design eliminates all miscouplings associated with conventional right angle drives. Excess torque is eliminated in the encased undergear assembly, ensuring constant magnet coupling.

Maintenance The register/measuring assembly is easily removable and replaceable if needed, and doesn't require taking the meter off line.

Connections The DLJ Turbine Meters are available with standard Class 150lb ANSI flanges (4 bolt in 2, 2 1/2" and 3", 8 bolt in 4, 6 and 8"). Companion Flange sets in Cast Iron or PVC and Uni-Flanges are available for ease of connection.



Specifications						
Characteristics	DLJ 200T 2"	DLJ 250T 2 1/2"	DLJ 300T 3"	DLJ 400T 4"	DLJ 600T 6"	DLJ 800T 8"
Length (Inches)	12	7.75	8.75	9.75	11.6	13.6
Weight (Pounds)	32	29	35	40	92	141
Crated Weight (Pounds)	43	40	47	50	110	150

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Stacking Shipping Containers on Land for an Off-Axis Detector

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Fermi National Accelerator Laboratory, Batavia, IL 60510

(May 29, 2003)

Introduction

Fig. 1 shows a typical International Standards Organization (ISO) Series 1 shipping container.

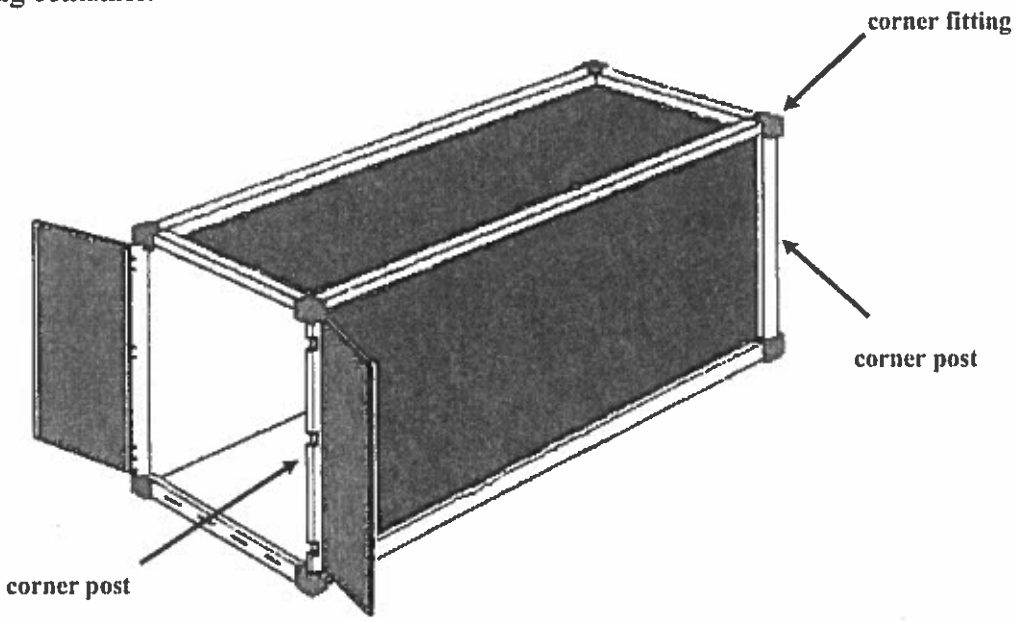


Figure 1. ISO Series 1 Shipping Container

These containers are designed to make vertical contact with each other through discrete corner fittings; when stacked, all vertical force is transferred through these fittings, in turn loading the corner posts, and not the walls, of the container. The number of containers which can be stacked on each other is determined by the strength of the corner posts.

ISO Standard 1496[1] states that the corner posts of ISO Series 1 containers should be tested to a load of 86,400 kg (190,480 lbs). This is the load applied to the posts of the bottom container in an 8-on-1 stack of 24,000 kg (gross weight) containers,

multiplied by a factor of 1.8. This extra factor is used to take into account "conditions aboard ship and the relative eccentricities between superimposed containers."[1] The "conditions aboard ship" were derived from a 1964 study of maximum acceleration values under the worst sea and wind conditions.[2]

Calculating the safe stacking height for loaded containers *on land* requires some understanding of the corner posts, their material properties, possible failure modes, and what constitutes an adequate factor of safety.

Corner Post Geometry and Compressive Load-Bearing Capacity

Corner post steels typically correspond to the specification ASTM A-572, with a yield stress of 47,000 psi, and an ultimate stress of 70,000 psi. This is a low alloy columbium or vanadium steel commonly used for high-strength steel weldments, such as bridges. The load-bearing characteristics of corners posts are complex, because in a walled container the posts receive substantial lateral stability, and compressive cross sectional area, from the participation of the walls and doors.

The corner post can fail in two ways: The first is collapse, or buckling. This occurs in a slender column when the compressive load reaches a critical load P_{cr} which is so large that the column can no longer recover from small lateral displacements along its length. The result is sudden and catastrophic loss of stiffness, and gross deformation of the column and its attached material.

A second type of failure can occur if the compressive load P_{comp} exceeds the value S_yA, where S_y is the yield stress of the material, and A is the cross sectional area of the post. Even a column which is stable against buckling failure can fail from compressive yielding. Failures of this type are rare for columns, since the yielding will tend to produce larger cross sectional area through plastic deformation, and eventually become self-limiting. This self-limit may not be reached before even a very short column becomes unstable, however, resulting in a type of collapse that is characterized by large amounts of plastic deformation.

The most likely failure mode, given the substantial lateral constraint offered by the walls, is probably a combination of collapse and gross yielding, a type of failure referred to as elastic/plastic collapse.

The calculation of collapse (buckling) loads for long, slender steel columns uses the Euler equation:

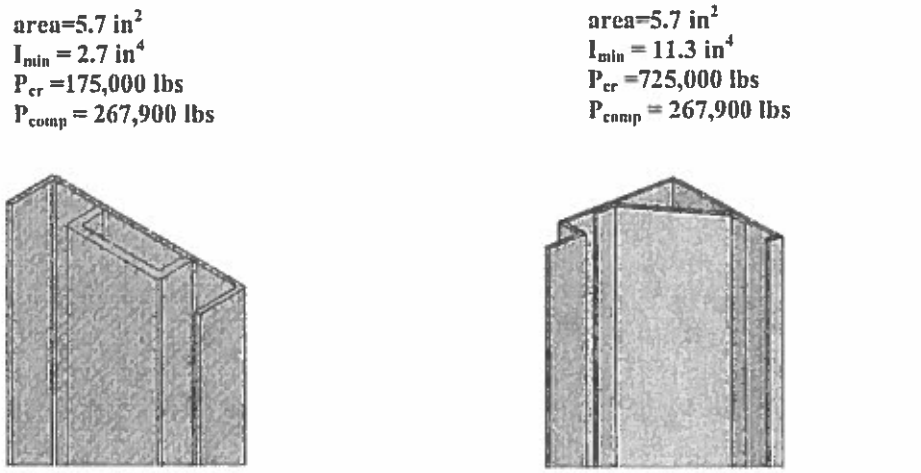
$$P_{cr} = k\pi^2 EI/L^2$$

where P_{cr} = critical (collapse) load
E = modulus of elasticity of steel = 30e6 psi
I = minimum moment of inertia of section
L = length of column
k = factor for end rotational restraint (theoretical range from 1-4)

For the corner posts, the degree of end rotational restraint is difficult to quantify. The top, bottom, and side rails will serve to provide substantial restraint, and even the corner fitting contact of the loading container above a corner post will tend to limit rotation. Therefore, a k factor of 2 is chosen for calculating the estimates of collapse load.[3] This is less than the complete rotational restraint (k = 4), but greater than free rotation (k = 1).

In addition to resisting collapse, the corner post must also work at a compressive stress that is below the yield of the material. Corner posts will yield at a stress of 47,000 psi. Therefore, the minimum cross sectional area for resisting the corner post loads is A = 190,840/47,000 = 4.05 in^2.

While the minimum performance of a corner post is standardized via ISO, the actual geometry of the post is not. Manufacturers have explored many different designs for many different types of containers, all of which will pass the ISO test load of 86,400 kg or 190,840 pounds. Figure 2 shows the most common corner post cross-sections at the door and walled ends of a Series 1 container. These posts are made of 6mm thick pressed steel shapes welded together along the length of the post. In the case of the door end post, a piece of hot rolled channel 113 x 40 x 10 mm is welded to the 6mm plate. Both posts in Figure 2 have adequate cross sectional area from the standpoint of compressive stress. However, the Door End post (a), has a collapse load which is less than the load required by the ISO standard, and therefore must rely on interaction with the walls and doors of the container to produce the necessary load-bearing capacity.



(a) Corner Post at Door End **(b) Corner Post at Walled End**

Figure 2. Corner Post Cross Sections -- Properties and Load Capacities without Wall/Door Participation

The effect of participation of the walls and doors is illustrated in Fig. 3 The profile of Fig. 2(a) has been used with a 3-inch wide strip of adjacent container sidewall (3.6 mm thick) and a 2-inch wide strip of door panel (2 mm thick), to form a column of considerably higher strength than the profile of Fig. 2(a) alone. The cross section shown, with walls, has a critical load of approximately 252,000 lbs, which is well above the 175,000 lbs of the corner post alone, and well above the 190,480 lbs required by the ISO Standard.

These calculations show that the door is an important part of the load path under stacking, providing additional cross-sectional area for compression and stability. The door also acts as a sheer wall, preventing the parallelogram deformation of the end referred to as "racking" or "sidesway." For these reasons, in commercial practice, the doors on a container within a stack are presumably never opened. This is not a constraint on the way the containers are used in commerce, since only one container at a time is loaded or unloaded at terminals, with stacking occurring only during transit.

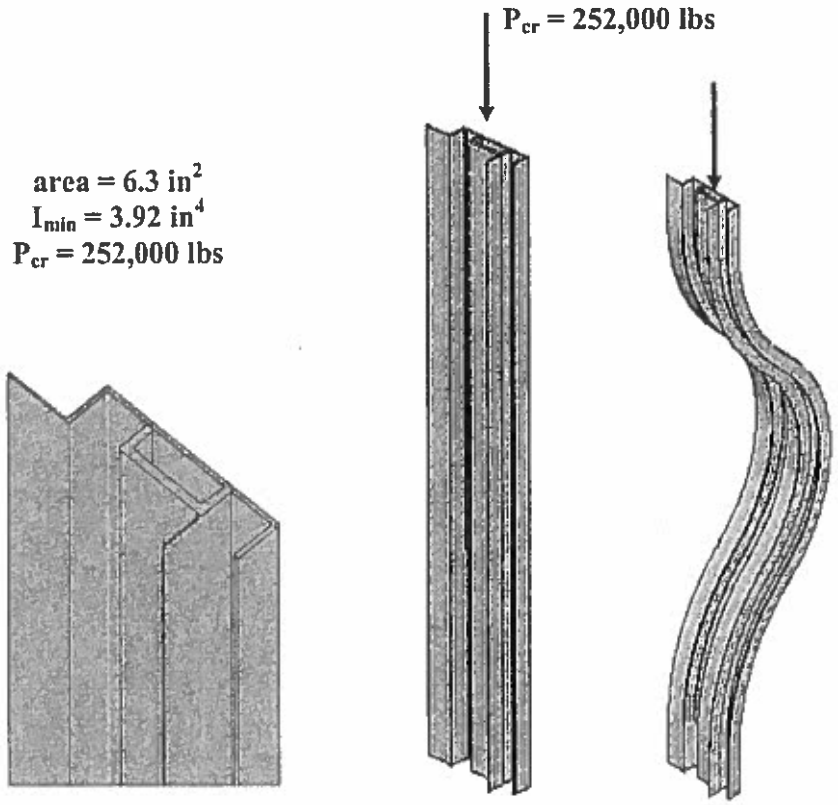


Figure 3. Corner Post from Fig. 2(a) showing increase in buckling strength due to participation of wall

Corner Fittings

The corner fittings shown in Figure 1 are an integral part of the load-bearing column in the container. ISO 1161-1984(E)[4] states "Corner fittings for Series 1 freight containers shall be capable of withstanding the loads calculated in accordance with the requirements of ISO 1496/1 for Series 1 containers." This means that the bottom corner fitting of the bottom container in a stack must withstand the weight of the containers stacked above it, plus the weight of the bottom container itself. The maximum load which a single corner fitting must take is then

$$P_{tot} = 190{,}480 + (52{,}800/4) = 203{,}680 \text{ lbs}$$

A typical corner fitting is shown in Fig. 4.. The cross sectional area of this fitting is shown in Fig. 5. The total cross sectional area available for compression is 10.15 in^2. This results in an average compressive stress under maximum load of 20,067 psi.

Corner fittings are typically cast and machined from A-216 steel, which has a minimum specified yield stress of 40,000 psi. Therefore, under maximum load, a corner fitting of the cross section shown below operates with a safety factor on yield of nearly 2.0

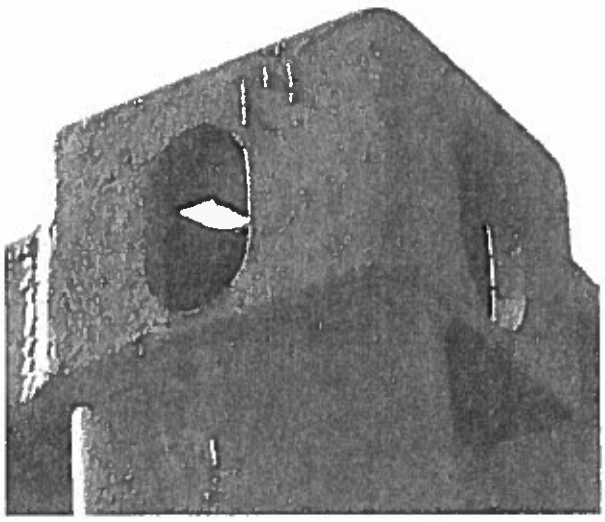


Figure 4. Corner Fitting

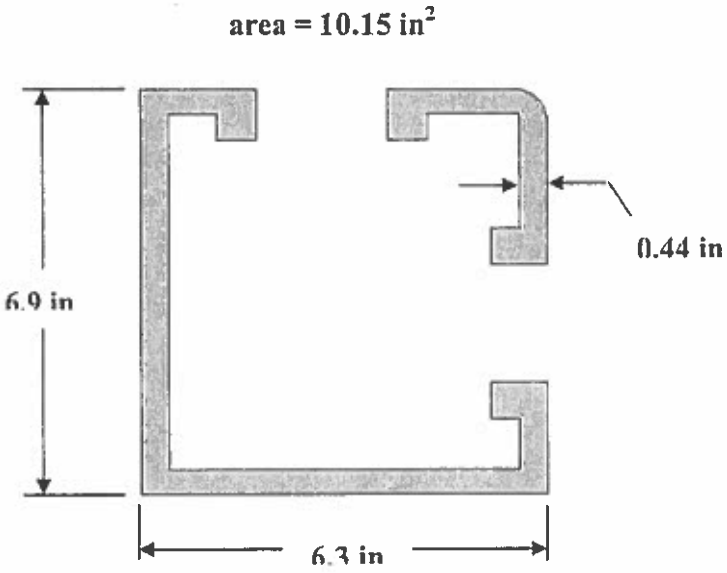


Figure 5. Fitting Cross Section

Safety Factor for Stacking Containers on Land

A safety factor for the corner posts in the bottom container of a stack can be defined as

$$SF = F_{cp\text{-}fail}/F_{cp\text{-}act}$$

where SF = safety factor
$F_{cp\text{-}act}$ = actual operating load on corner post
$F_{cp\text{-}fail}$ = failure load of corner post

The ISO Standard, however, does not define a force $F_{cp\text{-}fail}$; rather, it specifies the load that each corner post must withstand *without* failure. In this sense, the specified load is a *proof* load, F_{cp_proof}, which is simply a load which each corner post must be shown capable of resisting. For the purposes of calculating a safety factor, the specified test load can be thought of as an absolute lower limit on the failure load. Any safety factor calculated with $F_{cp\text{-}fail} = F_{cp_proof}$ will be smaller than the actual safety factor, since F_{cp_proof} is always smaller than $F_{cp\text{-}fail}$.

Using the expression above, the safety factor of an 8-on-1 stack of containers on land is at least 1.8 . Safety factors in engineering commonly range from 1.25 to 2.0 or greater, depending on the amount of confidence the designer has in material performance and load characterization. The AISC Steel Construction Code[5], for example, uses a safety factor of 2 for column loading; however, conservative design in civil structures is necessary because there is typically no load-testing of the parts; they are designed, manufactured, and set in place with only the calculation and fabrication standards serving as proof of merit. Aircraft design, however, uses safety factors closer to 1.25, due to the great penalties incurred by excess weight. The extremely rigorous materials and testing programs common in the aviation industry justify these smaller safety factors.

Because the corner posts of all containers are known to have been tested to the load stipulated by ISO 1496 with no failures occurring at a load that is less than the test load, a safety factor of about 1.5 is adequate for a stack of containers on land. Table I shows the safety factor on the corner post loading of the bottom container in a stack, for stacks of various heights. This table is based on the application of the equation for safety factor, with $F_{cp\text{-}fail} = F_{cp\text{-}proof} = 190{,}480$ lbs, and containers of 52,910 lbs gross weight:

Table I. Safety Factors on Land for Various Stack Heights on Land with Container Corner Post Capacity of 190,480 lbs (86,400 kg)

Number of Containers Stacked on One	Total Height of Stack	Safety Factor on Corner Post Loading
8	9	1.80
9	10	1.60
10	11	1.44
11	12	1.31

The table shows that we can stack 9-on-1 on land, and maintain a safety factor of greater than 1.5.

Possible Modifications

For a final detector design, good engineering practice would require that the corner posts of several containers be loaded to failure to more precisely determine F_{cp_fail}, from which more accurate stacking safety factors could be calculated. Some advantage might be taken of the fact that while $F_{cp\text{-}fail}$ is not known, it is certainly higher than 190,480 lbs (86,400 kg). If the measured failure load is just 4% higher than the test (proof) load, the safety factor on a 10-on-1 stack becomes 1.5, and stacking to that height becomes defensible.

Some vendors advertise containers with a higher capacity[(6)] than the ISO Series 1 standard, and advantage could be taken of the greater payload, as well as the higher post strength, in configuring the detector array. The typical higher post rating quoted is 214,290 lbs (97,400 kg), allowing exactly 9 on 1 stacking of 52,910 lb (24,000 kg) containers at sea and therefore allowing 10 on 1 on land with a safety factor of (9/8)*(1.44) = 1.62.

Similarly, if the Off-Axis detector density is small enough that our standard gross weight container is less than 52,910 lbs (24,000 kg), then even higher stacks could be supported. Table II shows the stack heights possible when the higher strength containers are used. A container volume of 33.2 m^3 is assumed with a tare weight of 2,250 kg and four different detector gross weights of 22,150 kg, 24,000 kg, 26,000 kg and 30,480 kg. The 30,480 kg number is the vendor quoted maximum gross weight for the higher strength containers. Comparing Tables I and II shows that the higher strength posts lead to the same height stacks as the lower strength posts for containers of density 0.75 gm/cc vs. 0.66 gm/cc.

Table II. Stack Heights on Land forVarious Detector Densities with Container Corner Post Capacity of 214,290 lbs (97,400 kg)

Number of Containers Stacked on One	Total Height of Stack (m)	Safety Factor on Corner Post Loading			
		with payload density = **0.60 g/cc** (22,150 kg gross)	with payload density = **0.66 g/cc** (24,000 kg gross)	with payload density = **0.75 g/cc** (27,150 kg gross)	with payload density = **0.85 g/cc** (30,480 kg gross)
8 on 1	23.3	2.20	2.03	1.80	1.60
9 on 1	25.9	1.95	1.80	1.59	1.42
10 on 1	28.5	1.76	1.62	1.43	1.28
11 on 1	31.1	1.60	1.48	1.30	1.16

Conclusion

Stacking ISO containers 10 high on land is reasonable, and stacks as high as 12 may be possible depending on the type of container purchased and on the loading of the container with Off-Axis detector elements. For a final detector design, good engineering practice would require that the corner posts of the selected containers be loaded to failure to more accurately determine the safety factor of the stacked array.

References

1. ISO 1496-1:1990 *Series 1 freight containers – Specification and testing – Part 1: General cargo containers for general purposes*

2. ISO/TR 15070:1996(E) *Series 1 freight containers – Rationale for structural test criteria*

3. "Commentary on the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", Section 1.8, American Institute of Steel Construction, 1978

4. ISO 1161-1984(E) *Series 1 freight containers – Corner fittings – Specification*

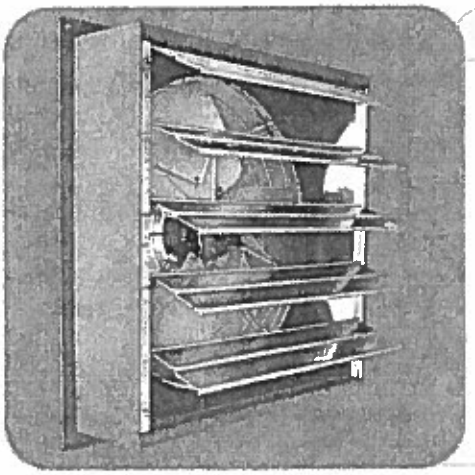
5. "Commentary on the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", Section 1.5.1.3, American Institute of Steel Construction, 1978

6. We have several specification documents from container vendors that stipulate a higher load capacity, but no details on just how this is accomplished by any container manufacturer via changes in the post configuration. We suspect that these vendors may just be taking advantage of a specification requiring a higher measured failure load as discussed in the preceding paragraph. After all, our post calculations for Figures 2(b) and Figure 3 indicate that these "standard" posts should easily pass a failure load test at 214,290 lbs vs. the original ISO test at 190,480 lbs.

STANDARD FANS

Efficient • Low Maintenance • Easy Installation

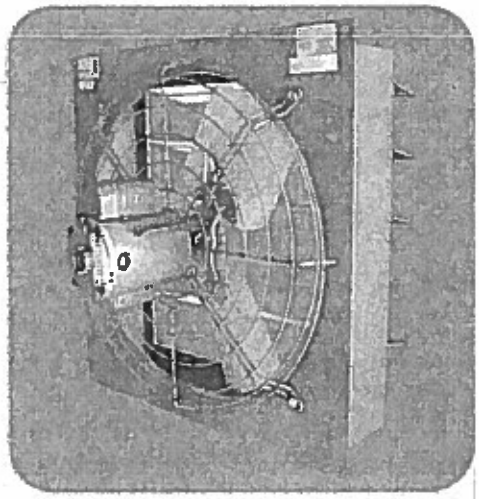
Canarm's Standard Fans follow a tradition of quality in design, materials and construction.



