Baffinland Iron Mines Corporation

Mary River Project

2012 Work Plan

Attachment 8

Fresh Water Supply, Sewage and Wastewater Management Plan

2011-12-16	A	Approved for Use	R. Kapadia	J. Binns	J. Cleland	
DATE	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY
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1. Introduction

1.1 Foreword

The current Fresh Water Supply, Sewage and Wastewater Management Plan focuses on the existing licensed facilities at the Mine Site and Milne Port as well as new facilities at Steensby which will support site activity during 2012. The construction phase of the Project will require the construction of several new potable, sewage and oily water treatment plants. This document supports a submission being made to the Nunavut Impact Review Board (NIRB) regarding the execution and management of 2012 Work. Specifically, this document focuses on freshwater supply and wastewater treatment and disposal at Milne Port, the Mine Site and Steensby Port. A project location map is provided in the Appendices.

1.2 Acknowledgements

This Management Plan has been prepared by Hatch based in part on technical documentation, support, and review services of various consulting engineers and scientists. The consulting companies involved, and the specific areas of technical expertise provided, are listed below:

- Seprotech Systems Inc. (Seprotech) of Ottawa, ON - Wastewater Treatment Plant Design Development, Installation, Maintenance, Technical Support, and Operator Training;
- Genivar Consultants PL (Genivar) of Timmins, ON - Polishing Waste Stabilization Ponds (PWSPs) and Piping/Outfall Design, Construction QA/QC and As-Built Drawings, Author of September 15, 2007, Version of the Wastewater Management Plan;
- AMEC Earth & Environment (AMEC) of Waterloo, ON - Treatment Plant Design Review, 2010 Sludge Management Plan, PWSP Effluent Discharge Plan, and general review; and
- Knight Piésold Ltd. (KPL) of North Bay, Ontario, and North/South Consultants (NSC) Inc. Of Winnipeg, Manitoba - Receiving Environment Baseline Data Compilation, Mass Balance Modeling, Effects Prediction and Assessment, and Toxicity Assessment.

2. Milne Site

A layout of the existing Milne Camp is provided in Figure 3 and Drawing 003.

2.1 Fresh Water at Milne Inlet

Fresh water is currently drawn from 32 km Lake water source using a small pump which then fills a water tank. The water tank delivers the water to storage tanks at the camp site where fresh water is drawn as needed. The maximum number of people at the site during the 2012 will be 60. The potable water demand for this population will be approximately 13.5m^3/day (using a per capita consumption of 225 Lpd/capita).

During 2012 the current practice will continue. The existing water supply tank supports a population of 60 people and as such a second tank no additional tanks or equipment will be required.

Existing water treatment consists of filtration followed by UV disinfection. The existing equipment will continue to be used.

2.2 Sewage Treatment at Milne Inlet

The Milne Inlet site is the shipping point for materials and supplies to and from the Mary River Operations. An all-season trailer camp was installed in 2007 to support the annual re-supply and Bulk Sample Program operations. The camp facilities at Milne consist of a ShancoTM accommodation complex with a RBC WWTF (complete with UV disinfection).

The Milne facilities and WWTF are sized for a nominal capacity of 60 workers to support peak periods of activity, primarily during the initial mobilization and final ore shipment stages of the Bulk Sample Program. Since the completion of the Bulk Sample Program in October 2008, the Milne Inlet Camp population has declined to two persons and the RBC was shut down and winterized.

Toilet wastes at Milne Inlet are being managed through use of latrines and the incineration of latrine waste. Small quantities of grey water are discharged to a leach pit located adjacent to the camp.

The RBC sewage treatment system was commissioned in October 2007. During the start-up period, effluent and sludge were disposed of in a Polishing and Waste Stabilization Pond (PWSP) constructed on site for that purpose (see Drawing 003). Treated effluent from this facility first met the water license discharge requirements in January 2008 and was directed to the approved receiving ditch upstream of Milne Inlet. Compliance with water license criteria enabled direct discharge to the receiving environment for the majority of 2008, with intermittent periods where effluent not meeting discharge criteria was directed to the PWSP. The effluent volume in the Milne PWSP was substantially reduced in June of 2009. Approximately 331 m^3 of treated effluent stored in the PWSP at Milne Inlet camp was discharged to a ditch that drains directly into Milne Inlet during the month of June. Pre-treatment prior to discharge was not required since stored effluent met effluent requirements and was acutely non-toxic.

Treatment of sewage at Milne Inlet is by a ROTORDISK®; B-30 packaged RBC System by Seprotech Systems Inc. In order to meet the requirement of the water license for a non-acutely toxic effluent, this unit was modified as part of its original installation to promote nitrification.

During the RBC start-up at Milne Inlet (from November 2007 to January 2008), treated effluent from the plant was transported to the PWSP via vacuum truck. Commencing in January 2008, treated effluent was discharged to the receiving environment with the exception of short periods when Water Licence criteria were not or not likely being met. During normal operation, treated effluent is transported regularly from the RBC via vacuum or tanker truck to local drainage ditch (non-fish bearing) where the effluent is released to the ditch that flows to the receiving environment. The dimensions of the ditch are as follows: average width of the drainage ditch is 15m; average depth relative to surrounding land is 1.9m and approximate length of the ditch 275m. The ditch discharges to Milne Inlet.

The Milne Inlet RBC was shut down and winterized in October 2008 and not operated during 2009.

The PWSP (see drawing 007) consists of a cell lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSP are 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. Total operating volume of the PWSP at Milne Inlet is approximately 575 m3.

The effluent from the RBC System is transferred to a holding tank with a capacity of two days of average flow. The effluent holding tank is housed adjacent to the RBC System to protect the tank from freezing. Inside temperature is normally kept at a minimum of 10 degrees C. The holding tank itself is sized to hold twice the average daily sewage volume generated.

The discharge location along the drainage ditch is protected by means of an energy dissipater to prevent erosion. Silt fences have been maintained downstream from the discharge location as an additional protective measure.

In June 2009, the PWSP at Milne was partially discharged (without pre-treatment) as the effluent met Water Licence effluent requirements and was acutely non-toxic. Similar to 2009, the residual effluent remaining in the PWSP will be retested in May 2010 and further discharged if criteria are met.

During 2012 the existing RBC shall continue to operate. The treated effluent will continue to be discharged using the same method as is currently practiced. The existing waste storage ponds shall not be modified.

Total sewage generated during the maximum occupancy of 60 personnel will be ~13.5 m3/day (using a per capita sewage generation of 225 Lpd/capita – estimated by Seprotech based upon "Cold Regions Utilities Monograph", Third Edition 1996).

