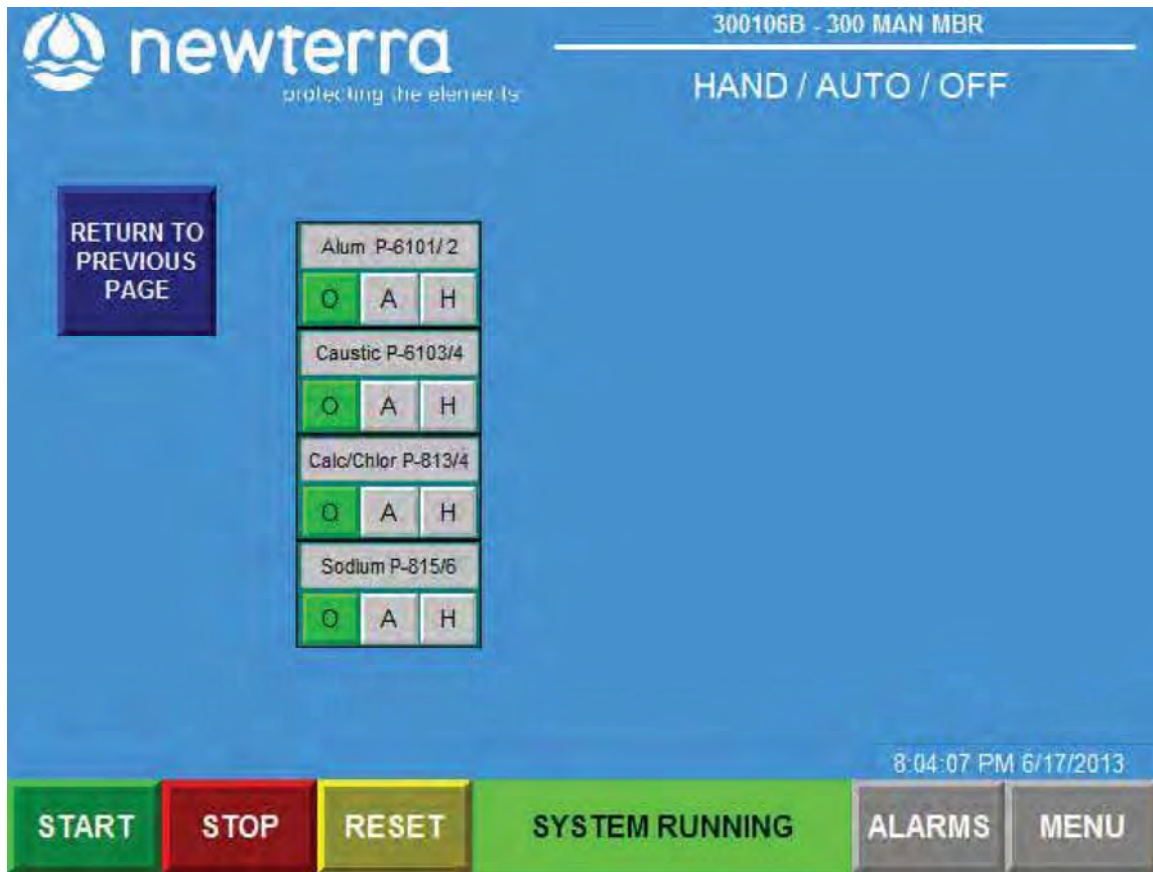


5.2.4 System HAO's (HAND /AUTOs/ OFF)

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

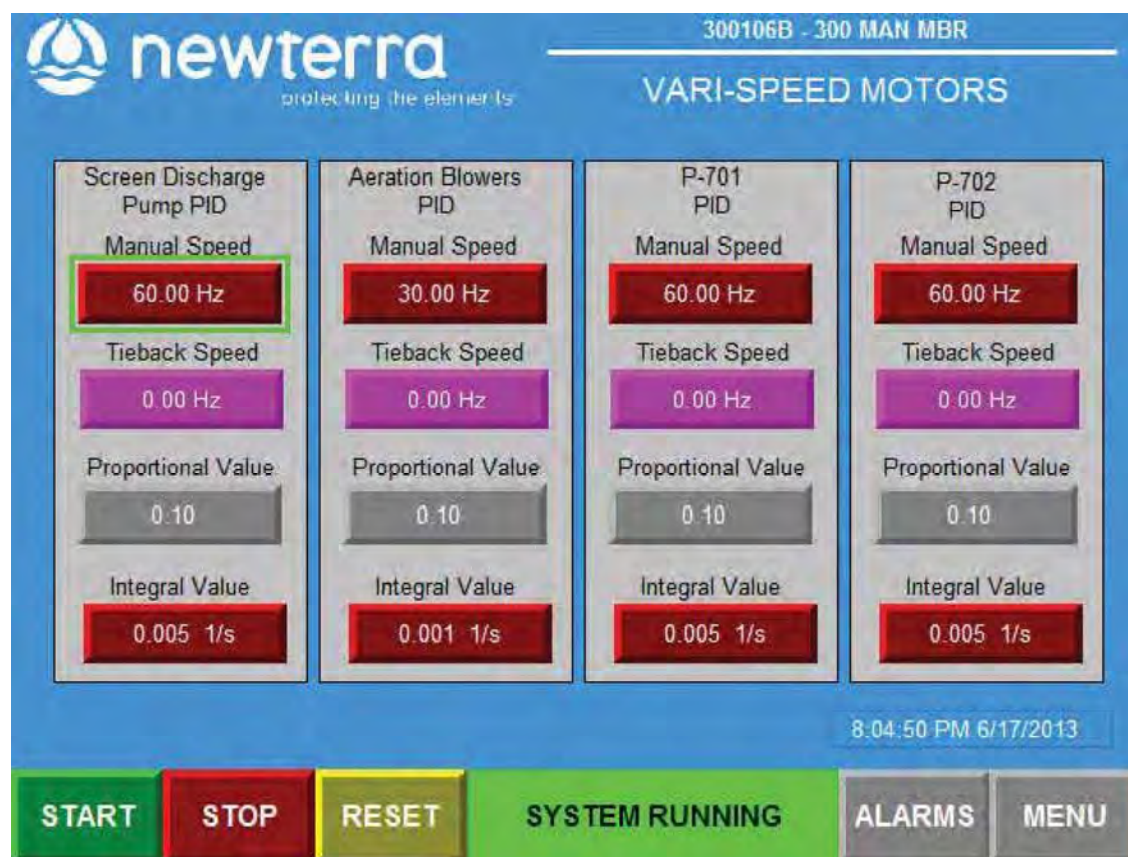


- Each PLC controlled motor or valve in the system has a **Hand/Auto/Off (HAO)** Switch to control its operation. This screen displays all the system HAO's
- For normal operation, all switches should be in the **AUTO (A)** position
- The **HAND (H)** position of a switch is used for testing and troubleshooting 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



5.2.5 Motor Info Control Screen

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



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).