Features

- Available in 8" to 36" sizes.
- Single, two and variable speed models are available.
- All fans use a totally enclosed, ball bearing motor with thermal overload protection.
- The motor mount is manufactured with heavy welded rods and has a powder coated finish.
- The fan blades are well-balanced, heavy gauge aluminum.
- The rugged steel welded box housing has a durable powder coated finish.
- Aluminum louver shutters are supported by long life nylon bushings (30" and 36" have PVC louvers).
- All fans are shipped completely assembled.

General Information



Canarm's Standard Fans follow a tradition of quality in design, materials and construction. All our Standard Fans are developed to be efficient and economically priced. All variable speed Standard Fans use an energy efficient variable speed, dual voltage motor and blade combination.

To determine the proper Canarm Fan for your applications, use the following formula.

Number of cubic feet in room / Number of minutes per air change = Required C.F.M. Capacity

*****Example*****

A general office, (see chart) which requires an air change every ten minutes, would require the following fan capacity. If office is 100' x 40' x 10' = 40,000 cubic feet

40,000 cubic feet / 10 minutes per air change = 4000 Required C.F.M.

From the "Performance Data" section on the back of this page, you would select a fan that is rated at 4000 C.F.M. at 1/8" S.P. (Static Pressure)

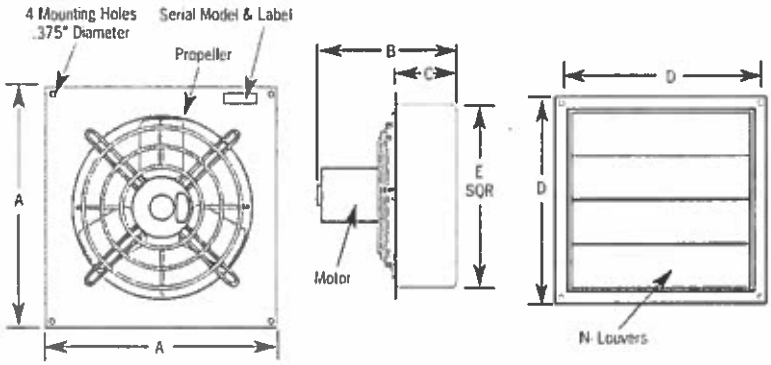
Fan Selection Chart

Application	Minutes per Air Change	Application	Minutes per Air Change	Application	Minutes per Air Change
Assembly Hall	7	Department Store	6	Plating Room	3
Auditorium	10	Dry Cleaning	5	Pressing Room	1
Bakery	3	Engine Room	6	Projection Booth	2
Barber Shop	6	Forge Room	3	Restaurant	6
Basement	8	Foundry	4	School	7
Battery Room	4	Garage	5	Summer Cooling	1
Boiler Room	1	General Office	10	Store	8
Bowling Alley	5	Gymnasium	8	Tavern	3
Church	15	Hospital	8	Toilet	3
Cocktail Bar	3	Kitchen	2	Transformer Room	1
Corridor	10	Laundry	2	Warehouse	12
Dairy	4	Locker Room	3	Welding Shop	2
		Machine Shop	8		

STANDARD FANS

Fan Dimensions

Fan Auto	A	B	C	D (c/c)	E	N
8"	13 1/4"	10"	4"	12"	10 3/4"	2
10"	15 1/4"	10"	4"	14"	12 3/4"	2
12"	17 1/4"	14"	6"	16"	14 3/4"	3
14"	19 1/4"	14"	6"	18"	16 3/4"	3
16"	21 1/4"	14"	6"	20"	18 3/4"	4
18"	23 1/4"	15"	6"	22"	20 3/4"	4
20"	25 1/4"	16"	6"	24"	22 3/4"	5
24"	29 1/4"	16"	6"	28"	26 3/4"	5
30"	35 1/4"	19"	6"	34"	32 3/4"	16
36"	41 1/4"	16"	6"	40"	38 3/4"	20



Performance Data & Specifications

Model Number	Fan Size	Motor HP	Operation Speed	Fan RPM	Current Load Amps @ 115V	Current Load Amps @230V	Input Watts	Airflow Capacity - CFM 0" S.P.	.10" S.P.	.125" S.P.	.25" S.P.	CFM Watts	Sound Level Decibel (A)	Framing Dimensions	Shipping Weight Lbs.
S8-B2	8"	1/20	Two	High 1550 Low 1300	0.95 0.45	- -	109	360 300	270 150	230 110	0 0	2.5	48 43	11" x 11"	12
S10-B2	10"	1/20	Two	High 1550 Low 1300	1.2 0.7	- -	125	690 580	590 460	570 390	0 0	4.72	56 50	13" x 13"	13
S12-E1	12"	1/4	Single	1750	3.5	-	245	1,640	1,540	1,510	1,390	6.00	63	15" x 15"	28
S12-E2			Two	High 1760 Low 1180	3.4 2.3	- -	230 132	1,650 1,090	1,550 950	1,520 930	1,390 -	6.74 7.31	64 50		32
SD12-EV			Variable	Max 1625 Min 600	2.2	1.1	205	1,650 560	1,540 440	1,510 420	1,390 -	7.50	60 -		32
S14-E1	14"	1/4	Single	1740	3.6	-	257	2,170	2,070	2,030	1,860	8.05	67	17" x 17"	30
S14-E2			Two	High 1740 Low 1170	3.8 2.2	- -	253 137	2,180 1,350	2,080 1,190	2,060 1,160	1,890 -	8.22 8.69	65 53		34
S16-E1	16"	1/4	Single	1740	3.7	-	274	2,370	2,270	2,210	2,060	8.28	68	19" x 19"	33
S16-E2			Two	High 1740 Low 1170	3.7 2.3	- -	270 152	2,380 1,640	2,280 1,490	2,230 1,430	2,070 -	8.44 9.80	69 55		36
SD16-EV			Variable	Max 1625 Min 450	2.6	1.3	248	2,370 610	2,270 580	2,210 570	2,063 -	9.15	63 -		36
S18-F1	18"	1/3	Single	1700	4.8	-	448	3,200	3,090	3,040	2,920	6.89	73	21" x 21"	37
S18-F2			Two	High 1700 Low 1140	5.7 3.1	- -	446 250	3,200 2,100	3,090 1,890	3,040 1,820	2,920 -	6.93 7.56	74 64		43
SD18-FV			Variable	Max 1625 Min 390	3..7	1.9	378	3,150 700	3,050 650	2,980 630	2,860 -	8.07	74 -		45
S20-F1	20"	1/3	Single	1735	4.8	-	322	3,420	3,220	3,170	2,920	10.00	77	23" x 23"	41
S20-F2			Two	High 1745 Low 1165	4.3 2.6	- -	315 190	3,440 2,300	3,240 2,000	3,180 1,950	2,930 -	10.20 10.52	77 67		45
SD24-F1	24"	1/3	Single	1075	4.3	-	370	5,000	4,500	4,300	3,600	12.80	70	27" x 27"	46
SD24-GV		1/2	Variable	Max 1100 Min 310	4.2	2.1	290	5,050 800	4,940 710	4,810 650	4,400 -	13.2	72 -		56
SD30-G1D	30"	1/2	Single	1075	4.6	2.3	600	8,000	7,000	6,000	5,000	11.5	82	33" x 33"	72
SD36-G1D	36"	1/2	Single	850	6.0	3.0	660	12,000	11,000	10,500	9,500	13.0	72	39" x 39"	88

NOTE: RPM Min (Minimum) is determined when louvers are opened one inch

Note: Wind has a significant effect on exhaust fans. A 10 mph wind creates a 0.05" pressure against the fan. A 20 mph wind creates 0.20" pressure and 30 mph a 0.45" pressure. These pressures are in addition to the static pressure in the building. Wind blocks or hoods should be included in all designs where fans will be subjected to winds above 10 mph.

Warranty

- 1 year on all components

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Code No. LIT-1927010
Issued February 1, 2009

A19 Series

Remote Bulb Control

Description

The A19 Series are single-stage temperature controls that incorporate environmentally friendly liquid-filled sensing elements.

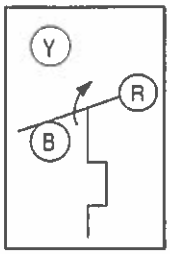
Features

- wide temperature ranges available
- constant differential throughout the entire range
- compact enclosure
- fixed or adjustable differential available
- variety of sensing element styles
- unaffected by cross-ambient conditions

Applications

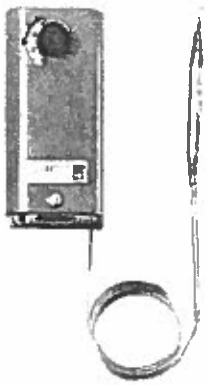
The A19 is suitable for temperature control in heating, ventilating, air conditioning, and refrigeration.

A19 Series



Action on Increase of Temperature

A19 Series
Terminal Arrangement for SPDT



A19ABC-24

Selection Charts

A19 Series Remote Bulb Control[1]

Code Number	Switch Action	Range °F (°C)	Diff F° (C°)	Bulb and Capillary	Bulb Well No. (order separately)	Range Adjuster	Max. Bulb Temp. °F (°C)
Adjustable Differential (Wide Range)							
A19ABA-40C [2]	SPST Open Low	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver Slot	140 (60)
A19ABC-4C	SPDT	50 to 130 (10 to 55)	3 1/2 to 14 (1.9 to 8)	3/8 in. x 5 in., 8 ft. Cap.	WEL14A-603R	Knob	170 (77)
A19ABC-24C [3]	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 8 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-36C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 20 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-37C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ABC-74C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential							
A19AAF-12C	SPDT	25 to 225 (-4 to 107)	3 1/2 (1.9)	3/8 in. x 3 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	275 (135)
Fixed Differential (Case Compensated)							
A19AAC-4C	SPDT	0 to 80 (-18 to 27)	5 (2.8)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAD-12C	SPST Open Low	-30 to 50 (-34 to 10)	2 1/2 (1.4)	3/8 in. x 4 in., 7 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential (Close)							
A19AAD-5C [4]	SPST Open Low	30 to 50 (-1 to 10) (Bulk Milk Cooler)	2 1/2 (1.4)	3/8 in. x 2 5/8 in., 6 ft. Cap.	WEL16A-601R	Screwdriver slot	190 (88)
A19AAF-20C	SPDT	-30 to 100 (-34 to 38)	2 1/2 (1.4)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAF-21C	SPDT	40 to 90 (4 to 32)	1 1/2 (0.8)	3/8 in. x 5 3/4 in., 6 ft. Cap.	WEL14A-603R	Screwdriver slot	140 (60)
Manual Reset							
A19ACA-14C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ACA-15C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ADB-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 3 1/2 in. 6 ft. Cap.	WEL14A-602R	Knob	290 (143)
A19ADN-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 4 in. 6 ft. Cap.	WEL14A-602R	Screwdriver slot	290 (143)

1. Specify the control model code number, packing nut code number (if required), and bulb well code number (if required).
2. Replaces White-Rodgers 1609-101
3. Replaces White-Rodgers 1609-12, -13, Ranco 010-1408, -1409, - 1410, -1490, 060-110, Honeywell L6018C-1006, L6021A-1005, T675A-1011, -1508, -1516, -1821, T4301A-1008, T6031A-1011, T6031A-1029
4. Case-Compensated

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2009 Johnson Controls, Inc.

Remote Bulb Control (Continued)

Selection Charts (Continued)

Replacement Parts

Code Number	Description
CVR28A-617R	Concealed adjustment cover
CVR28A-618R	Visible scale cover
KNB20A-602R	Replacement Knob Kit

Accessories

A packing nut is available for closed tank application.
Specify the part number **FTG13A-600R.**

Bulb wells (WEL14A Series) are available for liquid immersion applications.
Refer to the selection chart or to *Bulb Wells Catalog Page, LIT-1922135.*

Technical Specifications

Electrical Ratings

Motor Ratings VAC	120	208	240
Wide Range – Adjustable Differential			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
Fixed Differential and Close Differential			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Case Compensated – Fixed Differential A19AAC-4			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
A19AAD-12			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Manual Reset			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A	16.0	9.2	8.0
Pilot Duty – 125 VA, 24 to 600 VAC			

1. SPST and N.O. contact of SPDT control.
SPDT N.C. contact- 16 amps 120 to 277 VAC

The performance specifications are nominal and conform to acceptable industry standards. For applications at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products. © 2009 Johnson Controls, Inc.

Features

The 460's universal range from 190-480VAC, 50/60 Hz provides the versatility needed to handle global applications.

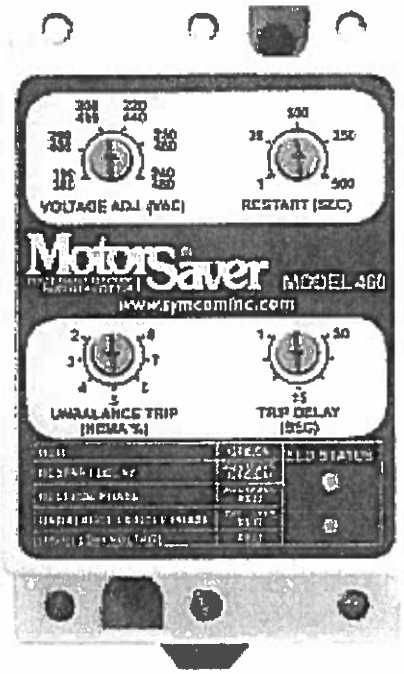
Four adjustment pots provide versatility for a variety of applications.

Diagnostic LEDs indicate trip status and provide simple troubleshooting.

Microcontroller-based circuitry provides better accuracy and higher reliability than analog designs.

Single-phase conditions are detected regardless of regenerated voltages.

Transient protection meets IEEE and IEC standards and permits operation under tough conditions.



MotorSaver
THREE-PHASE ELECTRONIC MOTOR PROTECTOR

Model 460

Three-Phase Voltage Monitor

•

Engineered Protection

•

Microcontroller Based

Protects 3-Phase Motors from:

- Loss of any phase
- Low voltage
- High voltage
- Voltage unbalance
- Phase reversal
- Rapid cycling

Additional Features:

- Compact design
- UL and cUL listed
- CE compliant
- Finger-safe terminals
- 5-year warranty
- Made in USA
- Standard surface or DIN rail mountable
- Standard 1-500 sec. variable restart delay
- Standard 2-8% variable voltage unbalance
- Standard 1-30 sec. variable trip delay
- One 10 amp general purpose Form C relay
- Optional manual reset

The **Model 460** is designed to protect 3-phase motors from damaging power conditions. The 460's wide operating range combined with UL and CE compliance enables quick access to domestic and global markets.

A unique microcontroller-based voltage and phase-sensing circuit constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for a specified amount of time (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

The Model 460 automatically senses whether it is connected to a 190-240V, 60Hz system, a 440-480V, 60Hz system, or a 380-416V, 50Hz system. An adjustment is provided to set the nominal line voltage from 190-240 or 380-480VAC. Other adjustments include a 1-30 second trip delay, 1-500 second restart delay, and 2-8% voltage unbalance trip point.

SymCom Inc
Motor Protection & Controls Since 1974

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www.symcominc.com • email: sales@symcominc.com

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MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

Specifications
•
Operating Points
•
Special Options

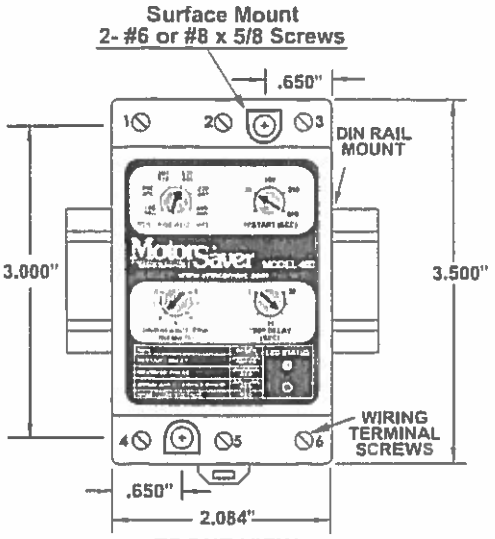
Model 460
Three-Phase Voltage Monitor

Specifications

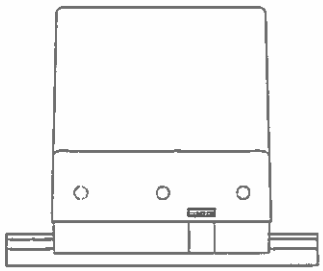
3-Phase Line Voltage	190-480VAC (475-600VAC optional) (95-120VAC optional)
Frequency	50*/60Hz
Low Voltage (% of setpoint)	
•Trip	90% ±1%
•Reset	93% ±1%
High Voltage (% of setpoint)	
•Trip	110% ±1%
•Reset	107% ±1%
Voltage Unbalance (NEMA)	
•Trip	2-8% adjustable
•Reset	Trip setting minus 1% (5 - 8%) Trip setting minus .5% (2 - 4%)
Trip Delay Time	
•Low, High and Unbalanced Voltage	1-30 seconds adjustable
•Single-Phasing Faults	1 second fixed
Restart Delay Time	
•After a Fault	1-500 seconds adjustable
•After a Complete Power Loss	1-500 seconds adjustable
Output Contact Rating	
•1-Form C	10A General Purpose @ 240VAC Pilot Duty 480VA @ 240VAC, B300
Power Consumption	6 Watts (max.)
Weight	14 oz
Enclosure	Polycarbonate
Terminal Torque	6 in.-lbs.
Wire Type	Stranded or solid 12-20 AWG, one per terminal
Safety Marks	
•UL	UL508
•CE	IEC 60947-6-2
Standards Passed	
•Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6kV contact, 8kV air
•Radio Frequency Immunity, Radiated	150 MHz, 10V/m
•Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5kV input power & controls
Surge	
•IEC	IEC 1000-4-5, Level 3, 4kV line-to-line, Level 4, 4kV line-to-ground
•ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
•Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° to 70° C (-4° to 158°F) Ambient Storage: -40° to 80° C (-40° to 176°F)
Class of Protection	IP20, NEMA 1 (FINGER SAFE)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Special Options	
Manual Reset	External momentary pushbutton required

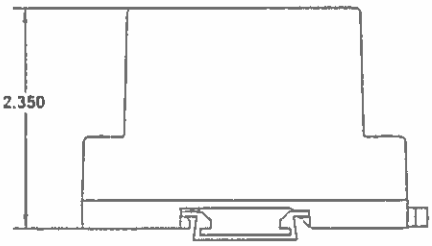
*Note: 50 Hz will increase all delay timers by 20%

SymCom warrants its microcontroller based products against defects in material or workmanship for a period of five (5) years from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material and workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, returns, and cancellations, please refer to the SymCom Terms and Conditions of Sale document.

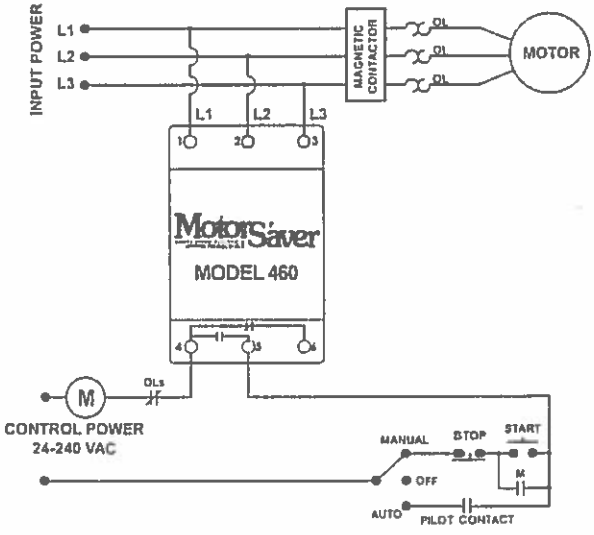


FRONT VIEW


BOTTOM VIEW



SIDE VIEW



TYPICAL WIRING DIAGRAM

SymCom Inc
Motor Protection & Controls Since 1974
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www.symcominc.com • email: sales@symcominc.com

10/05

Manual Document List

PMProjNum **RTS151**

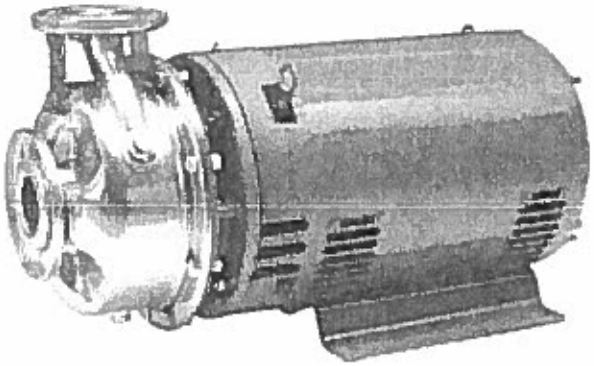
WTS, 150gpm, OWS-24, Carbon, 40' Container

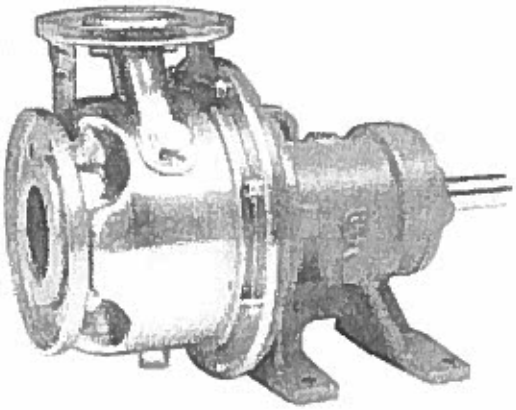
Tag	Part Number	Part Description		
Module:		*4900*		
P-4901	21028	Pump, Suction, Goulds, SSH Series, 4SH2K	Manucturer:	Goulds
			ManDoc:	#N:\Library\Goulds\Manuals\Goulds_Pu
Module:		*8200*		
8200	18396	Motor Saver, 460 w/Diagnostic 3ph	Manucturer:	Symcom
			ManDoc:	N:\Library\Symcom\Manuals\Motor Sav

G&L Pumps

Installation, Operation and Maintenance Instructions

Models SSH-C and SSH-F





Owner's Information

Please fill in data from your pump nameplate.
Warranty information is on page 28.