2.3 Oily Stormwater Treatment at Milne Inlet

There currently exists a wastewater treatment system to treat run-off from the fuel bladder farm. There are no pre-development requirements to expand the area of this farm and as such the current practices will continue without change.

The average flow rate treated will depend on run-off levels, which will vary throughout the year. The average treated run-off from the fuel storage tanks during the month of July (the month with the highest flows due to freshet) will be approximately 1.4m3/hr based upon a total tank area of 11,150 m2. Treated oily water will be discharged to the ocean. The oily water treatment system includes oil/water separation and membrane based filtration.

3. Mine Site

A layout of the existing Mary River Camp is provided in Figure 2 and Drawing 002.

3.1 Fresh Water at Mine Site

The water supply for the Mine Site is obtained using a submersible electric pump adjacent to the shoreline of Camp Lake. Water is pumped directly from the lake source to water storage tanks located at the camp. The average number of people at the site during the pre-development phase will be 120. The total camp watershed use for this source is estimated to range up to a maximum of $80m^3$/day. This consumption is due to potable demands as well as some geotechnical and exploration drilling water.

Existing potable water treatment consists of filtration followed by UV disinfection. The existing equipment will continue to be used and is designed with sufficient capacity.

3.2 Sewage Treatment at Mine Site

The existing camp at Mary River currently has a potential capacity for 200 persons. This capacity consists of a 100 person seasonal camp, originally set up and used for the exploration work prior to 2007, plus an adjacent all-season camp with a nominal design capacity of 100 people that was constructed in late 2007 and early 2008. The all-season camp consists of predominantly WeatherhavenTM tents, two steel Quonset huts as maintenance facilities, and numerous small wooden outbuildings, situated approximately 200 meters from the shores of Camp Lake.

A pre-engineered mechanical sewage treatment plant (referred to as the 'Tanks-a-Lot system') was commissioned in November 2007 and was operated until February 2008, when a new mechanical WWTF was commissioned. The new WWTF, consisting of a Rotating Biological Contactor (RBC) and ultra-violet light (UV) disinfection (manufactured and installed by Seprotech), was designed to achieve tertiary levels of treatment with the potential for piped, year-round, discharge to Sheardown Lake. The existing Tanks-a-Lot system was substantially decommissioned in 2008 following commissioning of the new WWTF.

With the design basis that was adopted, the new RBC WWTF was sized for a nominal occupancy of 150 persons. Since, October 2008, the camp occupancy at Mary River has declined from previous levels with very low numbers (less than 10 personnel) during the off-season period (October to April) and increased numbers (50-100 personnel) during the field season to support exploration drilling and site reclamation programs.

In 2008, BIM conducted a review of the design basis for the wastewater treatment facility, its standard operating procedures for operations and maintenance, and monitoring requirements, with the aim of consistently meeting discharge requirements thereby reducing the dependency on the use of the PWSPs (see Drawing 005 & 006). Since the implementation of the recommendations from this review, Water Licence effluent requirements have largely been met (since December 2008).

Although effluent produced from the Mary River RBC WWTF has been compliant for most effluent parameters, there have been problems with the WWTF consistently meeting the total phosphorous criterion. Because of this inconsistency in achieving the target total phosphorus concentration in the WWTF effluent, BIM has recognized the need for a conservative approach and has discharged all treated effluent to the PWSPs for further testing and treatment, as required, prior to final discharge to Sheardown Lake. During 2009, an appropriate polishing treatment, discharge, and monitoring plan for partially treated sewage effluent stored in the PWSPs was developed and implemented at the Mary River site. The treated 2,858 m^3 of effluent that was discharged to Sheardown Lake during this program met or exceeded applicable effluent criteria, including total phosphorus, and was not acutely toxic.

In response to operating experience in 2008 and 2009, Baffinland continues to review the Mary River WWTF design and operation with the aim of consistently meeting discharge requirements for all parameters, thereby reducing or eliminating the need for additional polishing treatment within the PWSPs prior to discharge. Baffinland recognizes that an appropriate discharge and monitoring plan for partially treated effluent was effectively developed and executed during 2009, and continuation of this plan may be an appropriate and protective method for ongoing treatment and discharge of treated effluent at the Mary River camp.

Baffinland will continue to work to reduce total phosphorus concentrations in treated effluent from the WWTF with the intention of direct discharging to Sheardown Lake. However, if testing results remain inconsistent for total phosphorus concentrations, our intention will be to continue to utilize the PWSPs for treated effluent storage.

Treatment of sewage at the Mary River Site is by a ROTORDISK®; N-70 packaged RBC System by Seprotech Systems Inc. Effluent from the sewage treatment system has the potential to be transmitted directly to the submerged outlet at Sheardown Lake via an insulated 75m forcemain (see Drawing 004). Since start-up in February 2008, treated effluent has been discharged to the three PWSPs constructed for that purpose.

The fully contained RBC system is comprised of a primary settlement tank, a Rotating Biological Contact (RBC) tank, and a secondary settling tank. Raw sewage is pumped into the primary settlement tank, whereby, heavy solids are retained through gravity settling and thickening. Supernatant from the primary settlement tank enters the RBC tank through an inlet slot located at the front section of the RBC tank. The RBC tank is made up of four stages, or disk banks. The four separate disk banks are mounted on a common rotating shaft. As the disk banks are partially submerged, the rotation serves to provide continual aeration for the fixed film biological growth and filtering process (which occurs on the disk banks).

The first disc bank represents 40% of the total RBC surface area and is responsible for the most significant reduction in BOD. Subsequently, the accumulation of biological growth will be the greatest on the first disc bank and gradually decrease through subsequent sections. The growth will be generally thick and often filamentous on the 1st disk bank, becoming thinner and more compact on stages 2 through 4. Under certain operating conditions, nitrifying bacteria may become dominant in the 3rd and 4th disc banks. The 4th disc bank has a circulation device that allows well-treated liquid to be recycled to the primary settling tank. Treated water from the RBC enters the secondary settlement tank, whereby biomass sloughed from the disks and other suspended solids settle through gravity. The existing RBC system uses aluminum sulphate (commonly called "alum") to precipitate dissolved phosphorus and form insoluble aluminum phosphate. This insoluble aluminum phosphate settles in the RBC tankage and is periodically removed along with the accumulated biological solids sloughed off from the rotating media. Thus, phosphorus removal is a 2-stage process whereby the dissolved phosphorus is first precipitated to form a solid, and secondly those solids are then removed from the treated water. For systems that experience occasionally high suspended solids concentrations in the effluent, meeting low phosphorus concentrations can be problematic. To ensure the Mary River WWTF is able to consistently meet a 0.5 mg/L phosphorus discharge target concentration, the existing alum addition program can be combined with effluent filtration.