newterra 300106B - 300 MAN MBR
protecting the elements

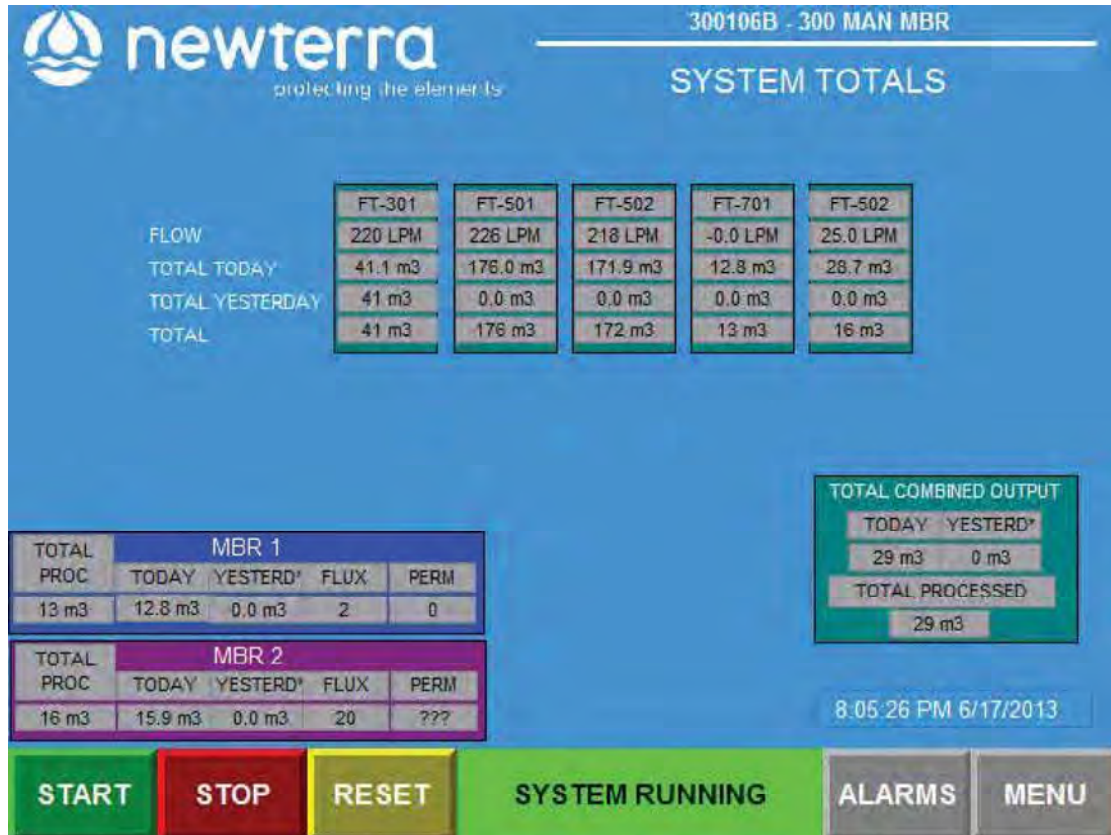
Motor Hours

DEVICE	SERVICED	REPLACED	OPTIONS		DEVICE	SERVICED	REPLACED	OPTIONS	
SCR-201	1	1	SERVICED	REPLACED	P-601	9	9	SERVICED	REPLACED
P-201	3	3	SERVICED	REPLACED	P-602	8	8	SERVICED	REPLACED
P-202	7	7	SERVICED	REPLACED	B-601-5	15	15	SERVICED	REPLACED
P-301	3	3	SERVICED	REPLACED	B-606-10	16	16	SERVICED	REPLACED
P-302	0	0	SERVICED	REPLACED	P-701	8	8	SERVICED	REPLACED
SCR-401	1	1	SERVICED	REPLACED	P-702	8	8	SERVICED	REPLACED
P-401	3	3	SERVICED	REPLACED	P-801	0	0	SERVICED	REPLACED
P-402	7	7	SERVICED	REPLACED	P-811	0	0	SERVICED	REPLACED
P-501	13	13	SERVICED	REPLACED	P-812	1	1	SERVICED	REPLACED
P-502	13	13	SERVICED	REPLACED	C-901	0	0	SERVICED	REPLACED
P-503	11	11	SERVICED	REPLACED	P-503	0	0	SERVICED	REPLACED
B-501	11	11	SERVICED	REPLACED	SPARE				
B-502	3	3	SERVICED	REPLACED	SPARE				