Pump Model: _____

Serial Number: _____

Dealer: _____

Dealer's Phone Number: _____

Date of Purchase: _____

Installation Date: _____

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Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠WARNING

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

NOTICE: INSPECT UNIT FOR DAMAGE AND REPORT ALL DAMAGE TO THE CARRIER OR DEALER IMMEDIATELY.

1. Important Instructions

1. Inspect unit for damage. Report damage to carrier immediately.
2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per National and Local electrical codes. Install an all-leg disconnect switch near pump.

⚠WARNING

ALWAYS DISCONNECT ELECTRICAL POWER WHEN HANDLING PUMP OR CONTROLS.

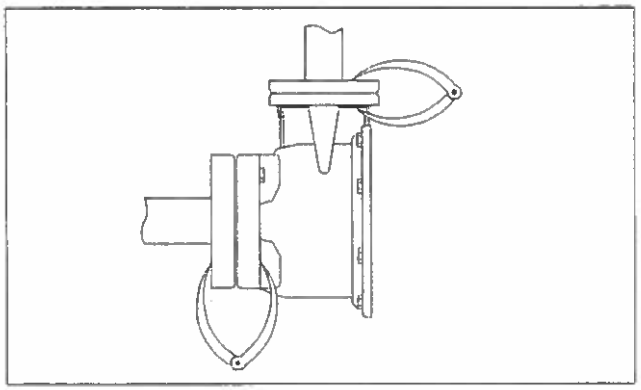
3. Motors must be wired for proper voltage (check nameplate). Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.
4. Single-Phase: Thermal protection for single-phase units is sometimes built-in (Check nameplate). If no built-in protection is provided, use a contactor with proper overload. Fusing is permissible if properly fused.
5. Three-Phase: Provide three-leg protection with proper size magnetic starter and thermal overloads.
6. Maximum Liquid Temperatures:
   212°F (100°C) with standard seal.
   250°F (120°C) with optional high-temperature seal.
7. Maximum allowable operating pressure: 230 PSI (15 bars).
8. Maximum number of starts per hour: 20, evenly distributed.
9. Regular Inspection and Maintenance will increase service life. Base schedule on operating time.

2. Installation

1. Close-coupled units may be installed inclined or vertical.

⚠ CAUTION DO NOT INSTALL WITH MOTOR BELOW PUMP. CONDENSATION WILL BUILD UP IN MOTOR.

2. Locate pump as near liquid source as possible (below level of liquid for automatic operation).
3. Protect from freezing or floods.
4. Allow adequate space for servicing and ventilation.
5. For close-coupled pumps, the foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration. Tighten motor hold-down bolts before connecting piping to pump.
6. For frame-mounted pumps, permanent and solid foundation is required for smooth operation. Bedplate must be grouted to a foundation with solid footing.
7. Place unit in position on wedges located at four points (Two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit, bringing coupling halves into reasonable alignment. Level or plumb suction and discharge flanges.
8. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming if necessary.
9. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before further tightening foundation bolts.
10. All piping must be supported independently of the pump, and must "line-up" naturally. Never draw piping into place by forcing the pump suction and discharge connections!
11. Angular alignment of the flanges can best be accomplished using calipers at bolt locations (See illustration).



12. On frame-mounted units, tighten foundation, pump and driver hold-down bolts before connecting piping to pump.
13. Avoid unnecessary fittings. Select sizes to keep friction losses low.
14. After completing piping, rotate unit by hand to check for binding. **Note:** A screwdriver slot or flats are provided in end of motor shaft.

3. Alignment

1. No field alignment is necessary on close-coupled pumps.
2. Even though the pump-motor unit may have a factory alignment, in transit this alignment could be disturbed and must be checked prior to running.
3. Check the tightness of all hold-down bolts before checking the alignment.
4. If re-alignment is necessary, always move the motor. Shim as required.
5. Final alignment is achieved when parallel and angular requirements are achieved with both pump and motor hold down bolts tight.

⚠CAUTION ALWAYS RECHECK BOTH ALIGNMENTS AFTER MAKING ADJUSTMENTS.

6. Parallel misalignment exists when the shafts are not concentric. Place dial indicator on one hub and rotate this hub 360° while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005" or less.
7. Angular misalignment exists when the shafts are not parallel. Place dial indicator on one hub and rotate this hub 360° while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005" or less.

4. Suction Piping

1. Low static lift and short, direct suction piping is desired. For suction lift over 15 feet, consult pump performance curve for *Net Positive Suction Head Required.*
2. Suction pipe size must be at least equal to suction connection of pump.
3. If larger pipe is used, an eccentric pipe reducer (with straight side up) must be used at the pump.
4. Installation with pump below source of supply:
   4.1. Install isolation valve in piping for inspection and maintenance.
   4.2. Do not use suction isolation valve to throttle pump!
5. Installation with pump above source of supply:
   5.1. To avoid air pockets, no part of piping should be higher than pump suction connection. Slope piping upwards from liquid source.
   5.2. All joints must be airtight.
   5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.
   5.4. Suction strainer open area must be at least triple the pipe area.
6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump.

5. Discharge Piping

1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or inspection of pump or check valve.
2. If reducer is required, place between check valve and pump.

6. Rotation

⚠WARNING

DO NOT PLACE HANDS IN PUMP WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

1. Pumps are right-hand rotation (Clockwise when viewed from the driver end). Switch power on and off. Observe shaft rotation. On frame-mounted units, check rotation before coupling pump to motor.
2. Single-Phase: Refer to wiring diagram on motor if rotation must be changed.
3. Three-Phase: Interchange any two power supply leads to change rotation.

7. Operation

1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

⚠CAUTION PUMPED LIQUID PROVIDES LUBRICATION. IF PUMP IS RUN DRY, ROTATING PARTS WILL SEIZE AND MECHANICAL SEAL WILL BE DAMAGED.

2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. Check coupling alignment.
3. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.

8. Maintenance

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

1. Bearings are located in and are part of the motor. For lubrication procedure, refer to manufacturer's instructions.
2. On frame-mounted units, regrease at 2,000 hours use or after 3 months. Use #2 Sodium or Lithium grease and fill until grease comes out of the relief fitting.

9. Disassembly

1. Always turn power off.
2. Drain system. Flush if necessary.
3. Remove motor hold-down bolts on close-coupled or disconnect coupling and remove spacer.
4. Remove casing bolts and pump hold-down bolts.
5. Remove motor and rotating element from casing.
6. Unscrew impeller bolt with a socket wrench. Do not insert screwdriver between impeller vanes to prevent rotation. It may be necessary to use a strap wrench around the impeller if impacting the socket wrench will not loosen the impeller bolt.
7. Remove impeller o-ring.
8. Insert two pry bars (180° apart) between impeller and seal housing. Pry off impeller.
9. Remove shaft sleeve, seal spring, cupwasher, seal rotary and impeller key.
10. Remove seal housing.
11. Place seal housing on flat surface. Press out stationary seal parts.
12. Remove deflector from shaft on frame-mounted units.
13. Remove bolts holding bearing cover to frame and remove bearing cover (frame-mount).
14. Remove lip seals from bearing frame and bearing cover (frame-mount).
15. Remove shaft and bearings from frame (frame-mount).
16. Remove bearing retaining ring (frame-mount).
17. Use bearing puller or arbor press to remove ball bearings (frame-mount).
18. Remove wear ring if excessively worn. Use pry bar and/or vicegrips.

10. Reassembly

1. All parts should be cleaned before assembly.
2. Refer to parts list to identify required replacement items.
3. Reassembly is the reverse of the disassembly procedure.
4. Replace lip seals if worn or damaged (frame-mount only).
5. Replace ball bearings if loose, rough or noisy when rotated (frame-mount only).
6. Check shaft for maximum runout of .005" TIR. Bearing seats and lip seal areas must be smooth and free of scratches or grooves. Replace if necessary (frame-mount only).
7. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.
8. If wear ring is being replaced, do not use lubricants on the metal-to-metal fit when pressing in the replacement.
9. If the impeller is removed, as for example to effect a mechanical seal change, this procedure must be followed: Old impeller bolt and impeller o-ring cannot be reused.
10. Install the mechanical seal stationary seat in the seal housing, using soapy water as a lubricant to ease insertion.
11. S-Group – Install the mechanical seal spring retainer, spring and rotary assembly on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft, be sure that a new shaft sleeve o-ring is used.

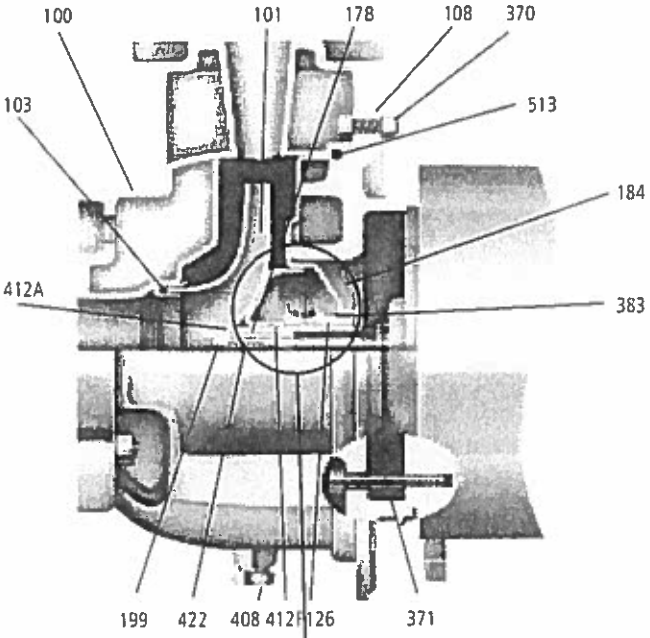
NOTE: THE SHAFT SLEEVE O-RING AND IMPELLER WASHER O-RING ARE ALMOST IDENTICAL IN DIAMETER. BE SURE TO USE THE SQUARE CROSS-SECTION O-RING IN THE IMPELLER WASHER. THE ROUND CROSS-SECTION O-RING IS USED IN THE SHAFT SLEEVE.

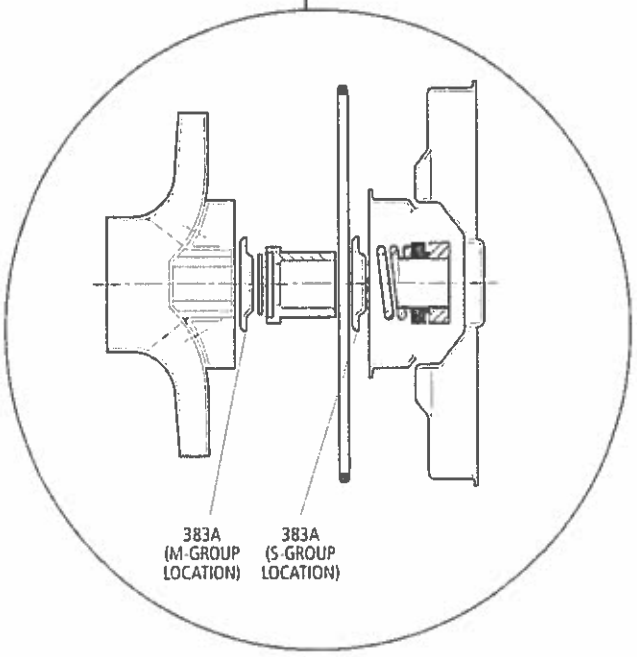
11. M-Group – Install the mechanical seal spring and rotary on the shaft sleeve using soapy water to lubricate. Slide the shaft sleeve over the pump shaft. Be sure that a new shaft sleeve o-ring is used. Place the mechanical seal spring retainer over the impeller hub.
12. Place the impeller key into the shaft keyway and slide the impeller in place. Install the impeller stud and impeller washer. Be sure that a new impeller o-ring is used. Tighten S-Group (⅜" thread) to 17 lb.ft. and M-Group (½" thread) to 38 lb.ft.

11. Troubleshooting

1. Motor does not start, and no noise or vibration occurs:
   1.1. Power supply not connected.
   1.2. Fuses or protection device tripped or defective.
   1.3. Loose or broken electrical connections.
2. Motor will not start, but generates noise and vibration:
   2.1. Motor not wired as directed on diagram.
   2.2. Shaft locked due to mechanical obstructions in motor or pump.
   2.3. Low voltage or phase loss on three phase supply.
3. Pump does not deliver rated capacity:
   3.1. Pump not filled and primed.
   3.2. Pump has lost prime due to leaks in suction line.
   3.3. Direction of rotation incorrect. See Rotation.
   3.4. Head required is higher than that originally specified. (Valve may be partially closed.)
   3.5. Foot valve clogged.
   3.6. Suction lift too high.
   3.7. Suction pipe diameter too small.
4. Protection trips as unit starts:
   4.1. Phase loss on three-phase supply.
   4.2. Protection device may be defective.
   4.3. Loose or broken electrical connections.
   4.4. Check motor resistance and insulation to ground.
5. Protection device trips too often:
   5.1. Protection may be set to a value lower than motor full load.
   5.2. Phase loss due to faulty contacts or supply cable.
   5.3. Liquid is viscous or its specific gravity is too high.
   5.4. Rubbing occurs between rotating and stationary parts.
6. Shaft spins with difficulty:
   6.1. Check for obstructions in the motor or the pump.
   6.2. Rubbing occurs between rotating and stationary parts.
   6.3. Check bearings for proper conditions.
7. Pump vibrates, runs noisily, and flow rate is uneven:
   7.1. Pump runs beyond rated capacity.
   7.2. Pump or piping not properly secured.
   7.3. Suction lift too high.
   7.4. Suction pipe diameter too small.
   7.5. Cavitation caused by insufficient liquid supply or excessive suction losses.
   7.6. Impeller blockage.
8. When stopped, unit turns slowly in the reverse direction:
   8.1. Leaks on air locks in suction pipe.
   8.2. Partial blockage in check valve.
9. In pressure boosting applications, the unit starts and stops too often:
   9.1. Pressure switch settings are incorrect.
   9.2. Tank size may be incorrect.
10. In pressure boosting applications, the unit does not stop:
    10.1. Pressure switch maximum setting is higher than was specified.
    10.2. Direction of rotation incorrect. See Rotation.

SSH-C Components





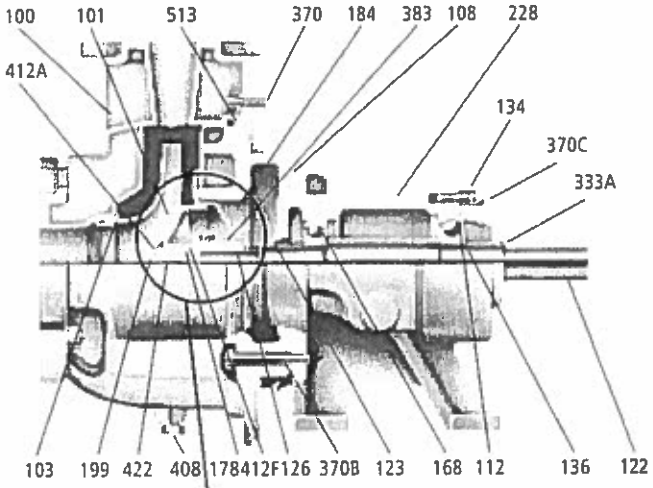
MATERIALS OF CONSTRUCTION

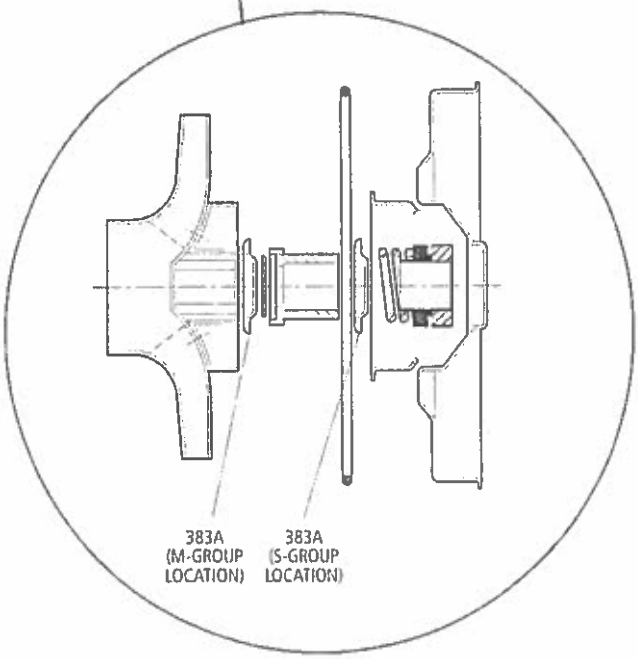
Item	Description	Material
100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw (Casing to Adapter)	AISI TYPE 316L Stainless Steel
408	Drain Plug — ¾ NPT	AISI TYPE 316 SS
126	Shaft Sleeve	316 SS
178	Impeller Key	Steel
422	Impeller Stud	Steel
199	Impeller Washer	316 SS
108	Adapter	Cast Iron ASTM A48CL20
371	Hex Head Cap Screw (Adapter to Motor)	Steel
412A	O-ring, impeller	BUNA-N
412F	O-ring, shaft sleeve	BUNA-N
513	O-Ring	BUNA-N
383	Mechanical Seal Part No. 10K13	Carbon/Ceramic Buna Elastomers 316 SS Metal Parts
383A	Spring Retainer	AISI Type 316 SS

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive

SSH-F Components





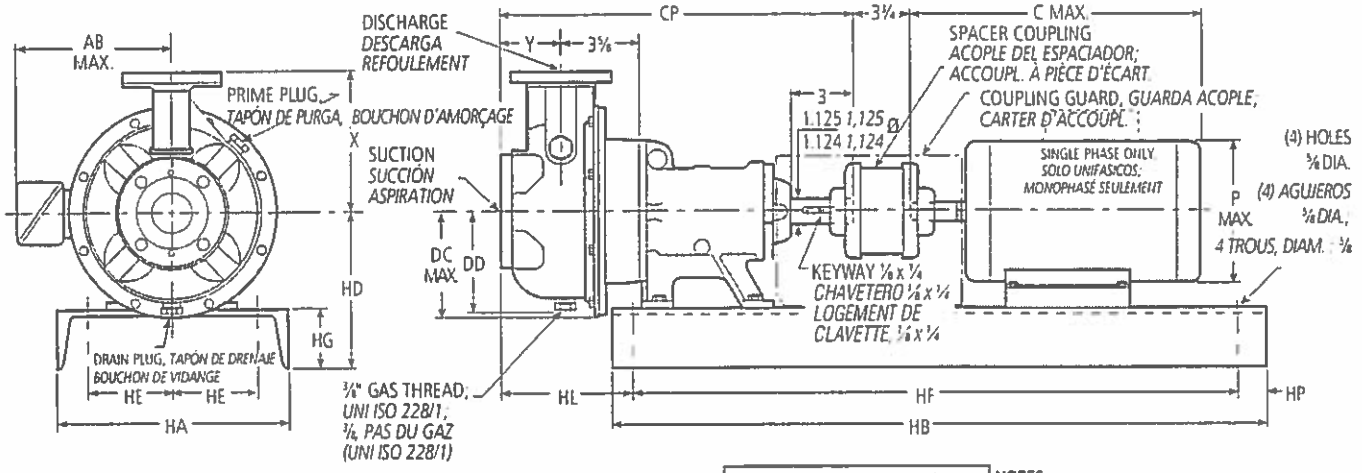
MATERIALS OF CONSTRUCTION

Item		Description	Material
Pump End Components	100 101 103 184 370	Casing Impeller Wear Ring Seal Housing Socket Head Cap Screw	AISI TYPE 316L Stainless Steel
	408	Drain plug – ¼ NPT	AISI TYPE 316 SS
	126	Shaft Sleeve	316 SS
	178	Impeller Key	Steel
	422	Impeller Stud	Steel
	199	Impeller Washer	316 SS
	412A	O-ring, impeller	BUNA-N
	412F	O-ring, shaft sleeve	BUNA-N
	513	O-Ring	BUNA-N
	383	Mechanical Seal Standard Part No. 10K13	Carbon/Ceramic BUNA-N Elastomers 316 SS Metal Parts
	383A	Spring Retainer	AISI Type 316SS
Power End Components	108 228 134	Adapter Bearing Frame Bearing Cover	Cast Iron ASTM A48 CL20
	122 168 112 136 370B 370C	Pump Shaft Ball Bearing (Inboard) Ball Bearing (Outboard) Retaining Ring Hex Head Cap Screw (Adapter to Bearing Frame) Hex Head Cap Screw (Bearing Frame to Cover)	Steel
	333A	Lip Seal	BUNA-N
	193	Grease Fitting	Steel
	123	V-Ring Deflector	BUNA-N

OPTIONAL MECHANICAL SEALS

John Crane Type 21 Mechanical Seals						
Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 SS	Hi-Temperature
	10K25		Ni-Resist	Viton		Chemical
	10K27		Tungsten Carbide	EPR		Hi-Temperature Mild Abrasive

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba;
Dimensions et poids – pompe

Pump, *Bomba, Pompe*		Suction *Succión* ① *Aspir.*	Discharge *Descarga* ① *Refoul.*	CP	DC Max., *DC Máx. DC max.*	DD	X	Y	Wt. (lbs.), *Peso (lib.) Poids*	Dimension "HL" Determined by Pump and Bedplate, *Dimensión "HL" determinada la bomba y el motor, Dimensions HL – pompe et plaque de base* Motor Frame Size, *Tamaño del bastidor del motor, Carcasse de moteur* 143/145	183/184	213/215	254/256	284/286
9SH	1 X 2–6	2	1	16⅜	5	4¼	6⅛	3¼	56	9⅛		7⅛		3⅛
10SH	1 X 2–8				5⅛	5⅛	7⅛		64					
11SH	1 X 2–10			17¼	6⅛	6⅛	8⅛		86	10		8½		4½
4SH	1½ X 2½–6	2½	1½	16½	5	4¼	6⅛	3¼	57	9¼		7¼		4
7SH	1½ X 2½–8			17¼	5⅛	5⅛	7⅛	4	66	10		8½		4¼
5SH	2 X 2½–6		2		5	4¼			57					
8SH	2 X 2½–8				6	5¼	7¹⁵⁄₁₆		68					
6SH	2½ X 3–6	3	2½						59					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. All pumps shipped in vertical discharge position. May be rotated in 90° increments. Tighten ⅛ – 16 casing bolts to 12 ft/lbs. torque.
2. Dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not to be used for construction purposes.