Since start-up, all effluents have been directed to the PWSPs.

The as-built report for the sewage treatment system including the RBC, PWSP No. 1 and No. 2, and associated piping and outfall was submitted to the NWB in July 2008. The as-built report for PWSP No. 3 was submitted to the NWB in March 2008. These reports contain detailed design and as-constructed survey information. In general, the designs of the PWSPs consist of cells lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSPs designed to be a minimum of 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. The total operating volume for the combined volume of the three PWSPs at Mary River is approximately 9,400 m3.

Freeze protection has been designed by Urecon Limited. The 75 mm DR 26 HDPE pipe is fitted with 50 mm of polyurethane insulation and a PVC jacket. Inside the insulation, an integral conduit houses a Thermocable C13-240-COJ heating cable with an output of 13 watts/meter controlled by an electronic thermostat set at 5 degrees C with a high limit of 65 degrees C for protection of the HDPE pipe. Operating experience has shown that due to the harsh climate and irregular topography along the pipeline route that it is risky and difficult to keep the line from freezing during winter conditions because the pipe is not self draining. Therefore, during the winter it is recommended that all discharge be directed to PWSP No. 3, rather than attempting to utilize the effluent discharge pipeline all the way to Sheardown Lake.

Since December 2008, the treated effluent from the Mary River RBC system has met effluent requirements with the exception of total phosphorus. During the open water season in 2009, the partially treated effluent contents of PWSP No. 2 and 3 were further treated and discharged to the receiving environment based on the strategy as presented in Revision 1 of the WWMP and in accordance with Water Licence requirements. Since the discharge event in August 2009, the effluent criteria from the RBC have been mainly within discharge criteria (including total phosphorus).

The existing equipment will continue to be used during 2012. The current approvals and wastewater management plan also allow for treated sewage to be discharged from the PWSPs after further treatment as required.

3.3 Oily Stormwater Treatment at Mine Site

Oily stormwater is generated within the existing bulk fuel and hazardous waste containment areas at the Mine Site. Oily water is currently treated by means of a mobile treatment trailer. The trailer is operated on an as needed basis. AMEC, an engineering consultant firm was hired to develop a system for treating oily water. When needed, contaminated water is drawn from the contaminated water source and sent through the purification system. Waste oil is re-used where possible otherwise the oil is stored and shipped south to be recycled.

The system consists of an influent pump, particle filter, clay absorption media filter, MyCelx Filtration system and Granular Activated Carbon before discharging onto the tundra.

The effluent from the Mary River Oily Water System met all regulatory environmental regulations for benzene, toluene, ethyl benzene, lead and total oil/grease. The process discharges 200 000 liters of treated water to the tundra when treating all the accumulated bermed water. Influent oil levels have averaged around 13 ppm.

A picture of the currently permitted oily water treatment system follows:

Figure 3-1 - Permitted oily water treatment system

The current oil water treatment practice is permitted and will continue during 2012.

4. Steensby Site

4.1 Fresh Water at Steensby Port

Currently Steensby Inlet Camp potable water comes from 3 km lake approximately 3 km east of the camp. A collapsible water line was installed from 3 km lake water source to the Steensby Inlet Camp. During winter water was drawn by truck from the 3 km lake and delivered to the camp.

During 2012 fresh water will be drawn from 3 km lake using a permanent pipe with heat tracing and insulation. This will feed the camp year round. The maximum number of people at the site during 2012 will be 90. The potable water demand for this population will be approximately 27m^3/day (using a per capita consumption of 300 Lpd/capita – see Design Basis - Potable Water Treatment Plant, H337697-4000-10-109-0001).

A new potable water treatment system will be installed and will consist of media filtration followed by disinfection (UV or chlorination). For details refer to Design Basis - Potable Water Treatment Plant, H337697-4000-10-109-0001.

4.2 Sewage Treatment at Steensby Port

Sewage generated by the camp site will be managed through a new sewage treatment plant (For details refer to Design Basis – Sewage Treatment Plant, H337697-4000-10-109-0002). Treated sewage effluent will be discharged to the ocean.

Total sewage generated during the maximum occupancy of 90 personnel will be ~27 m3/day (using a per capita sewage generation of 300 Lpd/capita, note that Design Basis – Sewage Treatment Plant, H337697-4000-10-109-0002 indicates that 344 Lpd/capita will be used. This is for design purposes to ensure the sewage treatment plant design incorporates a safety allowance). All sludge from the sewage treatment plant will be dewatered.

Sludge will be incinerated. The incinerator design will consider the solids content of the sludge from the dewatering device.

4.3 Oily Stormwater Treatment at Steensby Port

During 2012 oily water may be generated at the fuel dispensing points of the double walled ISO Fuel Containers. These sources will be managed using a mobile treatment trailer. The trailer will withdraw impacted water as needed and then treat the water to remove oil and other contaminants. The purified water will be discharged overland. Separated oil will be collected and re-used where possible; otherwise the oil will be shipped south for recycle.

5. Operations and Maintenance (O&M)

5.1 Training

The manufacturer of the potable water and sewage treatment equipment will provide training to BIM managers and facility operators during routine periodic visits to the Project site, as well as providing a training program at their offices. To enhance management capabilities and enable continuity of operation, BIM designates specific contract operators for its potable and wastewater treatment facilities. These operators have undergone on-site training by the manufacturer as described above. Equipment manufacturers are also available to provide on-call expert advice, as required. BIM is currently developing in-house training capabilities for its WWTF operators.

5.2 Routine O&M

BIM have developed a checklist for existing sewage and potable equipment for routine inspections that occur on a daily basis. A similar checklist will be developed for new equipment at Steensby. When the checklist is completed, it is provided to the BIM Camp Manager where the results of the inspection are reviewed and any actions taken as required. The record is safely stored in a record filing system developed for the purpose. In addition to reviewing the daily checklists for upset conditions that might require action, the treatment plant operators are instructed to immediately notify the Camp Manager as soon as an atypical condition is observed.

The following procedures associated with operation and maintenance of the potable and sewage facilities are performed on a scheduled basis while the Mary River and Milne Inlet Camp RBCs are in operation:

- Visual inspection of the RBC unit to detect any leaks, malfunctions, discoloration, foul odours (refer to checklist for complete list);
- Monitoring for indicator parameters such as pH and temperature;
- Visual inspection of camp kitchen grease traps to ensure proper operation;
- Visual inspection of effluent pipeline and heat trace checks along the pipeline to detect any leaks, damage or malfunction of the heat tracing system;
- Visual Inspection of the pump station at the camp to verify the liquid levels, and detect any system blockages; and
- Visual inspection of the discharge outfall to ensure continuous discharge and detect any leaks in the embankment.