START STOP RESET SYSTEM RUNNING ALARMS MENU

5.2.7 System Totals

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

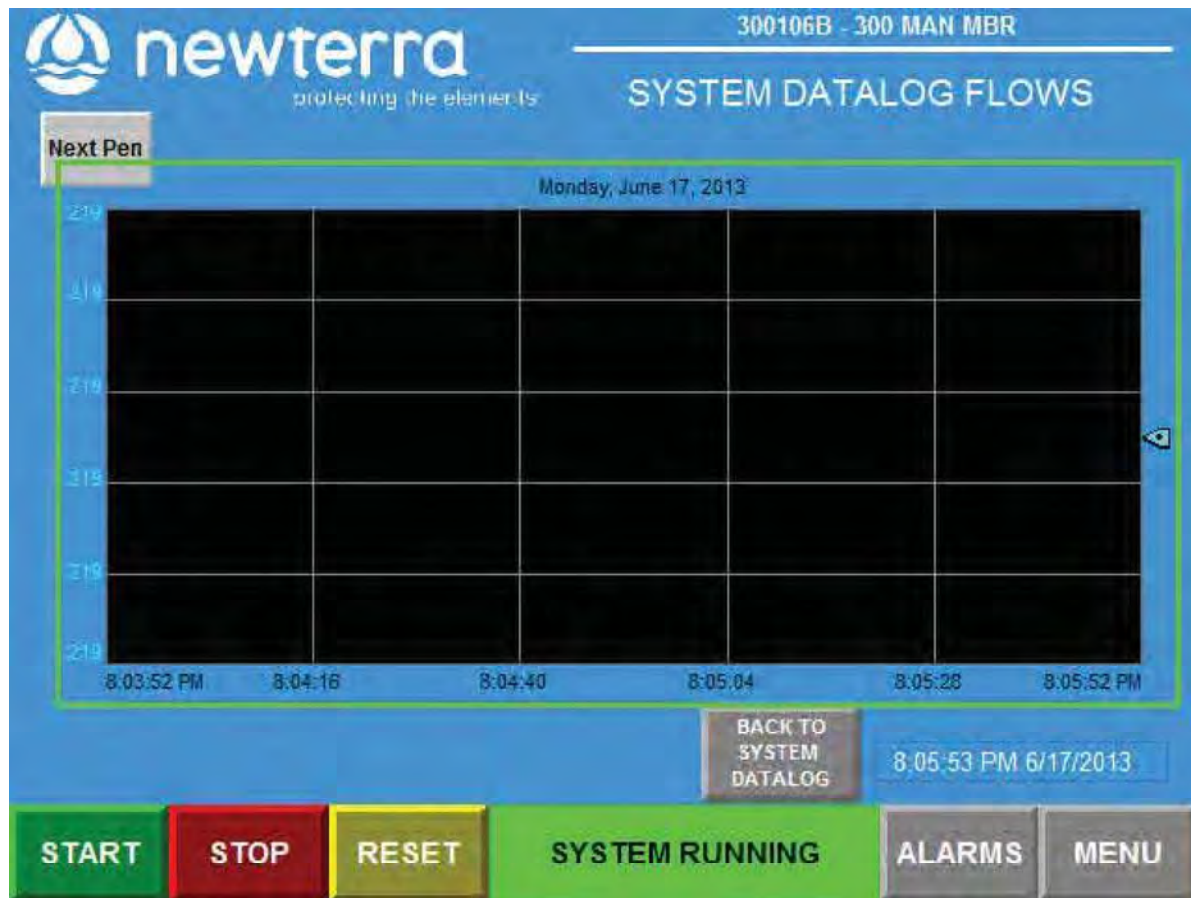


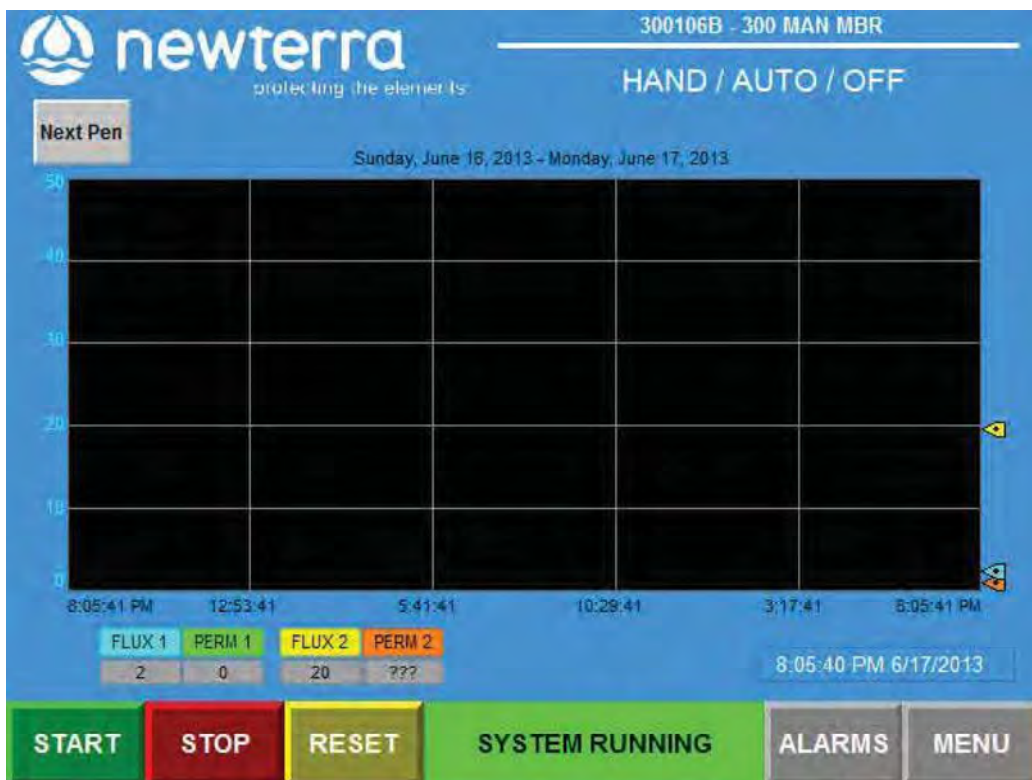
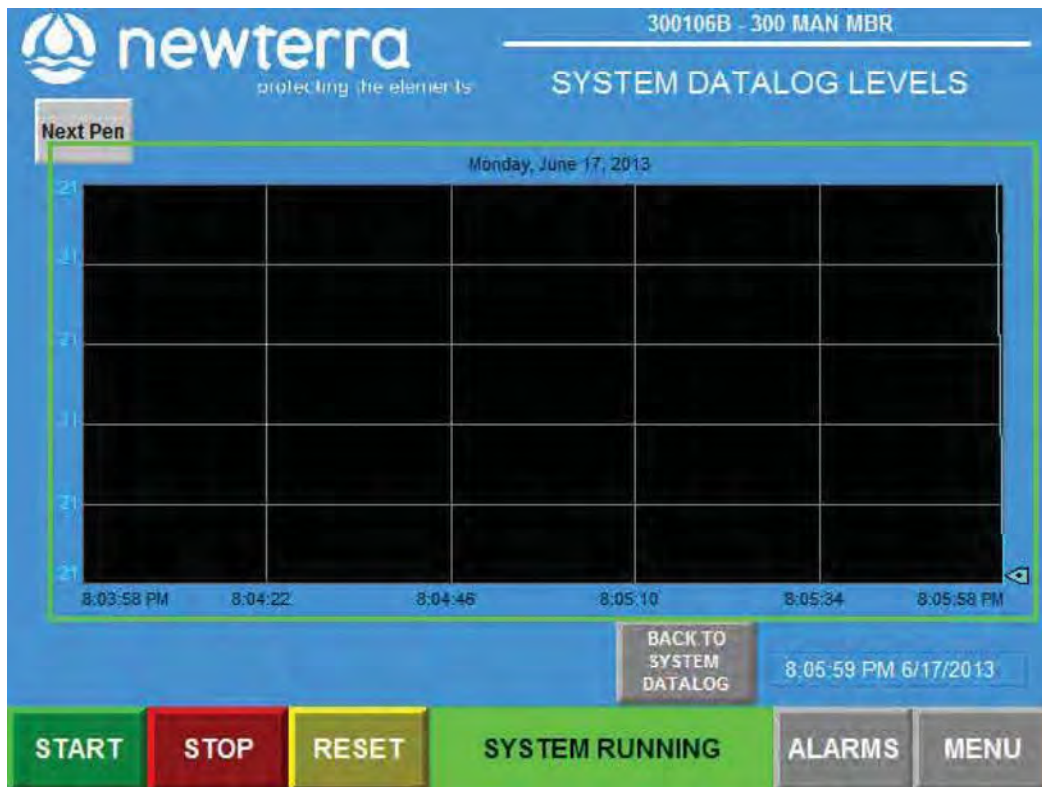
This screen is used to show:

- 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**

5.2.8 System Data Log Screens

- The following screens show how system is setup with extensive data 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





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 (m³)


V_t : Total volume of process tanks in MBR system (m³)

$MLSS_s$: 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).

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.

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

 <p>ATTENTION</p>	<p>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.</p>
---	--

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
Backwashing	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.

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	$F:M = [\text{Flow (m}^3/\text{d)} \times \text{BOD conc (mg/l)}] / [\text{Process volume (m}^3) \times \text{MLSS conc (mg/l)}]$
F:M (kg COD/kg MLSS/d)	0.15	0.05 – 0.3	$F:M = [\text{Flow (m}^3/\text{d)} \times \text{BOD conc (mg/l)}] / [\text{Process volume (m}^3) \times \text{MLSS conc (mg/l)}]$
SRT	> 15	12 – 50	

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

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 / <i>E-Coli</i>				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.

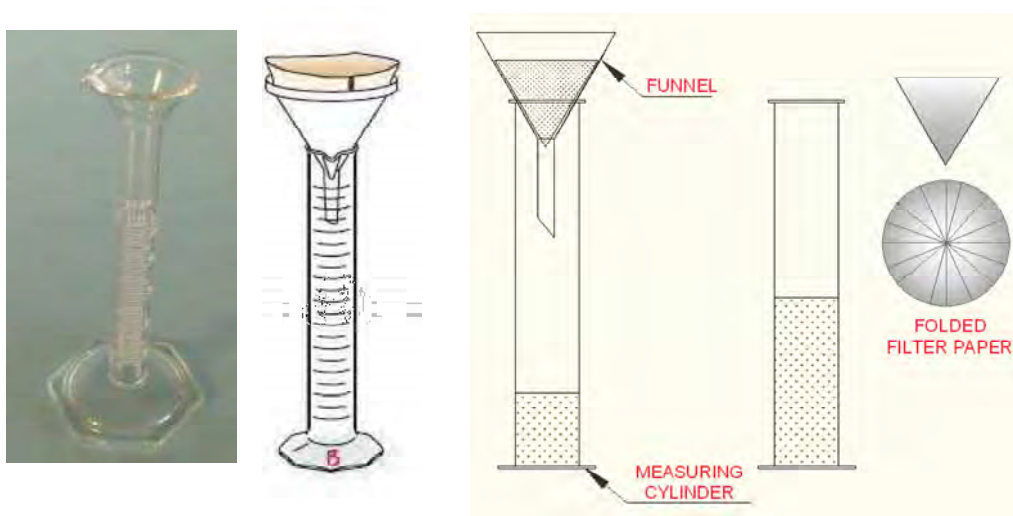
**The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.

*** 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.**

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

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.

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.