NOTAS:
1. Todas las bombas transportadas en posición de descarga vertical. Pueden rotarse en aumentos de 90°. Apretar ⅛ – 16 tornillos de carcasa a 12 pies/libras potencia.
2. Las dimensiones en pulgadas.
3. Las dimensiones puede que varíen con los fabricantes.
4. No para propósitos de construcción.

NOTA :
1. L'orifice de refoulement est orienté vers le haut. On peut le tourner de 90° en 90°. Serrer les vis ⅛ - 16 du corps de pompe à 12 lbf pi.
2. Les dimensions sont en pouces, et le poids en livres.
3. Les dimensions et le poids du moteur peuvent varier selon le fabricant.
4. Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor
Dimensions et poids – moteur et plaque de base

Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *HP a 3500 RPM, hp à 3 500 trimin*				HP @ 1750 RPM, *HP a 1750 RPM, hp à 1 750 trimin*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base*								
	Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicas, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicas, 3 Ø*						HA	HB	HD*	HE	HF	HG	HP*	Wt. (lbs.), *Peso (libras), Poids*	Motor Shim, *Plancha de relleno del motor Cale de moteur*	Bearing Frame Shim *Plancha de relleno del bastidor del cojinete, Cale de palier*
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC														
143T					1	1	1	1	5¼	13⅜	6⅛	45	10	28	8	3¾	24	2¾	¼	48	1¼	–
145T	2	2	2 or ou 3	2	1½	1½	1½ or ou 2	1½ or ou 2		14¼		53										
182T	3	3	5	3	2	2	3	3	5⅛	16⅛	7⅛	74										
184T	5	5	7½	5	3 or ou 5	3	5	3		18⅛		95										
213T			10	7½					7⅛	18	9⅛	116	12	31	8¼	4¼	29	3	1	65	–	–
215T			15	10						19¼		136										
254T			20	15					10⅛	21⅛	13	266	13	42	9¼	5¼	38½	4	1¼	110	–	1
256T			25	20						23⅛		264										
284TS			30	25					12⅝	24¼	15	392	15	44	10½	5¼	40½	3½		124	–	1¼
286TS			40	30						26⅛		432										

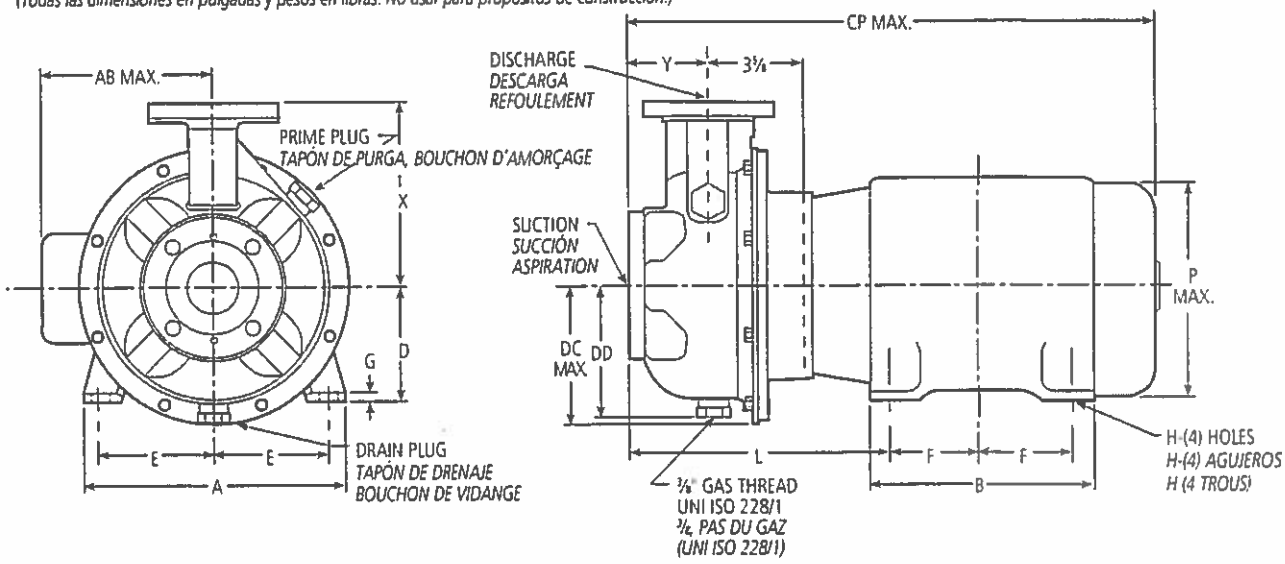
Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs.
"HP" Dimensions at motor end only.
* "HD" Dimension for 254T/256T motor frame on 1 x 2-10 only is 11", A ¾" motor shim and a 1¼" bearing frame shim are required.

Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.
Dimensiones "HP" sólo en el extremo del motor.
** La dimensión "HD" para el bastidor del motor 254T/256T de 1 x 2 - 10 es sólo 11", se requieren una cuña del motor de ¾" y una cuña del bastidor de apoyo de 1¼".*

ODP = carcasse abritée (à ouvertures de ventilation protégées) , TEFC = carcasse fermée autoventilée.
**Dimensions HP à l'extrémité du moteur seulement. La dimension HD pour la carcasse 254T ou 256T, version 1X2-10 seulement, est de 11 po ; une cale de moteur de ¾ po et une cale de palier de 1¼ po sont requises.*

SSH S-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe S*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*

Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lbf/po²*		CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur*				Wt. (lbs.), *Pesos (libras), Poids*
		Suct. ① *Succ. ① Aspir.*	Disch. ① *Desc. ① Refoul.*						143/145	182/184	213/215	254/256	
9SH	1 x 2 – 6	2	1	25¾	5	4¼	6⅜	3⅛	9⅛	10¼	11¼	—	24
10SH	1 x 2 – 8				5⅜	5⅛	7⅛						32
11SH	1 x 2 – 10			27⅛	6¼	6⅜	8⅛	4	10½	11⅛	12¼	12⅜	54
4SH	1½ x 2½ – 6	2½	1½	25½	5	4¾	6⅛	3¼	9¼	10⅜	11⅜	—	25
7SH	1½ x 2½ – 8			27⅞	5½	5⅜	7⅛	4	10½	11⅛	12⅛	12¾	34
5SH	2 x 2½ – 6		2		5	4¼	6⅜						25
8SH	2 x 2½ – 8				6	4¾	7 15/16						36
6SH	2½ x 3 – 6	3	2½										27

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ¾ – 16 bolts to 12 ft./lbs., ⅞ – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Motor dimensions may vary with motor manufacturer.
4. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posicion deseada, y apretar ¾ – 16 tornillos a 12 pies/libras, ⅞ – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *Las dimensiones puede que varíen con los fabricantes.*
4. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ¾ - 16 à 12 lbf pi et ⅞ - 14 à 20 lbf pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

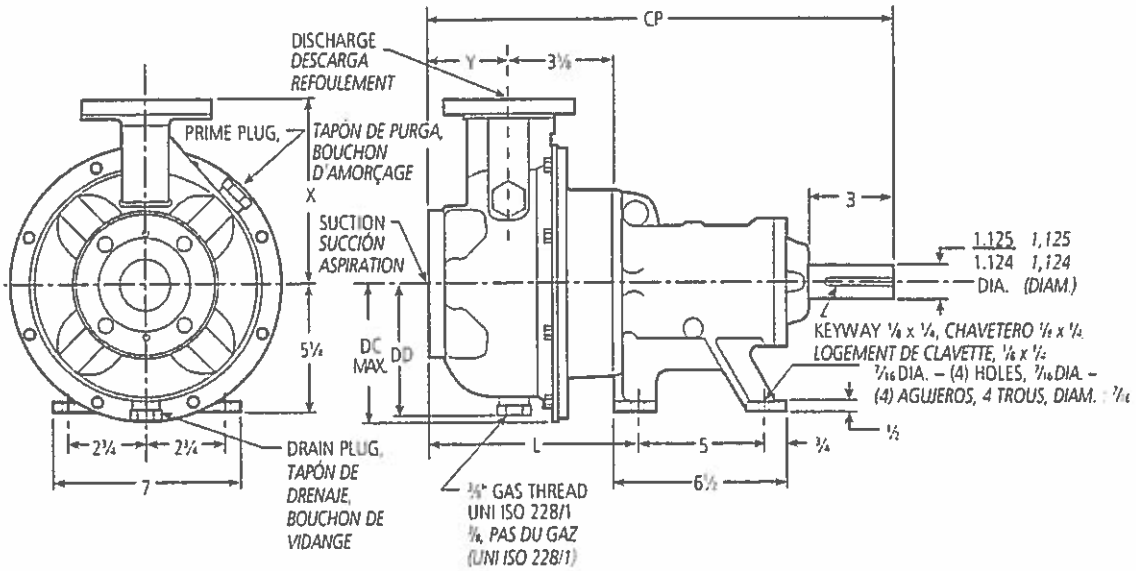
JM Frame, *JM Armazón, Carcasse*	A	AB	B	D	E	F	G	H Dia., *H Diám., H (diam.)*	P Max., *P Máx., P max.*	Motor Wt. (lbs.) *Peso Motor (lib.), Poids du moteur*
143JM	6½	5¼	6	3½	2¾	2	⅛	11/32	6⅝	41
145JM						2½				57
182JM	8½	5⅛	6½	4½	3¾	2¼	3/16	13/32	7⅛	77
184JM						2¼				97
213JM	9½	7⅛	8	5¼	4¼	2¼	7/32		9⅝	122
215JM						3½				155
254TCZ	11¼	9	9½	6¼	5	4⅛	¼	17/32	11½	265
256TCZ			11¼			5				320

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Motor Frame, *Armazón del Motor, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*							
	3500 RPM, *3500 RPM, 3 500 trimin*				1750 RPM, *1750 RPM, 1750 trimin*			
	1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*		1Ø, *Monofásicos 1 Ø*		3Ø, *Trifásicos 3 Ø*	
	ODP	TEFC	ODP	TEFC	ODP	TEFC	ODP	TEFC
143JM	–	–	–	–	–	–	1	1
145JM	2	2	2-3	2	1-1½	1-1½	1½-2	1½-2
182JM	3	3	5	3	2	2-3	3	3
184JM	5	5	7½	5	3	–	5	5
213JM	7½	–	10	7½	5	–	7½	7½
215JM	10	–	15	10-15	–	–	–	–
254TCZ	–	–	20	–	–	–	–	–
256TCZ	–	–	25	20-25	–	–	–	–

ODP = carcasse abritée (à ouvertures de ventilation protégées),
TEFC = carcasse fermée autoventilée.

SSH S-Group Frame-Mounted – Dimensions and Weights, *SSH Armazón Montado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur palier, groupe S*



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba,
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*		150 lb. Flange, *Brida de 150 lib., Bride, 150 lb/po²*		DC Max., *DC Máx., DC max.*	DD	CP Max., *CP Máx., CP max.*	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
		Suction ① *Succión ① Aspir.*	Discharge *Descarga ① Refoul.*							
9SH	1 x 2 – 6	2	1	5	4¾	16¾	7¾	6⅛	3⅛	56
10SH	1 x 2 – 8			5⅛	5⅛			7⅛		64
11SH	1 x 2 – 10			6⅛	6⅛	17¼	8½	8⅛	4	86
4SH	1½ x 2½ – 6	2½	1½	5	4¾	16½	7¾	6⅛	3¼	56
7SH	1½ x 2½ – 8			5⅛	5⅛	16½	8½	7⅛	4	64
5SH	2 x 2½ – 6		2	5	4¾					57
8SH	2 x 2½ – 8			6	5¼			6⅛		66
6SH	2½ x 3 – 6	3	2½							57

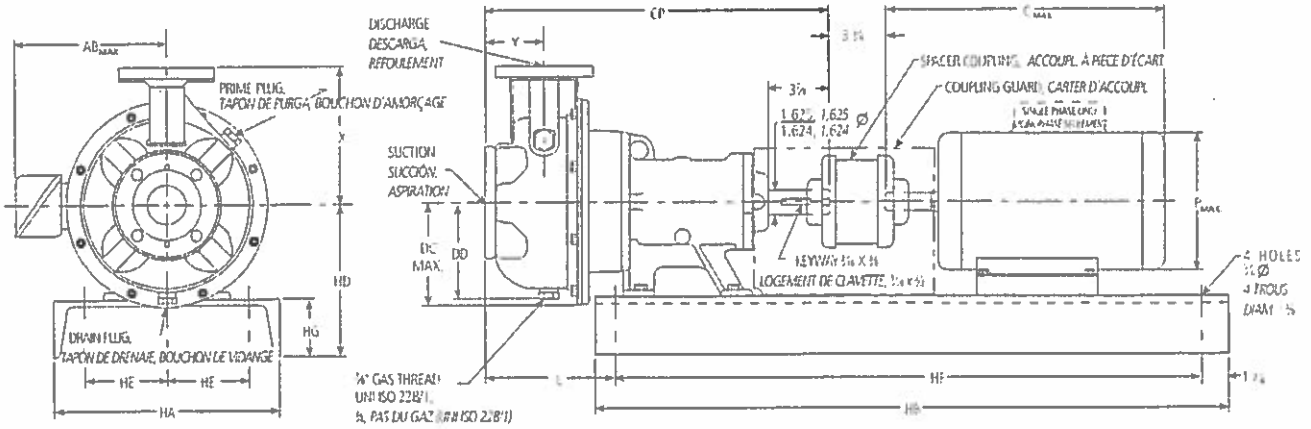
① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ –16 bolts to 12 ft./lbs., 7/16 – 14 bolts to 20 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, 7/16 – 14 tornillos a 20 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf·pi et 7/16 – 14 à 20 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Channel Steel Bedplate, Clockwise Rotation Viewed from Drive End;
Fundación de Acero, Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor;
Plaque de base profilée en U et rotation en sens horaire (vue de l'extrémité du moteur)



Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba,
Dimensions et poids – pompe

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅛	10⅛	8¹⁵⁄₁₆	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10				6⅞	6⅛		9¹⁵⁄₁₆		134
23SH	3 x 4-8	4	3	24			11⅛		5	136
28SH	3 x 4-10				7⅝	7⅛		11⅛		148

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTE:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position and tighten ⅜ – 16 bolts to 12 ft./lbs.
2. ALL dimensions in inches.
3. Not for construction purposes.

NOTA:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor,
Dimensions et poids – moteur et plaque de base

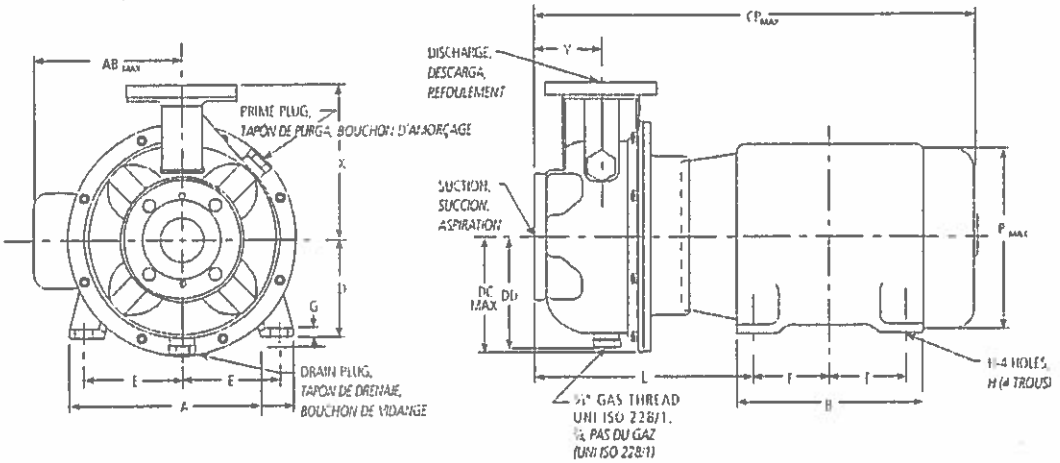
Motor Frame, *Armazón del Motor, Carcasse de moteur*	HP @ 3500 RPM, *hp à 3 500 tr/min*		HP @ 1750 RPM – T-Frame Only *hp à 1 750 tr/min – carc. T seulem.*				AB Max., *AB Máx., AB max.*	C Max., *C Máx., C max.*	P Max., *P Máx., P max.*	Wt. Max., *Peso Máx., Poids max.*	Bedplate Data, *Datos de la Fundación, Plaque de base*						
	Three Phase, *Trifásicos, 3 Ø*		Single Phase, *Monofásicos, 1 Ø*		Three Phase, *Trifásicos, 3 Ø*						HA	HB	HD	HE	HF	HG	Wt. (lbs.), *Peso (libras), Poids*
	ODP	TEFC	ODP	TEFC	ODP	TEFC											
184T			3 or ou 5	3	5	5	5⅞	18⅛	7⅛	95	13	42	10¼	5¼	38½	4	111
213T					7½	7½	7⅜	18	9⅝	116							
215T	15				10	10		19⅛		136							
254T	20	15			15	15	9½	21⅝	13	266							
256T	25	20			20	20		23⅜		264							
284TS/T	30	25			25	25	12⅝	24⅞	15	392	15	44	10½	5¾	40½	3½	124
286TS/T	40	30						26⅝		422							
324TS/T	50	40					14⅛	28¾	17⅜	592	18	48	12	7¼	44½	4	183
326TS/T	60	50						30¼		634							
364TS/T	75	60					15⅞	31⅝	18⅞	834			13				
365TS/T	100	75						32⅝		1000							
405TS/T		100					18	36¼	20½	1060	22	56	14	7¼	52½	4	214

Dimensions and weights vary with manufacturers. Dimensions in inches and weights in lbs
Dimensiones y pesos varían con los fabricantes. Dimensiones en pulgadas y pesos en libras.

ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée.

SSH M-Group Close Coupled – Dimensions and Weights, *SSH Acople Cerrado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur moteur, groupe M*

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)
(Todas las dimensiones en pulgadas y pesos en libras. No usar para propósitos de construcción.)



Dimensions "L" Determined by Pump and Motor, *Dimensiones "L" Determinadas por la Bomba y el Motor, Dimensions L – pompe et moteur*																
Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP Max., *CP Máx., CP max.*	DC Max., *DC Máx., DC max.*	DD	X	Y	Wt. (lbs.), *Peso (libras), Poids*	Motor Frame Size, *Tamaño del Armazón del Motor, Carcasse de moteur*						
										140	180	210	250	280	320	360
24SH	1½ x 2 ½-10	2½	1½	34½	6⅞	6⅝	8 15/16	4	75	10½	11⅛	12⅛	13⅜		14⅜	-
25SH	2 x 2½-10		2	36					75							15
22SH	2½ x 3-8	3	2½		6⅛	5⅞			72	-						
27SH	2½ x 3-10				6⅞	6⅝	9 15/16		84	-	-					
23SH	3 x 4-8	4	3	37				5	86	11½	12⅛	13⅜	14⅞		15⅜	16
28SH	3 x 4-10				7⅛	7⅜	11⅛		98	-	-					

① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps shipped in vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, and tighten ⅜ – 16 bolts to 12 ft./lbs., ⅞ – 14 bolts to 20 ft./lbs., ½ – 13 bolts to 35 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán en descarga vertical como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras, ⅞ – 14 tornillos a 20 pies/libras, ½ – 13 tornillos a 35 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ - 16 à 12 lbf·pi, ⅞ - 14 à 20 lbf·pi et ½ - 13 à 35 lbf·pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

Dimensions Determined by JM Motor Frame, *Dimensiones Determinadas por el Armazón del Motor JM, Dimensions – carcasse de moteur JM*

Frame, *Armazón, Carcasse*	A	AB Max., *AB max.*	B	D	E	F	G	H	P Max., *P Máx., P max.*
145JM	6½	5¼	6	3½	2¼	2½	⅛	11/32	7 5/16
182JM	8½	5⅞	6½	4½	3¾	2¼	3/16	13/32	8½
184JM						2¾			
213JM	9½	7⅜	8	5¼	4¼	3½	7/32		10 3/16
215JM									
254JM	11¼	9	11¾	6¼	5	4⅛	¼	17/32	13¼
256JM						5			
284JM	12¼	12¼	12¼	7	5½	4¾			15
286JM						5½			
324JM	14	13¼	14	8	6¼	5½	5/16	21/32	16 5/16
326JM						5½			
364TCZ	17¾	15½	15½	9	7	5⅝	1		19
365TCZ						6⅛			

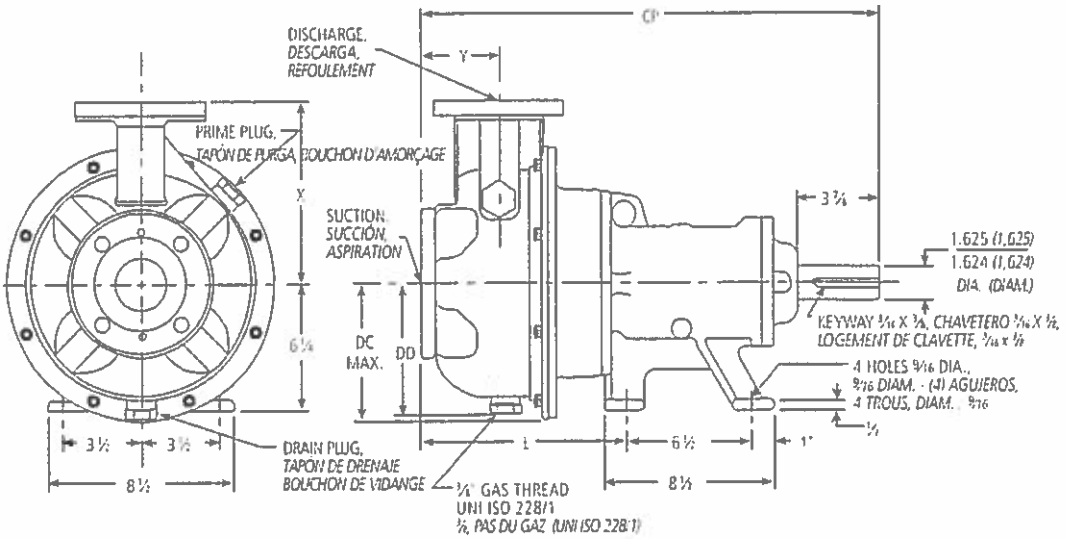
364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Dimensions may vary with manufacturer.;
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
Las dimensiones puede que varíen con los fabricantes.;
Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

Motor Frame Selections, *Selecciones del Armazón del Motor, Choix de carcasses de moteur*

Frame, *Armazón, Carcasse*	Motor Horsepower, *Potencia del Motor, Puissance (hp)*						Wt. Max., *Peso Máx., Poids max.*
	3500 RPM, *3500 r/min*		1750 RPM, *1750 r/min*				
	3 PH, *Trifásicos, 3 Ø*		1 PH, *Monofásicos, 1 Ø*		3 PH, *Trifásicos, 3Ø*		
	ODP	TEFC	ODP	TEFC	ODP	TEFC	
145JM	–	–	–	–	2	2	57
182JM	–	–	2	2, 3	3	3	77
184JM	–	–	3	–	5	5	97
213JM	10	–	5	–	7½	7½	141
215JM	15	10	–	–	10	10	155
254JM	20	15	–	–	15	15	265
256JM	25	20	–	–	20	20	320
284JM	30	25	–	–	25	25	419
286JM	40	30	–	–	–	–	422
324JM	50	40	–	–	–	–	562
326JM	60	50	–	–	–	–	625
364TCZ	75	60	–	–	–	–	775
365TCZ	100	75, 100	–	–	–	–	905

364TCZ and 365TCZ frames are built with 326JM shaft extensions.
Los armazones 364TCZ y 365TCZ se construyen con extensiones del eje 326JM.
ODP = carcasse abritée (à ouvertures de ventilation protégées) ; TEFC = carcasse fermée autoventilée. Les carcasses 364TCZ et 365TCZ possèdent la rallonge d'arbre de la 326JM.