Prior to inspecting the RBC unit, the operator must ensure that the unit is well ventilated and appropriate personal protective gear is worn, including disposable gloves. During routine visual inspection of the RBC unit, attention will be paid to the nature of the biological growth on the disk media. The colour of the growth will typically be dark brown to black on the 1st disk stage. The growth on disks 2-4 will typically range between medium brown to tan on the final section.

Unusual discoloration/texture of the disk media growth or strong sour odours could be indicative of process malfunction.

A similar procedure will be in place for new Steensby equipment.

5.3 Non-Routine O&M

Non-routine O&M procedures will be performed associated with the following system needs:

- Sewage sludge management;
- Unit Start up;
- Unit Shutdown; and
- Special start-up procedures must be followed if any of the sewage treatment units has been out of operation. These procedures for existing sewage equipment are briefly summarized below:
    - Support bearings on shaft and coupling re-lubricated;
    - Primary settling tank should be filled with fresh water;
    - While the RBC is rotating, introduce wastewater at design or less than design loading rates;
    - Unit start-up normally requires 2 ½ to 3 weeks, with 50% BOD removal often occurring after one week; and
    - Shut down procedures are necessary if the treatment unit is to be taken out of operation for any significant period of time. These procedures are briefly summarized below:
        - Remove all accumulated sewage sludge from settlement chambers;
        - Clean disk media and flush unit clean; and
        - Drain tanks and pipes and disconnect pipes.

6. Routine Sludge Management and Long Term Technical Strategy and Work Plan

6.1 Routine Sludge Management

At the design capacity of the RBC System at Mary River, the sludge accumulates at a rate of approximately 13.5 kg per day in the Primary Settling Tank. During periods of camp occupancy at design capacity, this sludge is removed to PWSP No 1 as required based on sludge depth measurements within the RBC. Sludge is not discharged to PWSP Nos. 2 or 3, since these two ponds are to be used for future polishing treatment efforts. The accumulation of sludge in the WWTF can be indirectly monitored by visually observing the thickness of the scum blanket on the surface of the primary settlement tank and sludge depth measurements taken by means of a Sludge Judge sampling pole. The quantification of sludge volumes is difficult and depends on density and amount of effluent removed with the sludge. At the design capacity of the RBC System at Milne Inlet, sludge accumulates at a rate of approximately 12.9 kg per day in the Primary Settling Tank. No sludge has been generated at Milne Inlet since shutdown of the RBC in October 2008.

6.2 2009 Sludge Testing Program

The 2009 sludge management program involved the quantification and characterization of sludge within each of the PWSPs resulting in a solids inventories and bench scale test work. The volume of sludge measured in the Mary River PWSPs Nos. 1 and 2 totals approximately 542 m3. There is a minimal, non-measureable, volume of sludge in PWSP No. 3. The estimated volume of sludge in the Milne PWSP is <200 m3. Sludge thickness varies from 0.15 to 0.45 m.

The physical characteristics for the settled sludge at the Mary River site are of relatively light density for primary sewage solids and as a result, the concentration is estimated to be approximately 10,000 mg/L. The lighter weight solids cause the intermediate water depths to have relatively high concentrations of suspended solids which have been measured between 700 to 1000 mg/L TSS throughout in the majority of the water column.

During 2009, bench scale testing was conducted to simulate two passive sludge dewatering methods. These include:

- Geotextile dewatering bags (Geotube brand geosynthetic dewatering material); and
- Freeze/thaw sludge dewatering trials.

6.3 Sludge Management and Technical Strategies – 2012 Work Plan

The sludge management work plan for 2012 built on the results from previous years. For example, the following strategies were reviewed and assessed in 2010:

- Shorter term (1-2 yrs) dewatering and disposal strategy. This strategy would be implemented in the event there is a requirement to rapidly reclaim and close the site. Specifically, containerized geotubes and mechanical dewatering were assessed; and
- Longer term (3-5 yrs) management and disposal strategy. This strategy would be implemented in the event there is longer time frame to reclaim and close the site. The technologies to be assessed include sludge drying beds and geotubes.

Disposal of sludge solids will require that specific criteria are met. The suggested criteria at this time include: passing the slump test for physical consistency, passing the TLCP test for landfill disposal, and easy material handling of the dewatered sludge utilizing existing equipment at the site.

To develop, a successful and sustainable sludge handling, treatment, and disposal process for the project requires additional site specific information and testing to increase the confidence level of the proposed technologies.

7. Contingency Measures

Design criteria for the Mary River Camp WWTF have been reviewed and revised to provide additional safety factor. The average occupancy level for Mary River has now been established at 123 persons, revised downward from the original 150 persons. In the event that the Mary River Camp occupancy expands to greater numbers, a provisional contingency involving the installation of additional RBC media can be implemented. There is currently acceptable safety factor built into the Milne Camp WWTF. The WWTF's and PWSP effluent discharge strategy and work plan are designed to be protective of the receiving environment and meet or exceed the requirements of the water license. Baffinland has incorporated the temporary storage ponds to be used during periods of start-up, shut-down or during periods of system upset.

The RBC units and the PWSPs are located sufficiently remote from surface water bodies. The RBC is a fully enclosed unit and the PWSPs are designed with an impermeable liner. In the event of a spill of untreated or partially treated sewage from these facilities, Baffinland will follow the procedures in its spill response plan. Sewage spills are treated the same as more immediately hazardous hydrocarbon based spills.

8. Sampling, Monitoring, and Reporting

Monitoring and reporting under the water license is described in the updated Site Water Management Plan. Generally, sampling and monitoring of the wastewater treatment systems will include the following:

- Regular sampling of sewage discharge at both WWTFs and PWSPs in accordance with Water Licence requirements;
- More frequent internal process sampling (minimum once per week) and monitoring (daily) to identify potential upset conditions early that could lead to non-compliance;
- Record of volumes of sewage effluent discharged and sludge generated in accordance with Water Licence requirements;
- Completion of daily checklists related to the O&M requirements for the facilities and the reporting of any upset conditions that require action; and
- Aquatic effects monitoring program to confirm/validate environmental predictions. The monitoring program will identify upset conditions related to the WWTF and PWSPs which will be immediately reported to the Camp Manager for corrective action.

9. Effluent Effect on Receiving Waters

Knight Piésold Ltd. (KPL) and North/South Consultants (NSC) were retained by BIM in 2007 to assess potential effects on the receiving waters from the WWTF and confirm that facility designs were appropriate given the projected operating schedule, and projected discharge concentrations and loadings. Based on available receiving environment data and process design considerations, the final effluent from the facilities was expected to be non-acutely toxic. The potential for eutrophication of the fresh water receiving environment (Sheardown Lake) was also evaluated by means of a mass balance modelling approach that used conservative assumptions. The model results indicated that fully mixed concentrations of TSS, ammonia, and nitrate would be within CCME guidelines for the protection of aquatic life, and that total phosphorus increases would remain within triggers specified in the CCME guidance framework for the management of phosphorus. Localized and short-term effects to biota were predicted to occur in the vicinity of the outfall, including localized DO depletion and chronic effects related to TSS, ammonia, and nitrate.