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. <u>Check uniformity of membrane air distribution periodically to ensure air scoring is effective across all membrane plates.</u>

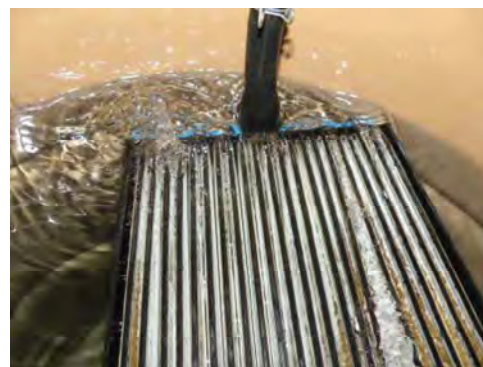
7.1.1 Air Scouring Patterns in Membrane Tanks

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.

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.

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	
	Check electrical leads				X		
ELECTRICAL	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.

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 ($1 \frac{1}{2}$) 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

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 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °C)

Procedure

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

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%)

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 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °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)

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.

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.

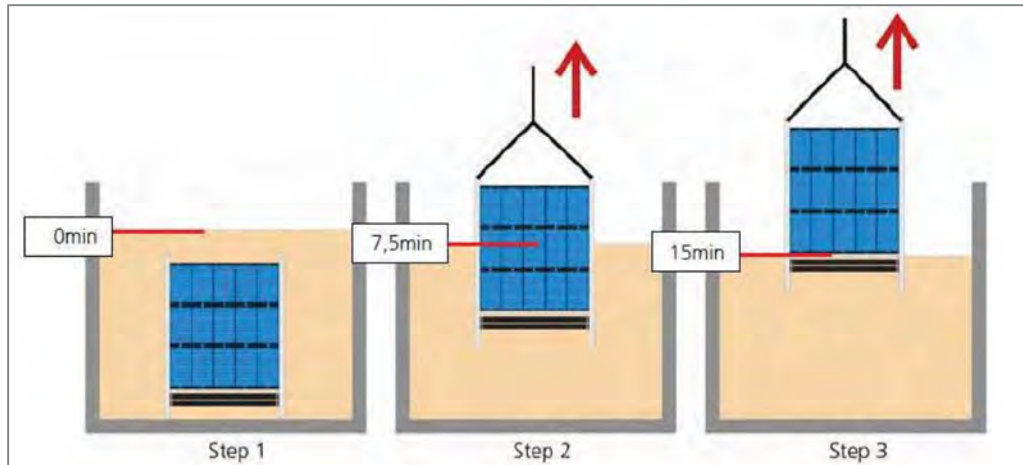


Once membrane inspection or replacement has begun, it must be completed promptly. It is important that the membrane **DO NOT DRY OUT OR FREEZE** during this procedure.

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 emptying 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.



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

Membrane module replacement

If membranes require changing verify 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.

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.

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/cm³. 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°C - 20°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.

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.

**APPENDIX F STEENSBY AND RAIL CAMPS FWSSWWMP – PLANS FOR FUTURE
WORK**

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 60 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

There will be no construction and development of Steensby and the Rail camps in the near future. Updates to these sections of the Plan will be done when required 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 fresh water equipment will not be used and a new fresh water distribution system will be installed. The fresh water 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 fresh water to a fresh water 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 fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water 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 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

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 61 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

treatment system and fresh water distribution system will be put in place to support the construction phase operations. The fresh water 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 fresh water to a fresh water tank during summer. During the winter, water will be trucked from Ravn Camp Lake to the fresh water 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 fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water 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 fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on the drawing Ravn River - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Ravn Camp Lake with duty/standby pumps to deliver fresh water to a fresh water 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 fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water 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 fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 62 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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 fresh water to a fresh water 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 fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water 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.1.1.5 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 fresh water distribution system will be put in place to support the construction phase operations. The fresh water 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 fresh water to a fresh water 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 fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water 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.

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 63 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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 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 areas 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. Treated effluent will be discharged 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 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.

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

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 64 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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.

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 every effort will be made to reduce this volume by using low flow showers and toilets and potentially

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 65 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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.

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

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 66 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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. 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.

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 67 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

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).

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.

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 68 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

APPENDIX G PWSP EFFLUENT DISCHARGE PLAN

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 69 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		



Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
900 Maple Grove Road, Unit 10
Cambridge, ON N3H 4R7
Canada

T: 519-650-7100

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



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.

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 (NH ₃ -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.

**Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited**



Jack Hinds, P.Eng

Process Engineer

Tel: 519-650-7143

Email: jack.hinds@woodplc.com



Jered Munro, P.Eng

Senior Engineer


Tel: 519-650-7130

Email: jered.munro@woodplc.com

APPENDIX H MOBILE OWS MANUAL

(See BAF-PH1-830-T07-0001)

BIM-5200-PLA-0022 Fresh Water Supply, Sewage, and Wastewater Management Plan	Issue Date: 2024-04-20	Page 70 of 71
Site Wide	Next Review date: 2026-02-28	Revision: 11
Document Owner: Environmental Superintendent	Document Approver: General Manager	
The information contained herein is proprietary to Baffinland Iron Mines Corporation (BIM) and used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by BIM. CONTROLLED IN CDMS. UNCONTROLLED WHEN PRINTED OR SAVED.		