SSH M-Group Frame Mounted – Dimensions and Weights, *SSH Armazón Montado – Dimensiones y Pesos, Dimensions et poids – SSH montée sur palier, groupe M*



Dimensions and Weights – Bare Pump Only,
Dimensiones y Pesos – Solamente Bomba
Dimensions et poids – pompe nue seulement

Pump, *Bomba, Pompe*	Pump Size, *Tamaño de la Bomba, Dimensions*	① Suction *Succión Aspir.*	① Discharge *Descarga Refoul.*	CP	DC Max., *DC Máx., DC max.*	DD	L	X	Y	Wt. (lbs.), *Peso (libras), Poids*
24SH	1½ x 2 ½-10	2½	1½	23	6⅞	6⅝	10½	8 15/16	4	125
25SH	2 x 2½-10		2							125
22SH	2½ x 3-8	3	2½		6⅛	5⅞				125
27SH	2½ x 3-10									134
23SH	3 x 4-8	4	3	24	6⅜	6½	11½	9 15/16	5	136
28SH	3 x 4-10				7⅛	7⅜		11⅛		148

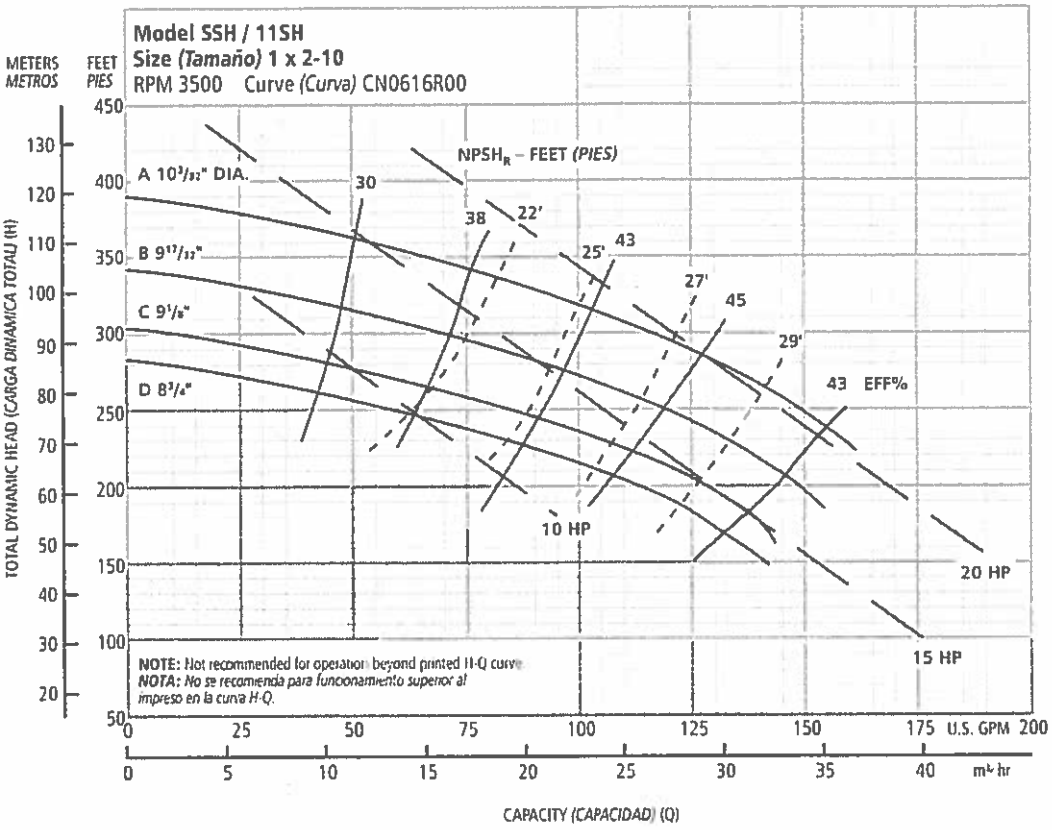
① For use with ANSI class 150 mating flanges.
Para usar con bridas que casan ANSI clase 150.
À utiliser avec des contre-brides ANSI, classe 150.

NOTES:
1. Pumps will be shipped with top vertical discharge as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten ⅜–16 bolts to 12 ft./lbs.
2. Motor dimensions may vary with motor manufacturer.
3. Not for construction purposes.

NOTAS:
1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y apretar ⅜ – 16 tornillos a 12 pies/libras.*
2. *TODAS las dimensiones en pulgadas.*
3. *No para propósitos de construcción.*

NOTA :
1. *L'orifice de refoulement est orienté vers le haut. Pour l'orienter autrement, enlever les vis de fixation du corps de pompe, placer l'orifice dans le sens voulu, puis reposer et serrer les vis ⅜ – 16 à 12 lbf pi.*
2. *Les dimensions sont en pouces, et le poids, en livres.*
3. *Les dimensions et le poids du moteur peuvent varier selon le fabricant.*
4. *Ne pas utiliser les dimensions pour la construction si elles ne sont pas certifiées à cette effet.*

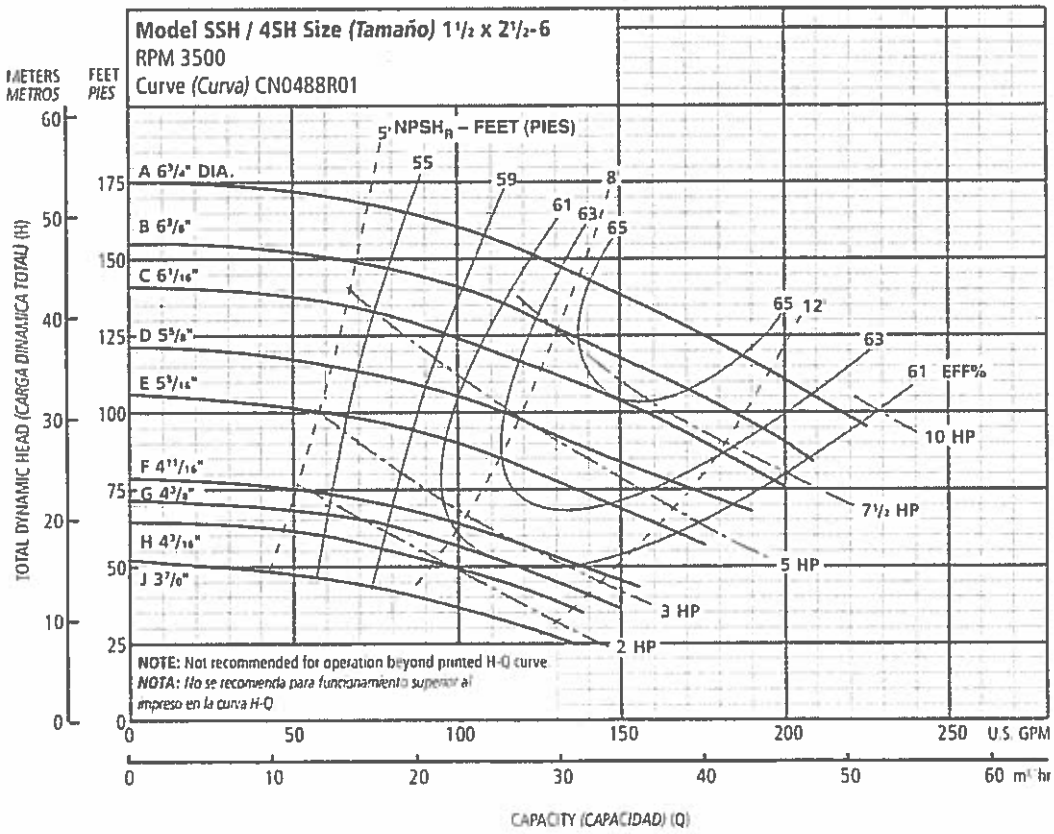
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	Dia., *Diá.*	Standard HP Rating, *Estándar HP Potencia*
A	10 3/32"	20
B	9 17/32	15
C	9 1/8	15
D	8 3/4	15

NOTE: Pump will pass a sphere to 1/4" diameter.

NOTA: La bomba pasará una esfera a 1/4" diámetro.



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	Dia., *Diá.*	Standard HP Rating, *Estándar HP Potencia*
A	6 3/4"	10
B	6 3/8	7 1/2
C	6 1/16	7 1/2
D	5 5/8	5
E	5 5/16	5
F	4 11/16	3
G	4 3/8	3
H	4 3/16	2
J	3 7/8	2

NOTE: Pump will pass a sphere to 3/16" diameter.

NOTA: La bomba pasará una esfera a 3/16" diámetro.

GOULDS PUMPS

Wastewater Pumps

Dewatering, Effluent and Sewage

Installation and Operation Manual

Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Control Model Number: _____

Dealer: _____

Dealer Phone No. _____

Date of Purchase: _____ Installation: _____

Current Readings at Startup:

1Ø	3Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

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Goulds Pumps

ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.

⚠ WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. These fluids and gases may be present in containment areas. Tank or wetwell must be vented per local codes.

Only pumps specifically Listed for Class 1, Division 1 are allowable in hazardous liquids and where flammable gases may exist. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*

⚠ WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.

⚠ CAUTION All three phase (3Ø) control panels for submersible pumps must provide Class 10, quick-trip, overload protection.

PRE-INSTALLATION CHECKS

Open all cartons and inspect for shipping damage. Report any damage to your supplier or shipping carrier immediately.

Important: Always verify that the pump nameplate Amps, Voltage, Phase, and HP ratings match your control panel and power supply.

Many of our sewage pumps are oil-filled. If there are any signs of oil leakage or if the unit has been stored for an extended period check the oil level in the motor dome and the seal housing, if so equipped.

Check the motor cover oil level through the pipe plug on top of the unit. The motor chamber oil should just cover the motor. Do not overfill, leave room for expansion!

To check the seal housing oil level, where used, lay the unit on its side with the fill plug at 12 o'clock. Remove the plug. The oil should be within ½" (13mm) of the top. If low, refill with an ASTM 150 turbine oil. Replace the plug.

Oil is available in 5 gallon cans through our distributors. You can also source oil locally at motor repair shops. Typical oil brands are: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 and Mobil DTE Light.

Check the strain relief nut on power cable strain assemblies. Power cables should be torqued to 75 in. lbs. for #16 cables and 80 in. lbs. for all other cable assemblies. Seal/heat sensor cables, where used, should be torqued to 75 in. lbs.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

LIFTING OF PUMP

⚠ WARNING

DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

Lift the pump with an adequately sized chain or cable attached to the lifting eye bolt. DO NOT damage electrical and sensor cables while raising and lowering unit.

OPTIONAL GUIDE RAIL OR LIFT-OUT SYSTEM

In many effluent and sewage basins or lift stations it is advisable to install the pump on a guide rail system or on a lift-out adapter to facilitate installation and removal for inspection and/or service. Most codes do not allow personnel to enter a wetwell without the correct protective equipment and training. Guide rails are designed to allow easy removal of the pump without the need for entry into the wetwell or need to disturb piping. The guide rail or lift-out adapter should locate the pump opposite the influent

opening preventing stagnate areas where solids can settle. The basin or pit must be capable of supporting the weight of the pump and guide rail. The pit floor must be flat.

NOTICE: FOLLOW THE INSTRUCTIONS THAT ARE PROVIDED WITH THE GUIDE RAIL ASSEMBLY.

PIPING

Discharge piping should be no smaller than the pump discharge diameter and kept as short as possible, avoiding unnecessary fittings to minimize friction losses.

Install an adequately sized check valve matched to the solids handling capability of the pump to prevent fluid backflow. Backflow can allow the pump to "turbine" backwards and may cause premature seal and/or bearing wear. If the pump is turning backwards when it is called on to start the increased torque may cause damage to the pump motor and/or motor shaft and some single-phase pumps may actually run backwards.

Install an adequately sized gate valve AFTER the check valve for pump, plumbing and check valve maintenance.

Important – Before pump installation. Drill a 3/16" (4.8mm) relief hole in the discharge pipe. It should be located within the wetwell, 2" (51mm) above the pump discharge but below the check valve. The relief hole allows any air to escape from the casing. Allowing liquid into the casing will insure that the pump can start when the liquid level rises. Unless a relief hole is provided, a bottom intake pump could "air lock" and will not pump water even though the impeller turns.

All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

The pit access cover must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

WIRING AND GROUNDING

Important notice: Read Safety Instructions before proceeding with any wiring.

⚠ Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.

⚠ Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.

⚠ Install an all leg disconnect switch where required by code.

⚠ Disconnect and lockout electrical power before performing any service or installation.

⚠ The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.

⚠ All splices must be waterproof. If using splice kits follow manufacturer's instructions.

⚠ WARNING Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.

⚠ WARNING Seal all controls from gases present which may damage electrical components.

⚠ WARNING
Hazardous voltage

FAILURE TO PERMANENTLY GROUND THE PUMP, MOTOR AND CONTROLS BEFORE CONNECTING TO POWER CAN CAUSE SHOCK, BURNS OR DEATH.

SELECTING AND WIRING PUMP CONTROL PANELS AND SWITCHES

FLOAT SWITCH TYPES

There are two basic float switch designs; single-action and wide-angle. Single-action switches operate over a range of 15° so they open and close quickly. Wide-angle floats operate over a 90° swing with the tether length between the float body and the pivot point controlling the On-Off range. The design determines how many floats are required with different systems or controls.

Floats may be normally open (NO) for pump down applications or to empty a tank. Normally closed (NC) switches are used to pump up or to fill a tank.

A single-action control switch may be used only with a control panel, never direct connected to a pump.

The wide-angle, pump down switches may be used as direct connected pump switches or as control switches.

SETTING THE FLOAT SWITCHES

There are no absolute rules for where to set the float switches, it varies from job to job.

Suggested Rules to Follow:
All floats should be set below the Inlet pipe!

Off Float: Best: set so the water level is always above the top of the pump (motor dome). **Next Best:** set so the water level is not more than 6" below the top of the pump.

On Float: set so the volume of water between the On and Off floats allows pumps of 1½ HP and under to operate for 1 minute minimum. Two (2) HP and larger pumps should run a minimum of 2 minutes. Basin literature states the gallons of storage per inch of basin height.

Lag/Alarm Float(s): should be staggered above the Off and On floats. Try to use most of the available storage provided by the basin, save some space for reserve storage capacity. *See Diagrams and Charts in Float Switch Chart Section.*

PANEL WIRING DIAGRAMS

Our control panels are shipped with instructions and wiring diagrams. Use those instructions in conjunction with this IOM. Electrical installation should be performed only by qualified technicians. Any problem or questions pertaining to another brand control must be referred to that control supplier or manufacturer. Our technical people have no technical schematics or trouble shooting information for other companies' controls.

ALARMS

We recommend the installation of an alarm on all Wastewater pump installations. Many standard control panels come equipped with alarm circuits. If a control panel is not used, a stand alone high liquid level alarm is available. The alarm alerts the owner of a high liquid level in the system so they can contact the appropriate service personnel to investigate the situation.

SINGLE PHASE PUMPS

Single phase (1Ø) pumps may be operated using a piggyback or hard wired float switch, a contactor, or a Simplex or Duplex control panel. *See Figures 1, 2 and 5.*

All 1/3 and 1/2 HP, 115 or 230 volt pumps, and some 3/4 and 1 HP pumps, are supplied with plug style power cords. They may be plugged into piggyback float switches for simple installations. It is allowable to remove the plugs in order to hardwire or connect to a Simplex or Duplex controller. Removing the plug neither voids the warranty nor violates the agency Listings. *See Figure 5.*

PLUG-CONNECTED UNITS MUST BE CONNECTED TO A PROPERLY GROUNDED, GROUNDING TYPE RECEPTACLE.

ON NON-PLUG UNITS, DO NOT REMOVE CORD AND STRAIN RELIEF. DO NOT CONNECT CONDUIT TO PUMP.

Pumps with bare lead power cords can be hard-wired to a float switch, wired to a 1Ø contactor, a Simplex controller or a Duplex controller. Always verify that the float switch is rated for the maximum run amperage, maximum starting amperage, and the HP rating on the pump. Single-phase wastewater pumps contain on-winding overloads, unless noted on the pump nameplate. *See Figures 1 and 2.*

THREE PHASE PUMPS:

As a Minimum a 3Ø pump requires a 3 pole circuit breaker/fused circuit, an across the line magnetic starter rated for the pump HP, and ambient compensated Quick Trip Class 10 overloads.

SINGLE AND THREE PHASE CONTROL PANELS:

Control panels are available as Simplex (controls 1 pump) or Duplex (controls 2 pumps). Our standard SES Series Panels are available with many standard features and can be built with our most popular options. We also custom build panels which offer many more design options than the SES panels. Custom control panels are available in many different configurations. Custom panel quote requests may be forwarded to Customer Service through any authorized distributor.

Our "SES" Duplex panels feature a solid-state printed circuit board design with standard high level alarm circuits. Other standard features are: an auxiliary dry alarm contact for signaling a remote alarm and float switch position indicator lights. Our 3Ø panels have built-in, adjustable, Class 10 overloads. The adjustable overloads on all our 3Ø panels mean less labor for the installer and no need to order specific overloads. Most SES panels are in stock for immediate delivery.

On pumps equipped with seal fail and/or heat (high temperature) sensors it is recommended that you use our control panel with the appropriate options. The pump sensors do not function without a seal fail relay or terminal connection in the control panel and a warning device such as a bell, horn or light.

Seal Failure Circuit - Some dual seal pumps are equipped with a standard, built-in seal failure circuit, which may also be called a moisture detection circuit. This circuit must be connected to a control panel with an optional seal fail relay. The panel must be special ordered with the seal fail relay and alarm. There are also stand alone seal fail panels such as the A4-3 or A4-4 available as standard items. The pumps can be identified by an extra control cable exiting the motor cover. The cable contains two wires, a black wire, connects to panel "terminal" going to "probe"; and a white wire, connects to the panel "terminal" going to the relay ground. Do not connect to the panel ground screw. Follow the wiring instructions supplied with the panel.

Heat Sensor and Seal Failure Circuit - Some pumps are equipped with a seal fail and normally closed, on-winding high temperature thermostats (heat sensors). The pumps have a control cable with four (4) leads, black (probe) and green (relay ground) for the seal fail circuit and red and white for the high temperature circuit. Connect the high temperature (heat sensor) circuit to the panel terminal strip as indicated on the panel drawing using the red and white wires. The high temperature panel circuit is also an optional item which you must specifically order when you order your control panel. The high temperature circuit is different from the Class 10 overloads which are always required on three phase pumps. *Follow the wiring instructions supplied with the panel.*

INSTALLATION

Connect the pump(s) to the guide rail pump adapters or to the discharge piping. Slide rail bases should be anchored to the wetwell floor.

Complete all wiring per the control panel wiring diagrams and NEC, Canadian, state, provincial and/or local codes. This a good time to check for proper rotation of the motors/impellers.

DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

Always verify correct rotation. Correct rotation is indicated on the pump casing. Three phase motors are reversible. It is allowable to bump or jog the motor for a few seconds to check impeller rotation. It is easier to check rotation before installing the pump. Switch any two power leads to reverse rotation.

Lower the pump(s) into the wetwell.

Check to insure that the floats will operate freely and not contact the piping.

OPERATION

Once the piping connections are made and checked you can run the pumps.

Piggyback Switch Operation – Plug the piggyback switch into a dedicated grounded outlet and then plug the pump into the switch. Test the pump by filling the wetwell until the pump goes On. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Check the operating range to insure a minimum one minute run time and that the pump goes Off in the correct position.

Control Panel Operation – Fill the wetwell with clear water.

Use the pump H-O-A (Hand-Off-Automatic) switches in Hand to test the pumps. If they operate well in Hand proceed to test Automatic operation. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Place Control Panel switch(es) in Automatic position and thoroughly test the operation of the ON, OFF, and Alarm floats by filling the wetwell with clear water. **Important:** Failure to provide a Neutral from the power supply to a 10, 230 volt Control Panel will not allow the panel control circuit to operate. The Neutral is necessary to complete the 115 volt control circuit.

Check voltage and amperage and record the data on the front of this manual for future reference. Compare the amperage readings to the pump nameplate maximum amperage. If higher than nameplate amperage investigate cause. Operating the pump off the curve, i.e. with too little head or with high or low voltage will increase amperage. The motor will operate properly with voltage not more than 10% above or below pump nameplate ratings. Performance within this range will not necessarily be the same as the published performance at the exact rated nameplate frequency and voltage. Correct the problem before proceeding. Three phase unbalance is also a possible cause. *See Three Phase Power Unbalance and follow the instructions.*

Reset the Alarm circuit, place pump switch(es) in the Automatic position and Control Switch in ON position. The system is now ready for automatic operation.

Explain the operation of the pumps, controls and alarms to the end user. Leave the paperwork with the owner or at the control panel if in a dry, secure location.

FLOAT SWITCH AND PANEL CHART

The purpose of this chart is to show the required switch quantities and the function of each switch in a typical wastewater system. The quantities required vary depending on the switch type, single-action or wide-angle. Switch quantities also vary by panel type: simplex with and without alarms, and duplex with alarms.