The conclusions of the 2007 assessment were that that overall sites and facilities were designed to limit the impact of the treated sewage effluent on the receiving environments. A revised and updated technical memorandum update was prepared by NSC. The purpose of the memorandum was to provide:

- An update to include additional baseline water quality data collected in Sheardown Lake prior to PWSP effluent discharge;
- A description of the results of the water quality monitoring conducted in Sheardown Lake immediately after PWSP sewage effluent release; and,
- An overall assessment of the effects of the PWSP sewage discharge event on water quality in Sheardown Lake, including mass balance modeling based on the effluent discharge data.

9.1 Effluent Toxicity

Environment Canada recommended toxicity testing of the treated effluent during review of BIM’s application to amend its water license in 2007, and the Nunavut Water Board incorporated this requirement into the amended water license. The WWTFs have been designed accordingly. Environment Canada developed a guideline with respect to ammonia in wastewater effluent discharges (Canada Gazette, 2004). This guideline recommends weekly testing of ammonia and pH in wastewater effluent to establish if the effluent is acutely toxic, based on the following relationship established between ammonia concentration and pH:

$$y = 306132466.34 \times (2.7183(-2.0437 \times pH))$$

This relationship between ammonia concentration, pH and acute toxicity is shown on the attached Figure 4, extracted from the Environment Canada guideline (Canada Gazette, 2004).

The acute toxicity of ammonia increases with increasing with pH. Knight Piésold measured pH in the marine waters of Milne Inlet on two occasions in August 2007 and recorded pH measurements of 8.05 and 8.15. During water quality monitoring of on-ice drilling in May and June 2007, a pH of 8.27 was recorded. Based on the higher of these two summer-time pH measurements (pH = 8.15), the threshold at which ammonia is acutely toxic in the receiving waters of Milne Inlet is 17.9 mg/L.

Based on a pH of 8.0 in Sheardown Lake, ammonia is acutely toxic in that receiving water at 24.3 mg/L. The RBC treatment facilities include nitrification such that ammonia-nitrogen concentrations in the final effluent will be less than 2 mg/L, which is non-acutely toxic according to the Environment Canada guideline. The final effluent from the RBCs is therefore expected to be acceptable for direct discharge to the final receiving waters of Sheardown Lake and Milne Inlet before mixing. The final effluent discharged from the PWSPs will be non-acutely toxic as demonstrated by water quality and toxicity sampling/analyses that will be conducted prior to and during discharge using applicable and approved methods.

Testing completed on the Mary River and Milne RBC and PWSP effluent have indicated that effluent samples collected were not acutely toxic to the test organisms (Daphnia magna and rainbow trout) and no mortalities of either test organism occurred over the duration of the toxicity tests.

9.2 Effects of Sewage Effluent Discharges to Sheardown Lake

The following provides a summary of the effects assessment to Sheardown Lake from the PWSP discharge event.

Approach Baseline data provided the foundation for assessing effects of effluent discharge on water quality in the receiving environment. Specifically, the monitoring results were examined for:

- Differences relative to baseline water quality conditions measured in the open-water seasons of 2007 and 2008;
- Spatial differences in water quality conditions across Sheardown Lake, in relation to distance from the effluent outfall; and
- Comparison to the Canadian Council of Ministers of the Environment (CCME) guidelines of the protection of aquatic life (PAL). Sewage effluent quality, discharge rates, and acute toxicity were monitored during discharge to Sheardown Lake in August 2009. As an additional screening tool, effluent quality was also compared to CCME PAL water quality guidelines. As CCME guidelines are representative of "chronic" conditions, this comparison to effluent quality is highly conservative. However, where parameters are shown to meet CCME guidelines at the end-of-pipe, there is high certainty that the effluent would not lead to in-lake chronic toxicity.

Lastly, to provide an additional measure of potential effects of the discharge of treated sewage effluents on water quality in Sheardown Lake, a mass balance modelling approach was applied using the measured effluent discharge volume and effluent quality for the discharge period in August 2009.

Baseline Water Quality and Limnology of Sheardown Lake Detailed descriptions of water quality in Sheardown Lake included information collected up to the fall of 2008.

Lower DO concentrations at depth have been observed at several sites in winter and concentrations were below the CCME PAL guidelines at one site in 2007 and numerous sites in winter 2009.

In general, Sheardown Lake NW is a relatively clear lake (low turbidity and high Secchi Disk depth), is alkaline in the open-water season (pH > 7) and near neutral in the winter (Mean pH of 7.03 in May 2007), soft (hardness typically at or below 60 mg/L), and contains a relatively low concentration of dissolved solids (mean of 71 mg/L in the open-water season and 102 mg/L in winter). Like other lakes in the area, Sheardown Lake NW is nutrient-poor and contains low levels of total phosphorus (TP) and inorganic forms of nitrogen. TP was generally near or below the analytical detection limit (0.003 mg/L) over the period of baseline studies. Lake-wide mean TP concentrations were somewhat higher in the open-water season of 2008 than 2007. Similarly, nitrate, nitrite, and ammonia concentrations are low and were generally not detected over the baseline studies. According to the CCME phosphorus guidance framework, Sheardown Lake would be classified as “ultra-oligotrophic” and “oligotrophic” on the basis of TP concentrations measured in 2007 and 2008

Similarly, on the basis of chlorophyll a concentrations measured in the open-water seasons of 2007 and 2008, Sheardown Lake would be categorized as ultra-oligotrophic or oligotrophic.

9.2.1 *Effluent Discharge and Effluent Quality*

PWSP treated sewage effluent discharge was monitored for toxicity and compared to CCME PAL guidelines (CCME 1999; updated to 2010) to assess chronic toxicity of undiluted effluent. All measurements of pH and ammonia were within or below CCME PAL guidelines. There was one exceedance of aluminum measured in a single sample which likely reflects an upset associated with the use of aluminum in the sewage treatment process. Aluminum was below the CCME PAL guideline in Sheardown Lake including the site nearest the effluent outfall.