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 1 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

Baffinland Iron Mines Corporation

Mobile Oily Water Separator (OWS) Manual

BAF-PH1-830-T07-0001

Rev 0

Prepared By: Andrew Vermeer
Department: Environment
Title: Environmental Coordinator
Date: March 21, 2016

Signature: 

Approved By: Allan Knight
Department: Environment
Title: Environmental Superintendent
Date: March 21, 2016

Signature: 

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose
03/21/16	0	AV <i>AV</i>	AK <i>AK</i>	Use

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.



	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 3 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

TABLE OF CONTENTS

1	PURPOSE AND SCOPE.....	5
2	REQUIREMENTS.....	5
2.1	Regulations	5
2.2	Hazards and Required HSE Equipment.....	5
2.2.1	Hazards.....	5
2.2.2	Personal Protective Equipment Requirements.....	5
2.2.3	Additional Safety and Environmental Equipment.....	6
2.3	General Safety Instructions.....	6
2.4	Training and/or Qualifications.....	6
3	DEFINITIONS.....	7
4	RESPONSIBILITIES.....	7
4.1	Environmental Coordinator.....	7
4.2	Operators.....	7
4.3	Surface Works Personnel	8
5	PROTOCOL.....	8
5.1	Oily Water Separator (OWS) Overview	8
5.2	Water Quality Discharge Criteria.....	10
5.3	Commissioning the Oily Water Separator	11
5.4	Operation and Maintenance Procedures	14
5.4.1	Target Operating Conditions	14
5.4.2	System Start-up.....	14
5.4.3	System Shutdown.....	15
5.4.4	Routine System Checks	15
5.4.5	System Alarms.....	16
5.4.6	Maintenance.....	17
5.4.7	Filter Bag Replacement.....	17
5.4.8	Lead Removal Media	18
5.5	Sampling Schedule, Supplies and Procedures.....	19
5.5.1	Sampling Equipment.....	20
5.5.2	Sampling Procedure.....	20
5.5.3	TOG Sample Analysis Procedure	21

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 4 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

5.6	Decommissioning the Oil Water Separator	22
5.6.1	Decommissioning For Transport	22
5.6.2	Decommissioning For Seasonal Storage	22
5.7	OWS Discharge Log, Results Dissemination and Approval for Discharge	23
6	REFERENCES	24

List of Figures


Figure 5-1 – OWS Process Flow Diagram	9
---------------------------------------	---

List of Tables

Table 5-1 – Effluent Quality Discharge Limits for Bulk Fuel Storage Facilities	10
Table 5-2 – Effluent Quality Discharge Limits for Landfarm Facilities	10
Table 5-3 – Adsorption Tank Medias and Quantities	11
Table 5-4 – Initial Operating Targets	14
Table 5-5 – Sampling Schedule	19

List of Appendices

Appendix A – Newterra OWS O&M Manual
Appendix B – OWS Commissioning JHA
Appendix C – OWS Operations JHA
Appendix D – OWS Discharge Log - Daily Log Sheet
Appendix E – Bottle Set Requirements for Sampling Stations
Appendix F – OWS Discharge Log - External Results Sheet
Appendix G - OWS Discharge Log – Summary Sheet

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 5 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 6 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

- 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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 7 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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;

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 8 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

- 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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 9 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