Duplex Panels using single-action switches:

Three Float Panel Wiring

SW1	Bottom	Pumps Off
SW2	Middle	1st Pump On
SW3	Top	2nd Pump & Alarm On

Four Float Panel Wiring ②

SW1	Bottom	Pumps Off
SW2	2nd	1st Pump On
SW3	3rd	2nd Pump On
SW4	Top	Alarm On

Duplex Panels using wide-angle switches:

Three Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Top	2nd Pump & Alarm On

Four Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Middle	2nd Pump On
SW3	Top	Alarm On

Simplex Panel using single-action switches:

Simplex Panel with Alarm ①

SW1	Bottom	Pump Off
SW2	Middle	Pump On
SW3	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Bottom	Pump Off
SW2	Top	Pump On

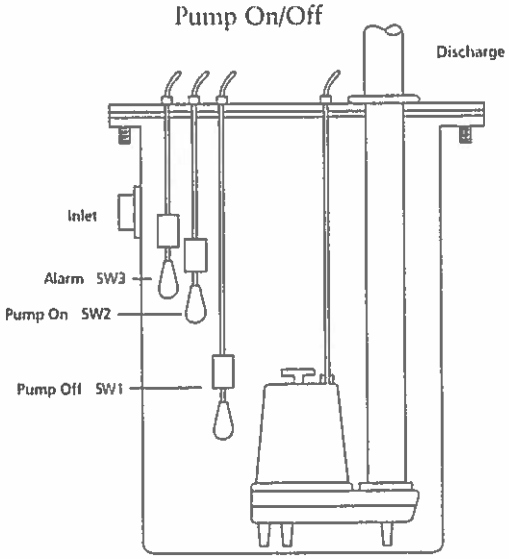
Simplex Panel using wide-angle switches:

Simplex Panel with Alarm

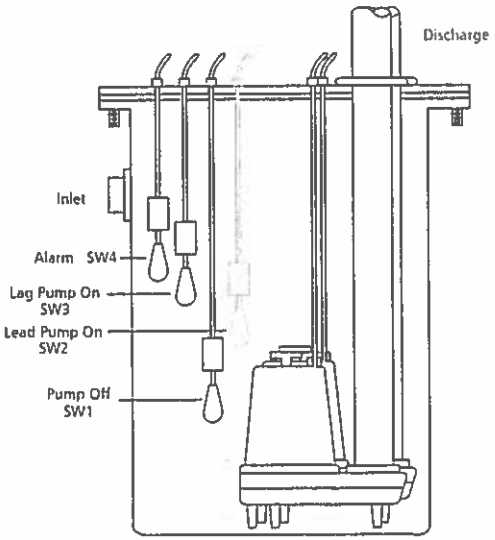
SW1	Bottom	Pump On/Off
SW2	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Pump On/Off



Simplex ①



Duplex ②

THREE PHASE POWER UNBALANCE

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained below.

If the current unbalance is 2% or less, leave the leads as connected.

If the current unbalance is more than 2%, current readings should be checked on each leg using each of the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp values together.

B. Divide the sum by three, yielding average current.

C. Pick the amp value which is furthest from the average current (either high or low).

D. Determine the difference between this amp value (furthest from average) and the average.

E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance.

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source.

Contact your local power company to resolve the imbalance.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T
Motor Leads	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-W = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-W = 49 amps
T2-W = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

INSULATION RESISTANCE READINGS

Normal Ohm and Megohm Values between all leads and ground

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10 (or more)
Motor in well. Readings are for drop cable plus motor.		
New motor.	2,000,000 (or more)	2 (or more)
Motor in good condition.	500,000 - 2,000,000	.5 - 2
Insulation damage, locate and repair.	Less than 500,000	Less than .5

Insulation resistance varies very little with rating. Motors of all HP, voltage and phase ratings have similar values of insulation resistance.

Insulation resistance values above are based on readings taken with a megohmmeter with a 500V DC output. Readings may vary using a lower voltage ohmmeter, consult factory if readings are in question.

This table was reprinted through the courtesy of Franklin Electric.

Engineering data for specific models may be found in your catalog and on our website (address is on the cover).

Control panel wiring diagrams are shipped with the control panels. Please use the control panel drawings in conjunction with this instruction manual to complete the wiring.

PUMP CONSTRUCTION	
Minimum Submergence	
Continuous Duty	Fully Submerged
Intermittent Duty	6" Below Top of Motor

Maximum Fluid Temperature	
Continuous Operation	104° F 40° C
Intermittent Operation	140° F 60° C

Pumpmaster and Pumpmaster Plus - Hard Wired

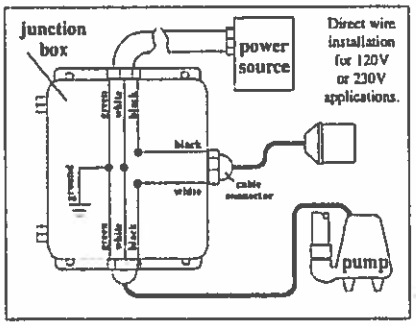


Fig. 1

Single-Action Float Switch "Typical" Installation

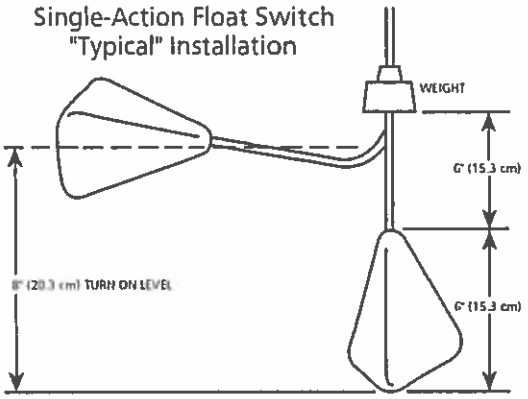


Fig. 4

Double Float - Hard Wired

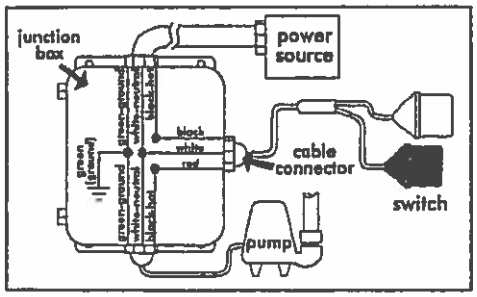


Fig. 2

Wide-Angle Float Switch

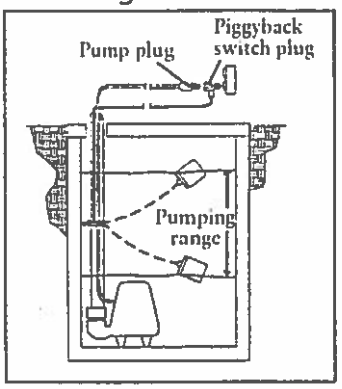


Fig. 5

Determining Pumping Range

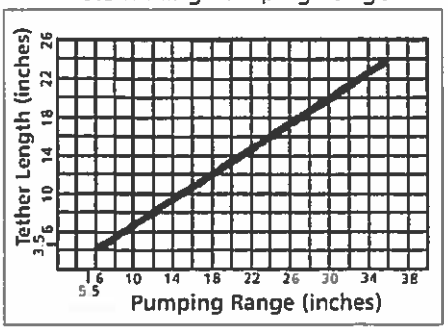


Fig. 3

Three Phase Connection Diagram

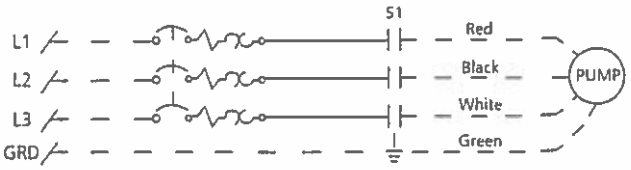
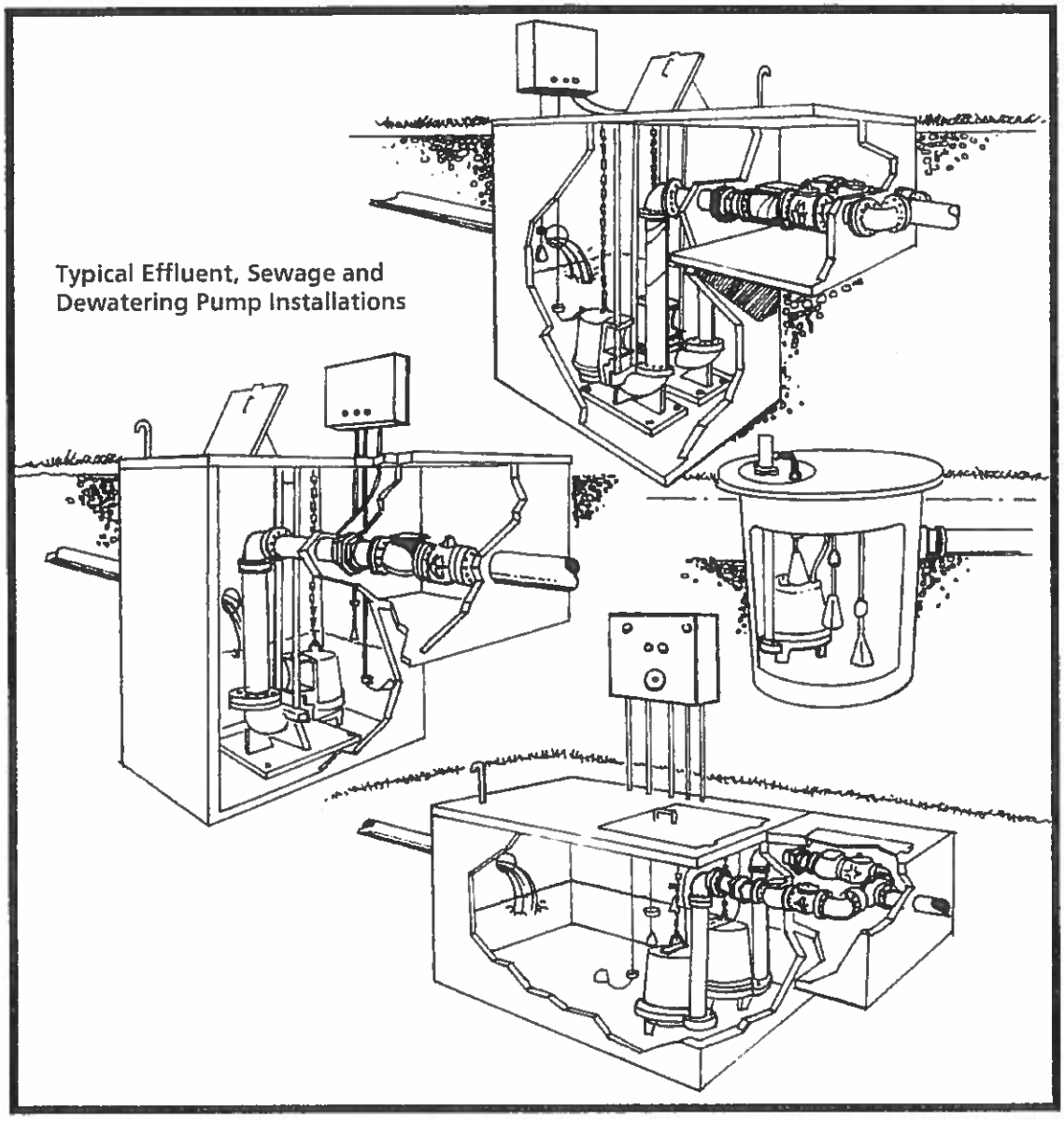


Fig. 6


Typical Effluent, Sewage and
Dewatering Pump Installations

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING NOTE: If circuit breaker "OPENS" repeatedly, DO NOT reset. Call qualified electrician.	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
	Pump impeller binding or jammed.	Check motor amp draw. If two or more times higher than listed on pump nameplate, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer.
a) Manual operation	Power cable is damaged.	
	Inadequate electrical connection in control panel.	
b) Automatic operation	No neutral wire connected to control panel.	Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
	Inadequate electrical connection in control panel.	Inspect control panel wiring. Call a qualified electrician.
NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic control or wiring is at fault. If pump does not operate, see above.	Defective liquid level switch.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
	Insufficient liquid level to activate controls.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Liquid level cords tangled.	Untangle cords and insure free operation.
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve, a 3/16" (4.8 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) above the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
PUMP CYCLES CONSTANTLY	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

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Goulds Pumps

ITT Industries

ITT

Wastewater

Goulds Pumps

WS_BHF Series Model 3887BHF

Submersible Sewage Pump

Prosurance available for residential applications.

FEATURES

- **Impeller:** Cast iron, enclosed, non-clog, dynamically balanced with pump out vanes for mechanical seal protection.
- **Casing:** Cast iron flanged volute type for maximum efficiency. Designed for easy installation on A10-20 slide rail or base elbow rail systems.
- **Mechanical Seal:** Silicon Carbide vs. Silicon Carbide sealing faces for superior abrasive resistance, stainless steel metal parts, BUNA-N elastomers.
- **Shaft:** Corrosion resistant, 300 series stainless steel. Threaded design. Locknut on all models to guard against component damage on accidental reverse rotation.
- **Fasteners:** 300 series stainless steel.
- Capable of running dry without damage to components.
- Designed for continuous operation, when fully submerged.

GOULDS PUMPS

AGENCY LISTINGS

Tested to UL 778 and CSA 22.2 108 Standards
By Canadian Standards Association — File #LR38549

Goulds Pumps is ISO 9001 Registered.

Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Sewage systems
- Dewatering/Effluent
- Water transfer
- Light industrial
- Commercial applications

Anywhere waste or drainage must be disposed of quickly, quietly and efficiently.

SPECIFICATIONS

Pump

- Solids handling capabilities: 2" maximum.
- Capacities: up to 220 GPM.
- Total heads: up to 81 feet TDH.
- Discharge size: 2" NPT threaded companion flange as standard. 3" option available but must be ordered separately. (Order no. A1-3)
- Temperature: 104°F (40°C) continuous
  140°F (60°C) intermittent.

MOTORS

- Fully submerged in high grade turbine oil for lubrication and efficient heat transfer. All ratings are within the working limits of the motor.
- Class B insulation on ⅓-1½ HP models.
- Class F insulation on 2 HP models.

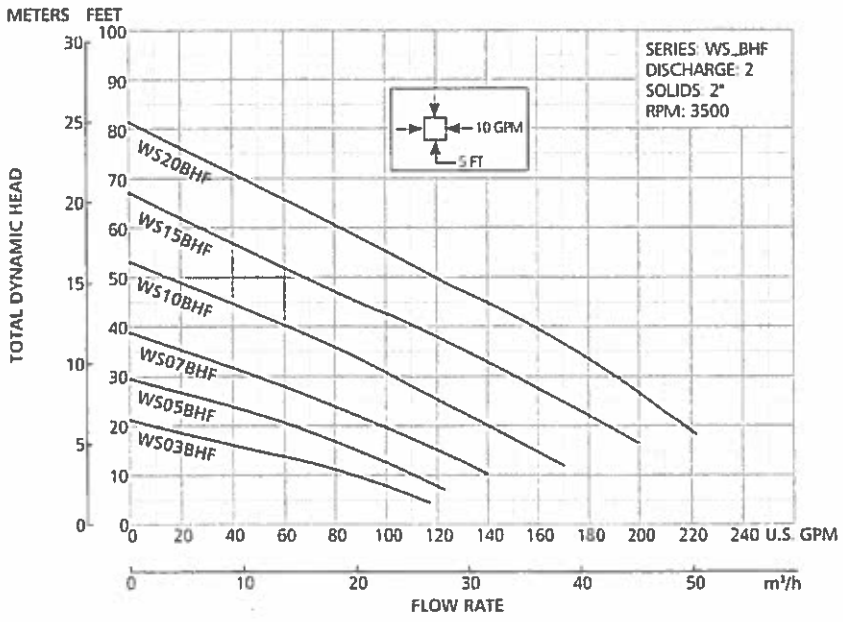
Single phase (60 Hz):

- Capacitor start motors for maximum starting torque.
- Built-in overload with automatic reset.
- SJTOW or STOW severe duty oil and water resistant power cords.
- ⅓ – 1 HP models have NEMA three prong grounding plugs.
- 1½ HP and larger units have bare lead cord ends.

Three phase (60 Hz):

- Class 10 overload protection must be provided in separately ordered starter unit.
- STOW power cords all have bare lead cord ends.

- **Designed for Continous Operation:** Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.
- **Bearings:** Upper and lower heavy duty ball bearing construction.
- **Power Cable:** Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. Standard cord is 20'. Optional lengths are available.
- **Motor Cover O-ring:** Assures positive sealing against contaminant and oil leakage.

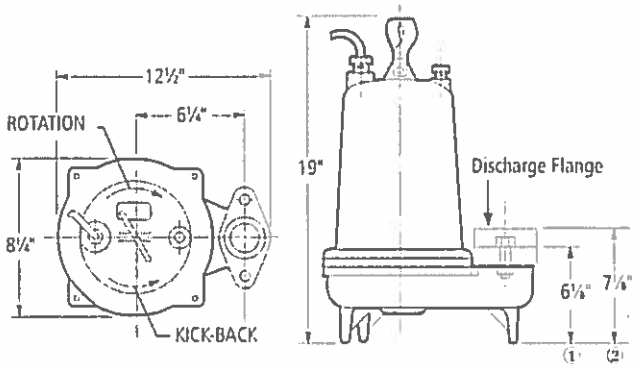


MOTOR AND MODEL INFORMATION

ORDER NUMBER	HP	PHASE	VOLTS	RPM	IMPELLER DIA. (IN.)	MAX. AMPS	LOCKED ROTOR AMPS	KVA CODE	FULL LOAD MOTOR EFF. %	RESISTANCE	
										START	LINE-LINE
WS0311BHF	0.33	1	115	3500	2.94	12.4	46.0	M	54	7.5	1.0
WS0318BHF	0.33	1	208			6.8	31.0	K	68	9.7	2.4
WS0312BHF	0.33	1	230			6.2	34.5	M	53	9.6	4.0
WS0511BHF	0.5	1	115		3.19	14.5	46.0	M	54	7.5	1.0
WS0518BHF	0.5	1	208			8.4	31.0	K	68	9.7	2.4
WS0512BHF	0.5	1	230			7.6	34.5	M	53	9.6	4.0
WS0538BHF	0.5	3	200			4.9	22.6	R	68	–	3.8
WS0532BHF	0.5	3	230			3.6	18.8	R	70	–	5.8
WS0534BHF	0.5	3	460			1.8	9.4	R	70	–	23.2
WS0537BHF	0.5	3	575			1.5	7.5	R	62	–	35.3
WS0718BHF	0.75	1	208		3.44	11.0	31.0	K	68	9.7	2.4
WS0712BHF	0.75	1	230			10.0	27.5	J	65	12.2	2.7
WS0738BHF	0.75	3	200			6.2	20.6	L	64	–	5.7
WS0732BHF	0.75	3	230			5.4	15.7	K	68	–	8.6
WS0734BHF	0.75	3	460			2.7	7.9	K	68	–	34.2
WS0737BHF	0.75	3	575			2.2	9.9	L	78	–	26.5
WS1018BHF	1	1	208		3.75	14.5	59.0	K	68	9.3	1.1
WS1012BHF	1	1	230			13.0	36.2	J	69	10.3	2.1
WS1038BHF	1	3	200			8.6	27.6	M	77	–	2.7
WS1032BHF	1	3	230			7.5	24.1	L	79	–	4.1
WS1034BHF	1	3	460			3.8	12.1	L	79	–	16.2
WS1037BHF	1	3	575			3.1	9.9	L	78	–	26.5
WS1512BHF	1.5	1	230		4.00	18.0	52.0	J	67	2.76	0.53
WS1538BHF	1.5	3	200			10.0	42.4	K	78	–	1.7
WS1532BHF	1.5	3	230			9.6	42.4	K	78	–	1.7
WS1534BHF	1.5	3	460			4.8	21.2	K	78	–	6.6
WS1537BHF	1.5	3	575			3.9	16.3	L	78	–	10.5
WS2012BHF	2	1	230		4.44	18.0	49.6	F	78	3.2	1.1
WS2038BHF	2	3	200			12.0	42.4	K	78	–	1.7
WS2032BHF	2	3	230			11.6	42.4	K	78	–	1.7
WS2034BHF	2	3	460			5.8	21.2	K	78	–	6.6
.WS2037BHF	2	3	575			4.7	16.3	L	78	–	10.5

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



Discharge Flange:

① 2" NPT standard

② 3" NPT optional (order an A1-3)

ITT

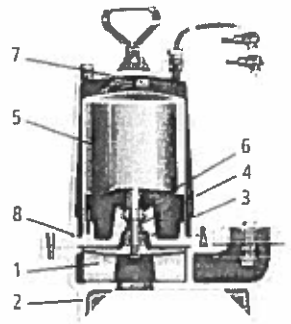
Wastewater

PERFORMANCE RATINGS (gallons per minute)

Order No.		WS03BHF	WS05BHF	WS07BHF	WS10BHF	WS15BHF	WS20BHF
HP ▶		1/3	1/2	3/4	1	1 1/2	2
RPM ▶		3500	3500	3500	3500	3500	3500
Total Head Feet of Water	10 ▶	86	110	140	–	–	–
	15	48	88	120	158	–	–
	20	–	62	98	139	186	217
	25	–	32	74	120	170	204
	30	–	–	49	101	150	190
	35	–	–	21	82	130	175
	40	–	–	–	60	110	159
	45	–	–	–	38	88	140
	50	–	–	–	–	67	120
	55	–	–	–	–	47	100
	60	–	–	–	–	29	80
	65	–	–	–	–	–	62
	70	–	–	–	–	–	43
	75	–	–	–	–	–	23

COMPONENTS *(for reference only)*

Item No.	Description
1	Impeller
2	Casing
3	Mechanical Seal
4	Motor Shaft
5	Motor
6	Ball Bearings
7	Power Cable
8	Casing O-Ring



** For repair parts, reference repair parts book.*

GOULDS PUMPS

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

B3887BHF April, 2007

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Engineered for life

MotorSaver®
THREE-PHASE ELECTRIC MOTOR PROTECTOR

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MOTORSAVER®
MODEL 460

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

BE SURE POWER IS DISCONNECTED PRIOR TO INSALLATION!
FOLLOW NATIONAL, STATE, AND LOCAL CODES!
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION!