9.2.2 *Ambient Water Quality Monitoring*

Water quality monitoring was conducted just after PWSP discharge using two approaches: effluent plume monitoring, and core water quality monitoring. The plume monitoring used field parameters to detect and characterize the plume in the vicinity of the outfall. The core water quality monitoring was conducted at five sites and analyzed for a broad range of parameters. The plume monitoring results indicated that there was no evidence of an effluent plume at the time of monitoring. Most routine water quality variables measured across four sampling sites in

Sheardown Lake were similar to lake-wide means obtained in 2007 and 2008 indicating that effluent discharge had no notable effect on water quality in the lake. Spatially, most routine water quality variables were similar across sites sampled in Sheardown Lake and there was no clear gradient from the effluent outfall to more distant sampling sites. The primary exception occurred for chlorophyll a, which was higher at the two sites nearest the outfall in August 2009. All measurements of routine water quality variables (nitrate, ammonia, pH, dissolved oxygen, and total suspended solids) were within CCME PAL guidelines in August 2009 and feacal coliform bacteria were not detected in the lake. A comparison of mean concentrations of total and dissolved metals for the open-water seasons of 2007 and 2008 and the August 2009 monitoring results indicates that conditions were relatively similar across years. The key exceptions were notably higher concentrations of total aluminum and sodium measured near the effluent outfall relative to other more distant sites. Although aluminum was within the range observed in Sheardown Lake NW in 2008, sodium was elevated relative to baseline studies.

9.2.3 Mass Balance Modelling

A whole-lake mass balance model was used to estimate the cumulative effects of treated sewage effluent discharged to Sheardown Lake NW in August 2009. The mass balance model indicates that if all effluents were instantaneously mixed in the lake (with no losses of water quality constituents), that the effects of the effluent on whole-lake pH, ammonia, TKN, TSS, TP, BOD, and faecal coliform bacteria would not be detectable.

9.2.4 Summary and Conclusions

Overall, the available water quality monitoring results indicate that discharge of treated sewage effluent did not result in notable changes in water quality in Sheardown Lake in August 2009, with the possible exceptions of slight elevations in total sodium and aluminum and chlorophyll a near the outfall. Effluent discharge does not appear to have caused or contributed to exceedances of CCME PAL water quality guidelines.

Mass-balance modeling indicated that the effects of discharge of the PWSP effluent to Sheardown Lake in August 2009 would not have been expected to cause a detectable change in routine water quality lake-wide.

9.3 Effects of Sewage Effluent Discharges at Milne Inlet

9.3.1 Receiving Drainage Ditch

The receiving environment for the treated sewage effluent at Milne Inlet is a large, wide ditch, several hundred metres in length, which reports to Milne Inlet. This drainage ditch has a small associated catchment of approximately 0.25 km^2.

9.3.2 Milne Inlet - Final Receiving Water

Near-shore water depths have not been collected but water depths ranging from 1.5m to 2.8m was measured in excess of 60m from shore, after which water depth quickly increases to 10 to 15 m. The assumed average water depth from the shoreline to 60 m from shore is 1.0m. Milne

Inlet has semi-diurnal tides with the lowest tide typically ranging from 0.1 to 0.3m and the highest tide typically ranging from 2.2 to 2.4m (Department of Fisheries and Oceans, 2006). Current velocity within the Eclipse Sound area generally ranges from 15-35 cm/s (Buckley et al. 1987; Dickens et al. 1990).

Data collected in Ragged Channel, located at Cape Hatt near the northern end of Milne Inlet, indicated that temperature and salinity characteristics at that site were typical of the region (Buckley et al. 1987). In the ice-free season, freshwater inputs from snow melt and rain run off establish a strong surface layer characterized by lower salinity and higher water temperature, which ultimately is mixed with underlying cooler and more saline water by wind and currents. As the open water season progresses and freshwater inputs are reduced, the strength of the surface layer is reduced and thermal and saline stratification is reduced.

At Ragged Channel, water temperature during ice covered conditions (June, 1980) was 1.5ºC throughout the water column. During open water conditions in August, 1980, at the same location, water temperature was approximately 4ºC at the surface and declined to -1ºC by about 70 m depth (Buckley et al .1987). Similarly, salinity was uniform at ~32 ppt through the water column during June, but was stratified during August. At that time, surface salinity was about 24 ppt, and increased through the upper 10 m or so of the water column to about 30 ppt (Buckley et al. 1987).

Recent salinity measurements at surface where the drainage ditch reports to Milne Inlet measured 22.9 ppt (Knight Piésold, unpublished data). In-situ water quality measurements were recorded by Knight Piésold on three occasions at the shore where the ditch discharges in August 2007, and water temperatures ranged from 4.4ºC to 9.2ºC, pH ranged from 8.05 to 8.15, and dissolved oxygen ranged from 10.75 to 11.30 mg/L (Knight Piésold, unpublished data).

9.3.3 *Discharge Conditions*

Discharge conditions will vary with the season. In early summer (i.e. July), the active layer thaws and sea ice deteriorates and pulls away from shore. July has the largest monthly runoff and is also the month subject to break-up. For example, in early July 2007 and 2008, most of the sea ice at the lower portion of the inlet had melted, whereas sea ice in the upper half of the inlet towards the mouth was still intact. Phillips Creek would appear to have a meaningful influence on the deterioration of ice at the head of the inlet. Freeze up begins in late September or early October.

Open water is present roughly from July through September. The effluent is trucked to a dedicated location where it is released to the ditch (refer to Figure 3) some infiltration of the effluent into the active layer is expected to occur as the effluent flows towards Milne Inlet, depending upon the progress of ground thaw. During regular RBC operations, it is expected that at the low rate of discharge to the ditch that very little to none of the treated effluent will report directly to Milne Inlet.

During winter operations, effluent discharged to the drainage ditch freezes. The maximum volume of effluent that could be discharged to the ditch during this 8-month period (measured as water and no ice) is roughly 3,240 m^3 based on the peak design capacity of the WWTF. Actual volumes will be less. Due to low temperatures, the effluent will freeze within the ditch. During the spring thaw, the frozen treated effluent will melt and flow to the thawing ice or marine waters of Milne Inlet. It is estimated that the ice pack will melt over an approximate four week period from approximately mid-June to mid-July. Since the final effluent will be non-toxic, no meaningful environmental effects are anticipated under this discharge scenario. The winter storage, melting, and subsequent mixing in the final receiving waters of Milne Inlet provide some contingency if the final effluent does not achieve the expected treatment levels. A mixing zone in Milne Inlet has not been calculated on the basis that the effluent already meets discharge and acute toxicity requirements. Mixing zones are commonly incorporated into the design of sewage management facilities.

The decanting of the Milne PWSP during June 2009 involved the discharge of approximately 200 m^3 of effluent over a one week. The small volume of discharged effluent was not acutely toxic based on testing results and was unlikely to have had an adverse effect on the receiving environment of Milne Inlet due to mixing due to tidal current action.