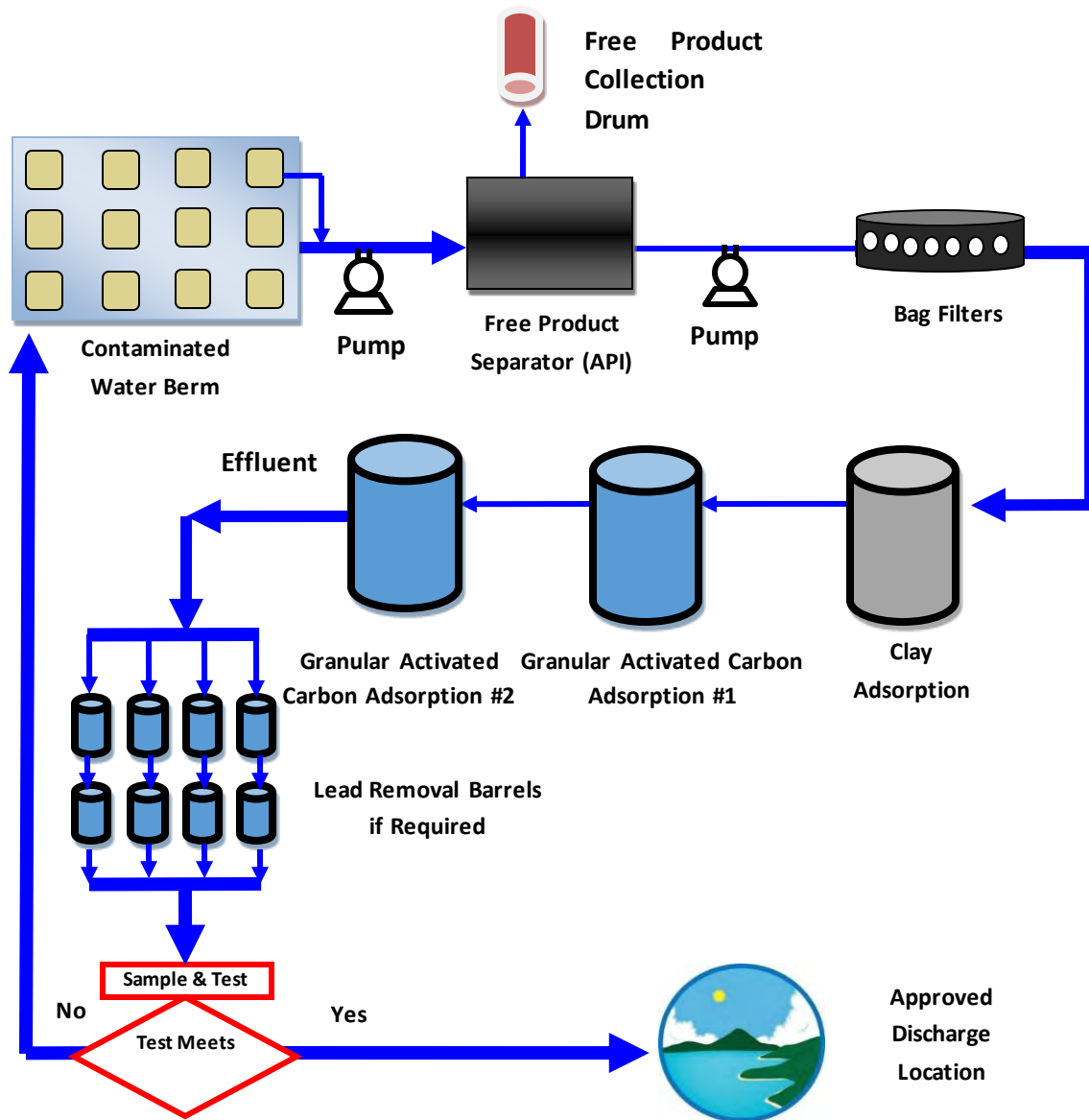



FIGURE 5-1 – OWS PROCESS FLOW DIAGRAM

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).

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 10 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 11 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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 coarse 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 coarse 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

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 12 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

$$\text{Percent removal} = \frac{\text{Conc influent} - \text{Conc effluent}}{100}$$

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.

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 13 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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 m³ (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 be 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.

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 14 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 15 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.).

- Once alarms are addressed go to main menu and clear alarms.
- 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.
- 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.
- If no issues are observed turn the system **ON** at the HMI. Pumps should be manually set to **AUTO** mode.
- Observe system operation to ensure the OWS is operating as designed. Check flow rates, pressures and confirm discharge.
- Open valves at top of adsorption units and bag filter to purge air as described above.

5.4.3 SYSTEM SHUTDOWN

- Turn system **OFF** on HMI.
- 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.

- Walk through system to check for leaks and ensure influent pump and discharge lines are properly placed/connected.
- Confirm discharge flow and conduct visual inspection for any sheen or odor at the discharge location.
- Record flow rates and pressures. Complete Daily Log presented in Appendix D. Collect samples as outlined in Section 5.5.2.
- 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**

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 16 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 17 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 18 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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 ft³ of media should be able to process approximately 70 m³ 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 will 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 ft³ 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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 19 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.


	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 20 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 21 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 22 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

Note: This is an UNCONTROLLED COPY. All staff members are responsible to ensure the latest revision is used.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 23 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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.

The information contained herein is proprietary to Baffinland Iron Mines Corporation and is used solely for the purpose for which it is supplied. It shall not be disclosed in whole or in part, to any other party, without the express permission in writing by Baffinland Iron Mines Corporation.

	Mobile Oily Water Separator Manual	Issue Date: March 21, 2016 Revision: 0	Page 24 of 24
	Environment Department	Document #: BAF-PH1-830-T07-0001	

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