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

The Model 460 MotorSaver® is an auto ranging voltage monitor designed to protect three-phase motors regardless of size. The MotorSaver® is used on 190-480 VAC, 50 to 60 Hz motors to protect from damage caused by single phasing, low voltage, high voltage, phase reversal, and voltage unbalance.

CONNECTIONS

1. Mount the MotorSaver® in a convenient location in or near the motor control panel. If the location is wet or dusty, the MotorSaver® should be mounted in a NEMA 4 or 12 enclosure. The MotorSaver® can be mounted to a back panel using two #6 or #8 x 5/8 screws or can be snapped onto a DIN rail.
2. Connect L1, L2 and L3 on the MotorSaver's terminal strip to the LINE SIDE of the motor starter. (See Figure No. 1).
3. Connect the output relay to the circuitry to be controlled. For motor control, connect the normally open contact in series with the magnetic coil of the motor starter as shown in Figure No. 1. For alarm operation, connect the normally closed contact in series with the control circuit as shown in Figure No. 2.

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Motor Protection & Controls Since 1974
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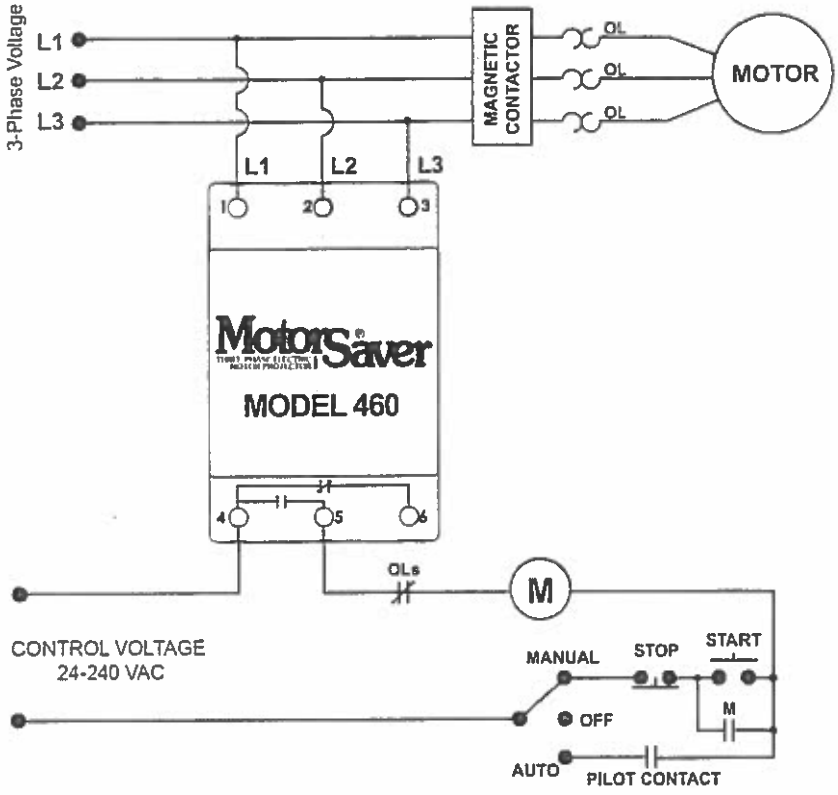


FIGURE NO. 1: CONTROL WIRING DIAGRAM

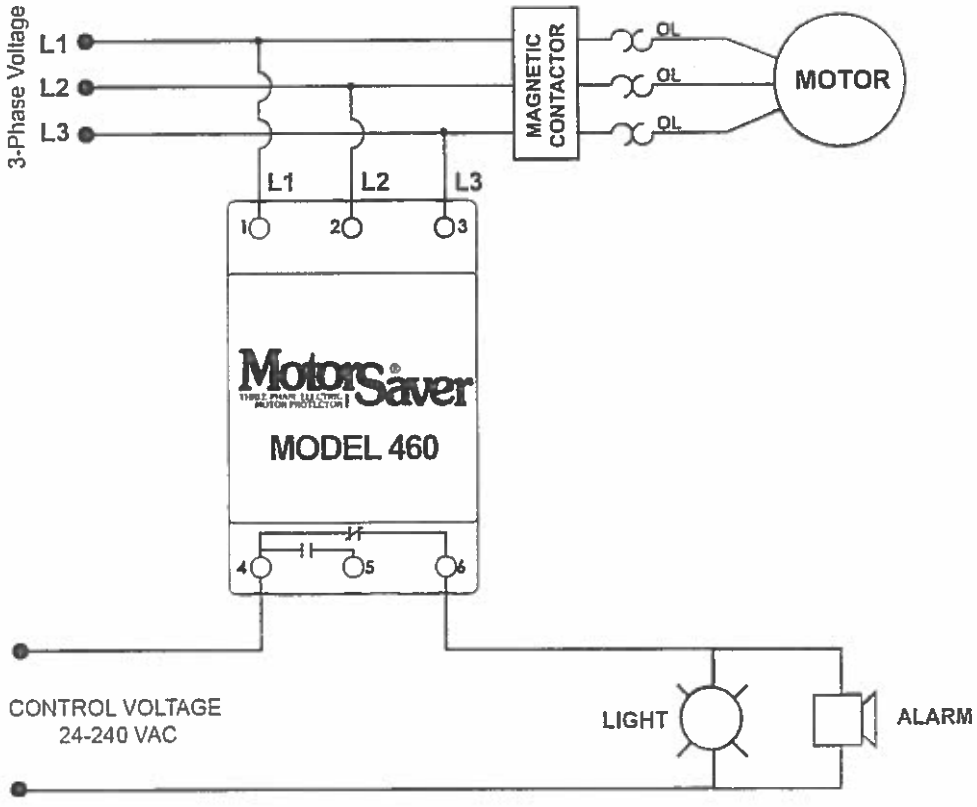
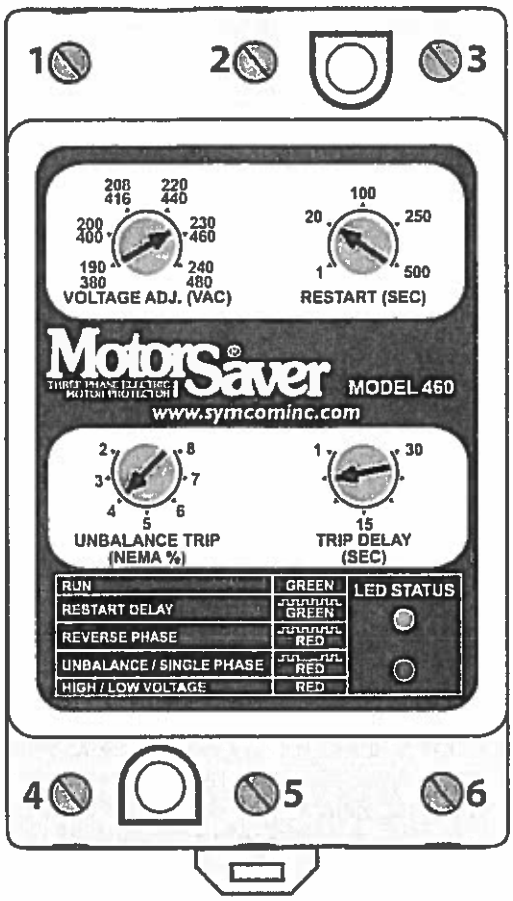


FIGURE NO. 2: ALARM WIRING DIAGRAM

SETTINGS



1. Line voltage adjustment: Rotate the **"VOLTAGE ADJ. (VAC)"** to the nominal three-phase line voltage feeding the motor to be protected.
2. Restart delay adjustment: Rotate the **"RESTART (SEC)"** adjustment to the desired position. The restart delay is the time between MotorSaver® seeing acceptable voltage and the MotorSaver® closing its output contacts. For compressor applications, the restart delay should be set for the approximate time it takes for the head pressure to bleed off of the compressor. For other applications, the restart delay is typically set between 2 and 10 seconds.
3. Trip delay adjustment: Rotate the **"TRIP DELAY (SEC)"** adjustment to the desired setting. This adjustment does not affect the trip delay on phasing faults. Typically, the trip delay adjustment is set between 1 and 5 seconds. In areas where voltage fluctuations are frequent, the trip delay adjustment may be set greater than 10 seconds.
4. Voltage unbalance adjustment: Rotate the **"UNBALANCE TRIP (NEMA%)"** adjustment to the desired unbalance trip level. The NEMA MG1 standard does not recommend operating a motor above 1% voltage unbalance without derating the motor. The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. SymCom recommends consulting the motor manufacturer for specific tolerances.

$$\text{Percent Unbalance} = \frac{\text{Maximum Deviation from the Average}}{\text{Average}} \times 100$$

Example: The measured line-to-line voltages are 203, 210, and 212.

$$\text{Average} = \frac{203 + 210 + 212}{3} = 208.3$$

The maximum deviation from the average is the largest difference between the average voltage (208.3) and any one voltage reading.

208.3 - 203 = 5.3 210 - 208.3 = 1.7 212 - 208.3 = 3.7

The maximum deviation from the average is 5.3.

$$\frac{5.3}{208.3} \times 100 = 2.5\% \text{ Unbalance}$$

POWER-UP

Turn on the 3∅ power to the motor. The MotorSaver's green RUN light will blink during the RESTART delay. After the RESTART delay, the MotorSaver® will energize its output contacts and the green RUN light will illuminate. If the contacts do not energize and the RUN light does not illuminate, see the TROUBLESHOOTING section.

DIAGNOSTIC INDICATOR LIGHTS	
RUN	GREEN
RESTART DELAY	GREEN
REVERSE PHASE	RED
UNBALANCE / SINGLE PHASE	RED
HIGH / LOW VOLTAGE	RED

CONGRATULATIONS!!
YOU HAVE JUST INSTALLED THE FINEST MOTOR PROTECTION AVAILABLE!!

TROUBLESHOOTING

SYMPTOM	LIGHT PATTERN	SOLUTION
No lights are on. The unit seems completely dead.	N / A	Measure the three line-to-line voltages. If any of the voltages are below 150 VAC, the MotorSaver® does not have enough power to operate its internal electronics. This may occur on a single-phased system. If the voltages are correct, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is blinking (on initial power up).	RED	Turn off the three-phase power. Swap any two leads powering the MotorSaver® (L1, L2, or L3). There is a 50-50 chance of connecting L1, L2, and L3 correctly the first time. Re-apply the three-phase power.
Red light is blinking (after the motor has been previously running).	RED	The incoming lines have been reverse phased. The MotorSaver® is preventing the motor from running backwards. Correct the phase sequence.
Red light is blinking in this pattern.	RED	The voltage is unbalanced or single-phased. Measure the incoming line voltages and calculate the % unbalance. If the voltage unbalance does not exceed the % unbalance reset value, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is on steady.	RED	The voltage is out of tolerance. Measure the three line-to-line voltages. Calculate the average of the three voltages. If the average is 7% above or below the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within ±7% of the selected line voltage, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Green light blinks and motor is not running.	GREEN	The MotorSaver® is in restart delay.
Green light is on steady, but motor does not start.	GREEN	The MotorSaver® is in run mode. Ensure other control devices are allowing the motor to start. Check control circuit for loose wires or malfunctioning switches.

Any questions or comments call SymCom at 1-800-843-8848 or 1-605-348-5580

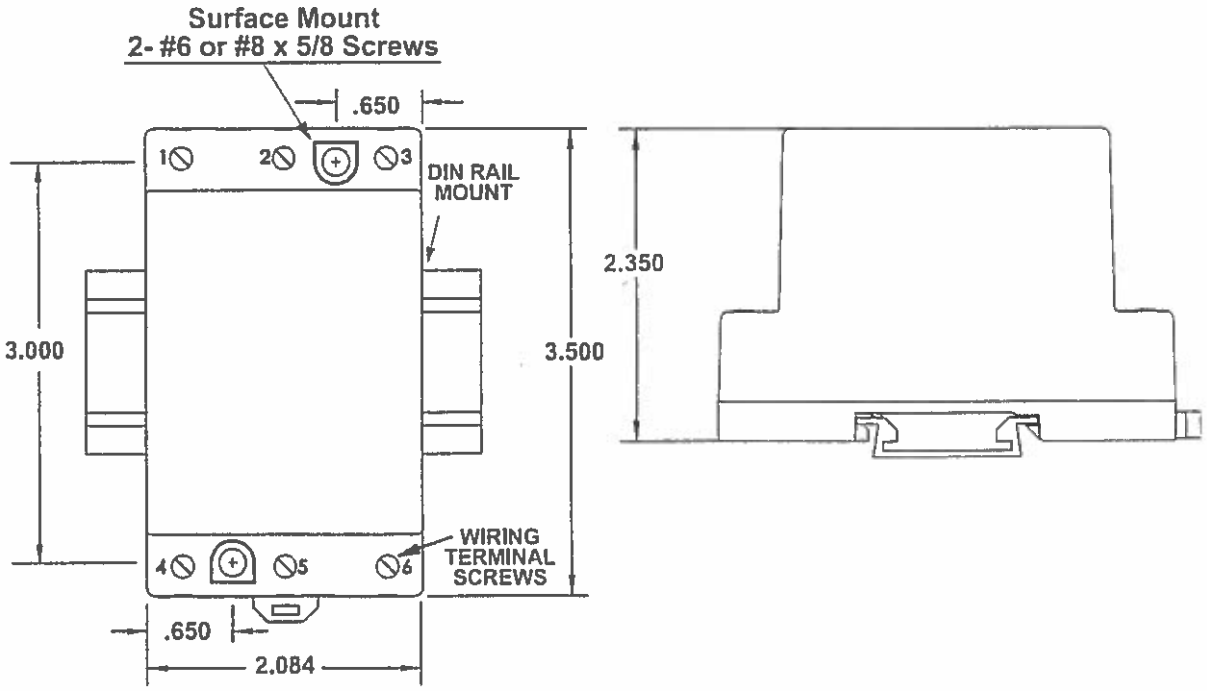
SPECIFICATIONS

3 - Phase Line Voltage	190 - 480 VAC
Frequency	50* - 60 Hz
Low Voltage (% of setpoint)	
Trip	90% ± 1%
Reset	93% ± 1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2 - 8% Adjustable
Reset	Trip Setting minus 1% (5 - 8%)
	Trip Setting minus 0.5% (2 - 4%)
Trip Delay Time	
Low, High, and Unbalanced Voltage	1 - 30 Seconds Adjustable
Single-phasing faults (>25% UB)	1 Second Fixed
Restart Delay Time	
After a fault or complete power loss	1 - 500 Seconds Adjustable
Output Contact Rating - SPDT	
Pilot Duty	480 VA @ 240 VAC
General Purpose	10 A @ 240 VAC
Power Consumption	6 Watts (maximum)
Weight	14 oz
Enclosure	Polycarbonate
Terminal	
Torque	6 Inch-Pounds Max.
Wire AWG	12 - 20 AWG
Safety Marks	
UL	UL508 (File # E68520)
CE	IEC 60947-6-2
Standards Passed	
Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6 kv contact, 8 kv air
Radio Frequency Immunity, Radiated	159 MHz, 10 V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kv input power and controls

*NOTE: 50 Hz will increase all delay timers by 20%

Surge	
IEC	IEC 1000-4-5, Level 3, 4kv line-to-line; Level 4, 4kv line-to-ground
ANSI / IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kv line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° - 70° C (-4° - 158°F) Ambient Storage: -40° - 80° C (-40° - 176°F)
Class of Protection	IP20, NEMA 1 (Finger Safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

DIMENSIONS



SymCom warrants its microcontroller based products against defects in material or workmanship for a period of five (5) years* from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material and workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, and conditions, please refer to the SymCom Terms and Conditions of Sale document.

Visit our website at www.symcominc.com for our complete catalog and new product listings!

SymCom Inc
Motor Protection & Controls Since 1974

2880 North Plaza Drive, Rapid City, SD 57702
Phone: (800) 843-8848 or (605) 348-5580
FAX: (605) 348-5685

Project Maintenance Document

27-Aug-13

RTS151 WTS, 150gpm, OWS-24, Carbo

Customer: newterra ltd.

Warning: This document does not replace the manufacturer's recommended maintenance schedules as referenced in the OM manual provided by the equipment manufacturer. It is provided as a quick guide to required OM activities for this project.

Section1: General Maintenance Activities
Section2: Cross Reference Maintenance Code to Parts
Section3: Maintenance Schedule by Hours

General Maintenance Activities

Daily

- Check the control panel for running status.
- Contact the system remotely to check system operation for:
  - Alarms
  - Operating Conditions

Weekly

- Check for Leaks.
- Check the volume of consumables. i.e. Chemicals, oil etc
- Check for excessive noise of various components.
- Check for Alarms.
- Check and record Flow Rates, Vacuums, Pressures, Temperatures, pH.
- Check for excessive moisture inside the control panels and transducer wiring boxes.
- Check for corrosion and grease the moving parts if required to reduce corrosion.

Monthly

- Test critical inputs for proper shutdown capacity.
- Test the operation of the overloads.
- Test building sump switch if it is present.

Yearly

- Test each input.
- Test alarm conditions.
- Test the operation of each output device.

Parts Listing per Maintenance Code

Fan

	Part		Qty	Module
F-7901	10329	Fan, Building, 24", 1/3hp, 1625rpm, 120/230V, 1ph, XPF	1	Building, Trailer or Skid
F-7903	M1072	Fan, Building, 12", 1/4hp, 1750rpm, 120V, 1ph, TEFC	1	Building, Trailer or Skid

Flow Meter (Liquid)

	Part		Qty	Module
FQI,FT-7001	15499	Meter, Water, 2", US Gal, w/ pulse, Turbine, DLJ	1	Liquid Phase Carbon

Gauge, Pressure

	Part		Qty	Module
PI-7001	16203	Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	2	Liquid Phase Carbon
P-4901	16203	Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60	1	Oil/Water Separator

Oil Water Separator

	Part		Qty	Module
OWS-4901	16263	Oil Water Separator, OWS-24, Stainless	1	Oil/Water Separator

Pump, Discharge

	Part		Qty	Module
P-4901	21028	Pump, Suction, Goulds, SSH Series, 4SH2K52C0	1	Oil/Water Separator

Strainer

	Part		Qty	Module
P-4901	M1523	Strainer, Wye, Brass, 3"	1	Oil/Water Separator

Vertical Level Switch (Almeg)

	Part		Qty	Module
LSHH-5201	12351	Switch, Level, Almeg, Vertical, ATB3-48B	1	Product Storage Tank

EVERY 200 OPERATING HOURS

Strainer

Remove strainer basket. Inspect strainer and empty if necessary.

EVERY 800 OPERATING HOURS

Pump, Discharge

Close-Coupled Unit
Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

Frame-Mounted Units
Regrease frame with a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seal. Then wipe off excess. Follow motor and coupling manufacturers' lubrication instructions.

Note: Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

Fan

1) Check the fan outlet pressure.
2) Check to ensure nothing is obstructing the air intake.
3) Check the fan wheel for corrosion.
4) Check the fan wheel alignment and positioning.

Flow Meter (Liquid)

Test the operation of the flow meter. Disassemble and clean the internal components if dirt or particles are preventing the meter from working properly.

Vertical Level Switch (Almeg)

1) Test the operation of the switch.
2) Remove the switch and check for debris buildup that can potentially cause a failure of normal operation.

EVERY **4000** OPERATING HOURS

Gauge, Pressure

1) Check accuracy of gauges.
2) Zero gauge if required.

Oil Water Separator

After the first 6 months of operation, the inlet should be inspected and cleaned as follows:
1) Stop the flow of influent to the separator.
2) Remove separator cover.
3) Dispose of separated oil per regular procedures.
4) Remove water from separator through drain or hose. Measure and record the depth of the solids. Use this measurement as the timing basis for the next solids inspection and clean out. Consult OWS drawing for depth of sludge baffle. Solids should not exceed this depth.
5) The HD Q-PAC plates can be either cleaned in place or removed and cleaned.
6) Examine the tank interior for damage and repair any damage to internal coating.
7) To restart separator, install HD Q-PAC plate packs and polishing pack in original position. Make sure that both are securely in place so that they do not float when unit is operational.

WINTER OPERATION AND STORAGE IN COLD CLIMATES

GENERAL

Systems operating in climates where seasonal temperatures regularly fall below freezing may need to be winterized. Depending on the equipment in the system, different steps must be taken to prepare for winter operation.

If the system is going to be shut down and stored for the winter, additional measures should be taken above and beyond normal maintenance practices for an extended shut down.

SYSTEMS OPERATING THOUGH THE WINTER

- Confirm that the enclosure heater is working. This can be done by adjusting the set point on the low temperature switch (TSL) to a setting above the ambient temperature inside the enclosure. Verify that the heater has turned on before adjusting the setting on the low temperature switch to a point above 32℉. If the heater is controlled by a temperature transmitter (TT), the set point can be adjusted through the HMI.
- Confirm that the control panel heater is working by adjusting the thermostat inside the panel – follow the procedure above.
- If the enclosure has a sump with a high level switch, ensure the sump is free of water to prevent ice from forming and potentially disabling the switch.
- If the system has a heat exchanger or rotary screw compressor, provisions may be included to prevent cycling cold air through the system. Depending on the design of the system, the following options may be available for winter operation:
    - Systems where the heat exchanger/compressor is recessed from the wall or ceiling, by removing the hood and withdrawing the insert, the discharge port can be fully or partially boarded up to allow warm air to be re-circulated back into the enclosure. See Figure 1.
    - The hood provided on the exterior of the enclosure may have been designed to allow air to be re-circulated back into the container through a duct on the wall above the heat exchanger/compressor or through the roof. See Figure 2.

Note: Depending on the parameters of the system, the above mentioned options may need to be fine-tuned onsite to optimize performance of the system. While these methods are good for maintaining the temperature inside the enclosure above freezing, there are some situations where too much air is being re-circulated and the heat exchanger is not able to cool the process air sufficiently. This will cause the high temperature switch on the discharge of the heat exchanger to trip and send the system into alarm.

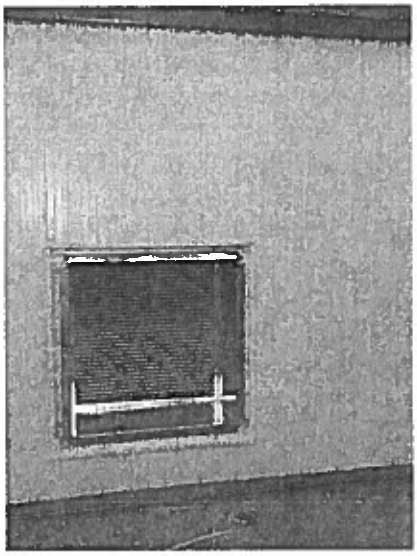


Figure 1: Recessed Heat Exchanger

Figure 2: Re-circulating Hood

SYSTEMS BEING STORED THROUGH THE WINTER

- All water must be drained from the system where possible.
- Valves should be left open to allow ice to expand in the event residual water was left in the system without damaging piping or equipment.
- Additional O&M as required for long-term system shutdowns.