10. Regulations, Standards, and Codes

As a minimum standard of acceptability, all actions undertaken will be compliant with appropriate sections of both Federal and Provincial legislation as indicated in the table below:

Table 10-1 - Applicable Regulations, Standards and Codes

Number / Acronym	Title
AWWA	*American Water Works Association*
IBC	*International Building Codes*
NSF	*National Sanitation Foundation*
GCWQ	*Guidelines for Canadian Drinking Water Quality*
NWT Reg 108-2009	*Northwest Territories Water Supply System Regulations*
Ontario Reg 170/03	*Safe Drinking Water Act, 2002*
Nunavut Waters and Nunavut Surface Rights Tribunal Act, SC 2002, c 10	
Northwest Territories Water Act	
Northwest Territories Water Regulations (SOR/93-303)	
Ontario Drinking Water Quality Standards	
Canadian Fisheries Act	
Canadian Environmental Protection Act (1999)	
CCME Water Quality Guidelines for the Protection of Aquatic Life	
Ontario Guidelines for Sewage Works 2008	
CCME Guidelines for Compost Quality	
NSF/ANSI Standard 61	Drinking Water System Components
AWWA Standard B100	Filtering Material
AWWA Standard B604	Granular Activated Carbon
OSHA	*Occupational Safety and Health Administration*

10.1 Roles and Responsibilities

The responsibilities for implementing this plan are divided among the various entities as follows:

Owner: Shall have overall responsibility for making sure that the plan is implemented as outlined and in accordance with the commitments provided in the Environmental Impact Statement, and shall undertake monitoring, review and auditing of the activities of the EPCM contractor.

EPCM Contractor: Shall provide onsite direction of all water supply and wastewater treatment activities.

Contractors: Shall be responsible for the supply of potable water in their working areas in accordance with this document. Contractors will be responsible for the offsite transportation and final disposal of all hazardous waste generated as a result of their activities.

ANNEX A

Polishing and Waste Stabilization Pond (PWSP) Effluent Release Work Plan - Milne and Mary River Sites

Polishing and Waste Stabilization Pond (PWSP) Effluent Release Work Plan - Milne and Mary River Sites

Site plans are provided in the appendices for both Mary River and Milne Inlet which identify the location of the PWSPs in relation to the camps. Plan and section drawings are also provided for the PWSPs at both Milne Inlet and Mary River.

In 2009, BIM retained AMEC to prepare a technical strategy for the management, treatment, and disposal of the wastewater and sludge solids stored in the polishing/waste stabilization ponds (PWSPs) at Milne Inlet and the Mary River facilities. The technical strategy was successfully implemented during the 2009 open water season. A large portion of the PWSP effluent at Milne was discharged (without pre-treatment) to Milne Inlet. At Mary River, the contents of PWSP Nos. 2 and 3 were treated and discharged to Sheardown Lake. The 2009 technical strategy also provided guidance regarding the future steps required to manage sewage sludge. This section summarizes the current PWSP release work plan, which is built on the success of the 2009 field program.

The next section provides an update on the sludge management strategy, also building on the data collection and test work completed during the 2009 field season.

This PWSP effluent release work plan was originally developed using information gathered from a number of sources including analytical monitoring/sampling data for the RBC and PWSPs, the Mary River RBC process design evaluation, and environmental discharge criteria

established based on Water Licence requirements and considering potential impacts to the receiving environment. The plan was developed iteratively and in cooperation with Knight Piésold (KP), North/South Consultants (NSC), and BIM, to quantify the projected discharge limits that are required to meet this objective. It is critical that discharge water from the PWSPs meet the Water Licence criteria specified in Part D, Items 10 and 11 of Water Licence 2BB-MRY0710.

The target level for phosphorus has been established at 0.5 to 1.0 mg/L in consideration of anticipated overall phosphorus loadings to Sheardown Lake and modeling results. Ammonia concentrations are required to be acutely non-toxic.

Most importantly, the PWSP effluent release work plan has been based on the practical experience and data that were collected during the 2009 open water season. The PWSP effluent release work plan for discharging the accumulated water from the PWSPs involves two options.

Option no. 1 will be implemented if the PWSP melt water samples collected in May 2010 are incompliance with effluent regulatory criteria. If effluent is compliant, then discharge will commence. Once discharge has commenced, Baffinland will implement a field testing program that will provide early warning that effluent is approaching regulatory criteria limits. Since there is no treatment required for this option, this activity is a permitted activity under the currently approved Water Licence.

Option no. 2 will be implemented if the PWSP water quality does not meet the effluent discharge criteria. In this case, the effluent would be treated using the polishing pond treatment system (as was used during the 2009 open water season). The various components, processes, monitoring program, and operating criteria for the system are described below. A process flow diagrams for the process is provided in the appendices.

Polishing Treatment System Unit Processes

The polishing treatment system was designed to provide additional treatment for total suspended solids (TSS) and total phosphorus TP removal, as well as pH control.

The polishing system contains the following unit processes:

Influent Pump and Flow Meter

A pump draws from one of the ponds and feeds water at a design flow of 100 US gpm. A flow meter is used to monitor this influent flow. Flow to the polishing system can be controlled by throttling the influent pump speed or by adjusting a 3-inch ball-valve that bleeds water back into the pond.

Chemical addition

Water treatment chemicals were added to the influent water to aid in the treatment process. The following chemicals were used in the 2009 polishing system:

- Aluminum sulphate (commonly called “alum”), and
- A polymer, marked “Polyfloc AP1138” by the manufacturer, GE Betz Inc.

Aluminum Sulphate (Alum) Addition

Aluminum sulphate is added to achieve three goals:

- Precipitation of soluble phosphorous to a solid;
- Coagulation of suspended solids; and
- Reduction of pH.

Alum is dosed into the influent pipe by means of a chemical metering pump and then mixed in the piping to promote precipitation and coagulation chemical reactions. Mixing is achieved in the piping by forcing the water through a serpentine section of piping constructed using a series of elbows that create mild turbulence and mixing of the bulk fluid.

Polymer Addition

Polymer is added, after the alum, to further enhance the formation of larger solids allowing them to separate more quickly from the bulk liquid once in the Dissolved Air Floatation (DAF) tank. The polymer serves as a flocculatant which promotes the agglomeration of smaller coagulated solids into larger flocs. These larger flocs are more readily removed by downstream processes. As with the alum, the polymer is dosed into the influent pipe by means of a chemical metering pump and then mixed in the piping to promote flocculation. Mixing is achieved in the piping by forcing the water through a serpentine section of piping.