WINTERIZING PROCEDURE

Progressive Cavity Pumps (Moyno)

- Remove bolts from pump end and ensure all water is removed.

Centrifugal Pumps (Goulds)

- Remove drain plug on the bottom of the outer steel body. Keep in mind water inside lines will also drain through these plugs depending on elevations.

Inlet Manifolds

- Drain all water from SVE and ground water extraction manifolds.

Vapor/Liquid Separators

- Drain all water from VLS.

Bag Filter Housings

- Drain all water and remove bag filter from housing.
- Pour antifreeze into bottom of housing ensuing drain valve is closed.

Oil/Water Separators

- Pour antifreeze in bottom of OWS, filling 1 to 2" from the bottom, ensuring drain lines are filled with antifreeze.

Air Strippers

- Sump should be drained and trays disassembled.
- Pour antifreeze in bottom of stripper and ensure drain lines are filled with antifreeze.

Air Compressors

- Drain receiver tank of any condensate.

Water Flow Meters (Paddlewheels and Rotameters)

- Remove via unions and drain. Store for the winter.

CAUTION

Freezing water poses a serious threat to the equipment in a system. Pipes, vessels and pumps can be severely damaged by freezing water.

Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Electrical Motor		
Motor will not start and there is no noise.	Motor may not be receiving the proper power.	Check fuses and power distribution between power lines to motor.
	Overload is tripped.	Reset overload.
	Main power may be off.	Check main power.
	Contactor may not be closing because motor is in manual position.	Switch motor to Auto position.
	Contactor may not be closing because PLC is not telling output to be on.	Check PLC operating sequence to determine if a start requirement is not met.
Motor will not start but makes a humming noise.	One of the phases of power is not getting to the Motor as a result of a blown fuse.	Change fuse.
	One of the phases of power is not getting to the Motor as a result of a poor wire connection.	Check wiring for a loose wire or a poor connection.
	The driven component (i.e. pump) will not spin and could be seized up.	Disassemble driven component, check clearances and clean internal components and replace any damaged components.
	Bearing on drive shaft of motor or driven component may be seized up.	Replace bearings.
Overloads trip immediately after startup.	Check for short circuit in motor windings.	Re-wind motor.
	One of the phases of power is not getting to the motor as a result of a blown fuse.	Change fuse.
	Motor power wires may be shorting out to ground.	Search for wiring short and replace wiring if required.
	Motor may have too much load or backpressure as a result of operating the driven component outside of its operating capabilities.	Check operating capabilities of driven component. I.e. Ensure positive displacement pump is not over pressured or that centrifugal pump is not operating at too high a flow rate.
Motors amps are above the allowable value on the nameplate.	Motor may be designed to operate on the upper limit.	Calculate maximum allowable amps. Name plate amps x safety factor.
	Driven component may have scale build up inside.	Clean internal components of driven component.

	Driven component may be rotating in the wrong direction.	Check direction of rotation and switch rotation of motor if it is incorrect.
	Check voltage of power. Low voltage results in high amps.	Adjust overloads for higher amps if the difference is only slight, otherwise change power or motor.
Centrifugal Pumps		
Pump does not produce sufficient pressure/vacuum.	Pump is not primed.	Prime pump.
	Pump is rotating in wrong direction.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Pump is not operating at required RPM.	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost due to an obstruction located between the pump and gauge.	Check for flow restrictions and clean strainers or piping if required.
	Pump is not turned on.	Turn pump on.
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. This is often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
Pump flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.

Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if needed. Replace flexible coupling if it is degraded.
Liquid Ring Pump		
Pump does not produce enough vacuum.	Pump is not primed.	Prime pump and start under vacuum.
	Service fluid is to low in seal oil tank.	Add seal oil.
	No restriction on inlet of pump.	Close valves to create suction.
	Dilution valve is open.	Close dilution valve.
	Service fluid is not flowing into the pump.	Check for flow restrictions in service fluid lines. Check strainer.
	Pump is rotating in the wrong direction.	Check and change direction if required.
	Vacuum gauge is not working correctly.	Replace vacuum gauge.
	Pump seals may be allowing air into the pump.	Check for leaking and replace seals if required.
	Pump is too small for application.	Replace pump.
	Vacuum relief valve is set too low.	Replace or reset vacuum relief valve.
	Air may be leaking into vapor lines.	Check for air leaks in vapor lines.
	Pump internal components are damaged.	Disassemble pump and replace components if required.
Pump is making a growling noise.	Cavitation is occurring.	Decrease the vacuum.
	Insufficient seal fluid flow or excessive seal fluid flow.	Increase/decrease seal fluid flow rate.
Pump is leaking.	Gaskets are faulty.	Replace gaskets.
	Mechanical seal has been overheated or is faulty.	Replace mechanical seal.
	Oil may be leaking from 1/8" vacuum relief valves in pump housing.	Remove valves and install plugs.
Pump is running too hot.	Seal fluid strainer is plugged restricting seal fluid.	Clean out strainer.
	LRP is not providing enough suction to draw sufficient seal fluid.	Increase seal oil suction. Pipe seal fluid into a higher vacuum port of pump.

	Seal fluid flow rate is too low.	Open seal fluid control valve to allow more seal fluid to enter the pump.
	Seal fluid heat exchanger is not working properly.	Check heat exchanger.
Excessive discharge pressure built up in seal oil tank.	Demister filter is plugged and requires replacement.	Replace demister.
	Seal oil is not being drawn out of demister filter through scavenger line.	Increase vacuum of LRP to allow oil to be sucked through scavenger line. Ensure that scavenger line has sufficient vacuum to draw oil out of the demister filter.
Seal Oil Low Level Alarm	Seal oil temperature may be operating too high causing the oil to evaporate.	Check seal oil operating temperature and increase seal oil flow.
	Seal oil suction line may be plugged causing seal oil to collect in bottom of demister filter.	Check for plugging of seal oil return line and clean or replace if required.
Air to Air and Air to Fluid Heat Exchangers		
Heat exchanger fan is drawing too many amps.	See troubleshooting for motors.	
	Fan blade pitch and diameter may be wrong.	Change fan blade.
	Motor may be operating at wrong RPM for fan blade.	Replace motor or fan blade.
	Check clearance of fan blade.	Make adjustments if blade is making contact.
Phase Separator		
Water will not pump out of phase separator.	Base of separator may be plugged with sand.	Flush sand and debris out of separator.
Electric Solenoid Valve		
Valve will not completely shut.	May have dirt or rocks preventing it from shutting properly.	Disassemble and clean out internal components.
Valve will not open	Check for power to solenoid.	Trace power lines and determine why power is not going to valve.
	PLC may not be telling it to open.	Check start requirements in manual.
	Coil may be damaged or faulty.	Replace coil.
Level Switches		
Level switch is staying closed when water in tank drops below switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.

	Sight glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick up.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed closed regardless of the switch position.	Replace switch.
	Wiring to level switch may be shorting out to ground causing the switch to appear closed at all times.	Disconnect switch from system wiring and separate system wires so they are not in contact with each other or any metal. If the input is still on, the input wiring is being grounded somewhere. Find short and replace or fix wiring.
	IS barrier is shorted out internally.	Switch IS barrier with working barrier and if problem goes away then the barrier may be faulty and should be changed.
	Input wiring is loose in terminal strip.	Tighten terminal strip where field wiring is brought into panel.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.
Level switch stays open when water in tank is above the switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick down.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed open regardless of the switch position.	Replace switch.
	IS barrier is blown preventing the level switch signal from crossing the barrier.	Switch IS barrier with working barrier and if problem goes away then the barrier may be blown. If barrier is blown, the input wire on the right side of the barrier will have 24 V DC and the wire on the opposite side will have 0V DC.
	Level switch is wired incorrectly.	Consult input wiring diagram and inspect wiring of level switch. Change if required.

Regenerative Blowers		
Blower does not produce sufficient pressure/vacuum.	Blower is not turned on.	Turn on blower.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Blower is not operating at required RPM.	Check and replace motor if required.
	Blower has wrong sized impeller.	Check impeller and replace if required.
	Pressure or vacuum is lost due to obstruction located between blower and gauge.	Check for flow restrictions and clean strainers or piping if required.
Blower is leaking.	Fittings are leaking on or around blower.	Tighten fittings.
Blower flow rate is too low.	Backpressure is too high for blower.	Reduce backpressure.
	Blower may not be sized correctly for process.	Replace blower.
	Blower impeller is too small.	Change blower impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.
Air Stripper		
Stripper leaks.	Gaskets are leaking.	Apply silicon grease to gaskets and close up stripper. If they cannot be fixed the gaskets may need to be replaced.
Pressure or vacuum is building up in stripper.	Stripper is being fouled by mineral precipitates.	Clean stripper with acid to dissolve precipitates.
	Airflow rate through stripper has risen or is above the design value.	Decrease airflow rate.
Stripper is not cleaning contaminants sufficiently.	Inlet concentrations are higher than the design values.	Decrease water flow rate to obtain required stripping capacity.
	Flow rate of water through stripper is too high.	Decrease flow rate allowing longer residence time in stripper.
	Water temperature is lower than the design (below 60°F).	Increase water temperature or slow down water flow rate or increase airflow rate.
	Airflow rate is not high enough.	Increase airflow rate or decrease water flow rate.

	Products that are not easily strippable may be in higher concentrations than originally planned.	Consult manufacturer with test results of discharge contaminants.
	Stripper may have been shut down manually causing the contaminated water in the trays to fall into the sump without being cleaned.	Allow stripper to go through proper shutdown cycle when stopping the unit.
	Stripper may be setup wrong allowing the water to bypass trays.	Check orientation of trays to ensure water will flow through each tray properly.
	Some contaminants may be present that are affecting the ability to strip other contaminants.	Consult manufacturer with test results of intake and discharge contaminants.
	Increase in pressure causes a decrease in airflow resulting in a decrease of contaminant concentrations.	See pressure rise in stripper troubleshooting above.
Water is collecting in discharge piping of stripper.	Air leaving the stripper is very humid and will condense some water in the pipelines.	Install a knockout drum in discharge line before air is piped to another section of the process.
	The stripper causes foaming of the water which results in water collecting in the discharge lines.	Test for foaming contaminants such as soaps and install antifoaming dosing system to prevent foaming.
	Airflow rate is higher than the design value causing water to be carried over into the discharge lines.	Decrease flow rate to within design range.
Stripper often shuts down on a high stripper sump alarm.	Transfer pump is flowing faster than the discharge pump.	Slow transfer pump or speed up discharge pump.
	Discharge pump is not working properly.	Troubleshoot discharge pump.
Moyno Pumps		
Pump does not produce sufficient pressure/vacuum.	Pump is not primed.	Prime pump.
	Wrong direction of rotation.	Check and change rotation if required.
	Vacuum or pressure gauge is faulty.	Replace gauge.
	Pump is not operating at required RPM.	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost due to obstruction located between pump and gauge.	Check for flow restrictions and clean strainers or piping if required.

	Pump is not turned on.	Turn pump on.
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. This is often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
	Pump was run in reverse allowing the rotor to spin off of the pump shaft.	Disassemble pump and screw rotor back onto shaft (See manufacturer's manual).
Pump flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter.	Replace filter and clean line.
Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if needed. Replace flexible coupling if it is degraded.
Pressure Switch/Vacuum Switch		
Switch is not reacting at desired set point.	Switch is out of adjustment.	Change set point to desired value.
Switch is not working.	Switch may be faulty.	Remove input wires and test switch at desired pressure. If it does not trigger, it should be replaced.
Flow meter		
Flow meter is not rotating.	Dirt could have caused meter internals to jam up.	Disassemble flow meter and clean internal components.
Flow meter is rotating but pulse input is not working.	Switch on meter may be faulty.	Remove wiring and test contacts on meter to ensure that they are opening and closing. If not meter head needs to be replaced.

	Input wiring may be grounding out preventing the signal from opening and closing.	Test input wiring by isolating input wires and checking if input is on. If so you have a grounded input wire.
	Input to PLC is not working.	Simulate rotating meter by contacting input wires together and check for a detected flow rate and change in totalized flow.
Belt Driven Assemblies		
Squealing noise occurs on startup.	Belt is too loose.	Check tension of belt and tighten if required.
Excessive wear on bearings.	Belt is too tight.	Loosen belt tension.
Belt is wearing excessively.	Check orientation of blower and motor.	Adjust orientation if required.
Carbon Vessel		
Vessel is operating over pressure.	Silt may have collected in water phase vessel.	Remove lid and check for silt. Remove top layer of silt or replace vessel.
Vessel is breaking through earlier than expected.	Flow rate through vessel may be too high. Check design specifications.	Decrease flow rate.
	Air contaminant concentrations are higher than expected.	Test inlet concentrations.
	Check piping orientation to ensure that water is going in the top of water phase vessels and air is going in the bottom of air phase vessels.	Repipe vessel if piping is wrong.
	Ensure that there is not a large trapped air gap in the top of the water phase carbon vessel allowing the water to bypass a portion of the carbon.	Release air gap if present.
Bag Filter		
Vessel is operating over pressure.	Bag filter may be full of dirt and silt.	Remove cover and check for dirt buildup in the bag. Replace filter element if required.
	Equipment down stream of bag filter may be plugging.	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure.	Check pressure output of pump with pump curve. Replace pump if needed.
Filters are plugging too fast	Filter element micron size may be too low.	Install larger micron filter element.

	Filter pressure switch setpoint may be too low.	Increase high pressure shutdown setpoint.
Oil Water Separator		
Water is collecting in product tank	Oil water separator may not be level causing water to spill into the skimmer tube.	Check level of oil water separator and adjust if necessary.
	Skimmer tube is not adjusted properly.	Check position of skimmer tube ensure that tube is rotated so the skimming slot allows at least 1-2" of oil to collect before spilling over into the oil tank.
	Skimmer tube is cracked or leaking.	Check that skimmer tube is not cracked, replace if necessary.
	Separator can be full of sludge on the bottom restricting water flow through to the clean water reservoir.	Check for dirt buildup in bottom. Drain and clean separator if necessary.
Oil is collecting on the clean water side	Oil water separator may be operating outside of design parameters.	Check that specific gravity of product and flow rate of separator match site-specific design print out for oil water separator. This can be found in the oil water separator section of your **newterra** manual or submittal package.
	Oil water separator was not primed with clean water on startup and large amounts of product were initially pumped into separator contaminating the clean water sections.	Drain separator, clean separator and media, and fill with clean water before proceeding.
	Silt can build up in the bottom of the separator restricting volume capacity and flow through media.	Inspect bottom of separator and inside of media. Drain and clean separator and clean or replace media if plugged or restricted.
	Inlet side of separator can have excessive amounts of oil on the top layer. This will reduce effective capacity of oil water separator.	Check level of oil collected in inlet side of separator. Adjust skimmer if required. Re-prime separator so only 1-2" of product remains on the top of the separator.
	Biological bacteria is suspending product in high-density mucus like collections that are passing through the separator.	Check for signs of bacteria in the inlet side of the separator. Contact **newterra** to discuss solutions to eliminating biological suspension.
	Product may be made up of two different components. The component breaking through may have a different density from what the separator was designed for.	Collect a sample of what is breaking through and confirm that it has the same properties as the product collecting on the inlet side.

	Oil storage tank may be full and high-level alarm not working properly. This will back the product up and fill the inlet side of the separator with product until the product passes under the lower weir and collects in the clean-water side.	Check product storage tank and ensure that level switch is working properly and that tank has not overfilled.
Oil and water is building up on inlet side but is not passing through separator and collecting in the clean water side.	Sludge and dirt may have built up on floor of separator preventing the water from passing by the lower weir.	Check for dirt buildup on bottom of separator. Drain and clean if necessary.
	Oil Water interface may be too low indicating that the separator has insufficient water to properly separate.	Fill the separator with clean water allowing water to collect in the inlet side forcing the oil water interface level to rise up too about 1" - 2" below the skimmer level.
	Only product is being pumped into inlet of separator.	If water is not present in sample entering the separator then it will not collect in the clean water side.
Water is in the oil outlet.	Skimmer opening is below the oil/water interface.	Adjust skimmer alignment to allow more oil to collect before skimming.
Oil is making its way to the outlet.	Water flow rate is too high.	Reduce flow rate through system.
	Filter media is plugged.	Replace or clean media.
	Oil discharge is plugged backing up OWS.	Drain oil down stream of skimmer.
Sand Filter		
Vessel is operating over pressure.	Sand filter may be full of dirt and silt.	Remove cover and check for dirt buildup on top of filter. Backwash filter.
	Equipment down stream of sand filter may be plugging.	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure.	Check pressure output of pump with pump curve. Replace pump if required.
Filters are plugging too fast.	Filter was not backwashed properly.	Backwash filter vessel as per manufacturer's instructions.
	Filter pressure switch setpoint may be too low.	Increase high-pressure shutdown setpoint.
	Filter sand has solidified with calcification.	Replace sand in filter.

	Process water flow rate is operating above the design flow rate for the sand filter.	Check process flow rate and compare with design flow rate listed on manufacturer's literature or on the component sheet of the sand filter section of your **newterra** Manual.
Rotary Screw Compressor Package		
Compressor not starting.	Motor Overload.	Reset overload. Check compressor output pressure. Oil separator may be dirty, replace if needed. Check supply voltage.
	Stopped by compressed air temperature relay.	Oil level is too low. Not enough cooling air flow. Wrong compressor oil. Ambient temperature too high. Cooler dirty.
Insufficient air output.	Clogged intake filter.	Check condition of the filter and replace if needed.
	Clogged oil separator element.	Check condition of the oil separator element and replace if needed.
	Pressure switch is not working.	Check pressure switch adjustment. Repair or replace if switch is faulty.
	Receiver blow down valve open.	Disassemble and clean out internal components.
	Too high air consumption.	Check network for leaks and air powered devices.
	Drive belt slipping.	Check tension of belt and tighten if required. Replace belt if worn.
Compressor overheating.	Insufficient amount of oil.	Add more oil.
	Clogged oil filter.	Check condition of the filter and replace if needed.
	Cooler dirty.	Clean.
	Ambient temperature too high.	Check temperature and air circulation.
High oil consumption.	Oil return tube or its orifice is blocked.	Open and clean all internal components.
	Oil separator or sealing damaged or loosened.	Check seals and repair if needed.
	Oil separator dirty.	Replace.
	Wrong compressor oil.	Change oil. Use the correct oil as specified in the manufacturer's instructions.
	Output air temperature too high.	Check output temperature correct if it is too high.

	Faulty non-return valve of oil return pipe.	Check operation and replace valve if needed.
	Too much oil.	Drain extra oil out.
Network pressure rises over set valve.	Pressure switch is not working or damaged.	Check operation of switch.
	Output valve leaking.	Replace seal.
	Loose wire connections.	Check for loose wires and correct as needed.
Compressor doesn't restart automatically.	Pressure switch damaged.	Replace pressure switch.
	Output valve leaks.	Replace seals of output valve.
	Loose wires.	Check for loose wires and correct as needed.
Compressor doesn't stop automatically.	Output valve leaks.	Replace seals of output valve.
	Pressure Switch Damaged.	Replace pressure switch.
Refrigerated Dryer		
Water down stream of dryer.	Residual air in piping.	Blow out system with dry air.
	Air bypass system is open.	Check the bypass valve position.
	Inlet and Outlet conditions are reversed.	Check for correct connection.
	Air temperature on outlet of dryer may be too low.	Add heat trace to piping.
	Automatic drain mechanism is not working.	Replace drain mechanism.
	Dryer overloaded.	Check flow rate and inlet temperature.
High pressure drop across dryer.	Inlet air strainer clogged.	Clean inlet air strainer.
	Excessive air flow.	Check flow rate and reduce if needed.
	Separator filter clogged.	Replace filter sleeve.
	Freezing of moisture in evaporator.	Shut down dryer until system thaws.
Fault Alarm.	Dryer overloaded resulting in high air outlet temperature.	Check operating conditions.
	High outlet air temperature.	Correct high temperature.
	Thermostat switch is malfunctioning or not securely mounted.	Replace thermostat switch.
Refrigeration system not functioning properly in on position.	Power failure.	Check power.
	Line disconnect switch is open.	Check disconnect.

	Fuses blown, breaker blown.	Check fuses or breaker.
	Loose or faulty wiring.	Check wiring.
Refrigeration system cycles on and off.	High or low ambient conditions.	Check min/max temperature ranges.
	Air filter clogged.	Clean filter.
	Condenser fins clogged.	Clean fins.
	Fan motor or control switch not working.	Replace fan motor or switch.

Analog 4-20mA Transmitters		
Transmitter is sending a signal that is not accurate.	There may be water in the air sampling lines that is throwing off the readings.	Drain any moisture out of the air sampling lines.
	Transmitter may be out of calibration.	Refer to transmitter specification sheets on how to calibrate the transmitter. Note if transmitter is more than 10-25% out of calibration it will likely require factory recalibration.
Transmitter is sending 0-2 mA to the PLC input.	Transmitter may not be wired properly or one or more wire connections may be loose.	Check wiring with device specification sheet and newterra drawing. Check wiring for loose connections.
	Transmitter may be damaged or not working properly.	If you have a similar transmitter installed in another location on the system, switch them around to determine if the faulty transmitter works in another location. If the transmitter works you know the transmitter is not the problem. If the transmitter does not work in the other location then it is likely the transmitter. If the good transmitter does not work in the faulty location the problem is likely the wiring at that location or the input into the PLC.
Transmitter is sending over 20 mA to the PLC.	Transmitter is likely damaged.	Send back to manufacturer for re-calibration.
PLCs		
Power is on, Lights are on but PLC is not running the logic. Run light is not on.	PLC may not be in run mode. If the power has been off to the panel for an extended period of time, the PLC will switch out of run mode and stop running the logic.	Use external switch on PLC to switch from "term" to "run" then back to "term". This will force the PLC back into run mode. The run light should now indicate that the PLC is in run mode.
Power is on to panel but PLC lights are not on.	Fuse for PLC is pulled out or blown.	Test PLC fuse and replace if necessary. This is in the "PLC" fuse holder.