Dissolved Air Flotation System

Water containing alum and polymer is combined with a recirculating stream of water which is supersaturated with dissolved air. As the dissolved air comes out of solution microscopic air bubbles are formed on the flocculated solids, thus increasing their buoyancy. These buoyant solids float to the surface and can be easily skimmed off.

Air Dissolving Pump

The dissolved air flotation (DAF) system is comprised of a number of components. The heart of the system is a Hellbender-brand air dissolving pump. This pump is specifically designed to accept large amounts of air mixed with water, and operates under high pressure to dissolve and shear the air into fine micro bubbles. When the high pressure, air-rich, stream meets the lower pressure flocculated influent water, dissolved air comes out of solution forming small air bubbles. These small bubbles attach to the flocculated solids causing them to rise to the surface once inside the DAF tank.

DAF Tank

Influent water that has already been combined with the air-rich recirculation water is distributed across the width of the rectangular DAF tank through a relatively large, 6-inch diameter distribution header. This large inlet header is used to minimize water entrance velocity and facilitate a quiescence of the water in the tank.

Sludge is periodically skimmed off the top of the tank, over a collection beach, into a sludge trough. The sludge trough discharges collected solids by gravity to two large totes for disposal.

At the opposite end of the DAF tank from the inlet is the outlet. Clarified water is collected through a 4-inch diameter effluent header located halfway up the height of the tank. The clarified water is directed to the final effluent clear-well tanks.

Final pH Adjustment

Two effluent clear-well tanks are connected in series so that the water can be pH adjusted with sodium bicarbonate, if needed.

Floated Solids Storage and Pumping

Two parallel solids holding tanks have been provided to capture the floated solids. A 3-inch diaphragm pump is used to pump the float solids into PWSP No. 1 for storage.

Effluent pumping and flow monitoring

Clarified water is pumped through two 4-inch Tsurumi brand trash pumps, connected in series that discharge into the 3-inch Sheardown discharge pipeline. The treated water discharge flow is measured using a Badger brand 3-inch paddle wheel flowmeter with totalizer.

Polishing System – General Operating Procedures

The treatment process was designed to operate 24 hours per day, 7 days per week. The system requires two operators to operate and maintain the treatment equipment. The following are the general procedures required for successful operation of the DAF system.

Preparation for Start-up

- Ensure all pumps are filled with fuel;
- Ensure all generators are filled with fuel;
- Make sure a full alum barrel has been made up (see procedure below); and
- Make sure a full polymer barrel has been made up (see procedure below).

DAF pump start-up

- Ensure that the water level in the DAF tank is high enough so that the inlet to the DAF pump is submerged;
- Ensure that the DAF pump is flooded with water by opening the 2-inch ball-valve on the suction side of the DAF pump piping, making sure the globe let-down valve is at least partially open and verifying water is flowing out of the sample port on the 6-inch influent header;
- Ensure the air eductor-loop valves are closed;
- Turn on the DAF pump, and have one person standing at the generator to shut it down if the pump cavitates or vapor locks;
- As soon as the pump is turned on, adjust the globe valve so that the pressure in the pump discharge piping (pressurized side) reads 92 psi. This high discharge pressure is necessary for proper DAF pump function, and will allow sufficient back pressure in the DAF pump to shear and dissolve air into the fine bubbles needed for effective solids separation. Read the Hellbender manual for more detail on the DAF pump operation;

- Once the recirculation pump is operating, and the required backpressure has been achieved, slowly open the valves on the eductor loop, making sure the rotameter is off initially. If the pressure in the pump drops quickly, shut the eductor loop valves, and start again. Once the eductor loop valves are open, re-adjust the backpressure valve back to 92 psi;
- Slowly open the rotameter and begin introducing air into the pump. From 2009 operating experience an air flow rate of 20-30 scfh appears to be sufficient to achieve the dissolved air requirements. If a gravel-like sound can be heard in the pump, turn down the air or shut it off. Wait for the sound to disappear, and slowly introduce air again; and
- While starting up the influent to the system, make sure someone is watching the backpressure valve. If the pressure drops off quickly, immediately shut the eductor loops. If this does not bring the pressure up, the pump has already vapour-locked, and needs to be immediately shut down.

Influent Start-up

- Prime the raw influent pump by using flow from the DAF pump, opening the influent line to the influent pump, and removing the plug at the top of the pump casing to allow the displaced air to escape. Close the pump discharge valve to isolate the pump. Start the pump, and watch for the water to move up the suction line. Repeat the priming process if needed. Once primed, replace the plug in the pump casing and open the pump discharge valve to permit forward-flow;
- Once water is flowing into the system, measure the flow rate on the flowmeter and ensure that the flow is 100 gpm;
- Open the alum supply valve and turn on the alum dosing pump;
- Open the polymer supply valve and turn on the polymer dosing pump;
- Take a sample from the alum sample port, and measure the pH, and observe the water for coagulation and floc formation;
- Based on 2009 operating experience, for treating PWSP No. 3, the target pH will be approximately 7.15 units;
- Adjust the alum dosing pump as needed to achieve this target pH;
- Take a sample from the polymer sample port, and observe for floc formation. Compare the alum sample and the polymer sample and verify that the polymer is increasing the floc size and decreasing the formation time; and
- Initially, take frequent pH readings to ensure consistent alum dose.

Alum Make Down

- New alum solution will likely have to be made up every 4 to 8 hours. Check the alum level in the barrel every hour;
- When 50L, or about 6 inches, of alum solution is left, fill the barrel with water and add one bag of alum;
- Mix the alum right away to prevent formation of an alum paste that is harder to dissolve; and
- The 50 L level should be marked at the bottom of the barrel, and the new alum and water should be added at this same point every time as best as possible to ensure a consistent alum solution is being dosed. Always check that the influent pH has not changed after making up a new alum solution. Adjust the alum dose to maintain the same pH if the concentration of the dosed solution has shifted the pH.

Polymer Make Down

- Based on 2009 operating experience, the target polymer dose is 1 ppm for PWSP No. 3. The polymer dosing pump appears to have an upper flow limit of approximately 10 L/hr. Therefore, at 100 USgpm pond water flor rate, a polymer concentration of 2500 mg/L is needed to achieve this 1 ppm dose. This 2500 mg/L concentration is equivalent to 750 g of dry polymer per 300 L barrel;
- Polymer is most effective when it has been wetted and allowed to age for a minimum of 1 hour. To achieve this, and remain operating, add 50g of polymer powder per 20L bucket of water added. The operators should not to let the polymer make-down barrel empty very much. Ideally only 40 L of make-up water/polymer should be added at one time, which will be needed approximately every 4 hours; and
- Dry polymer powder needs to be added to water very slowly so it doesn't form into large clumps that are difficult to dissolve. When adding the dry polymer, make sure the mixer is running, and sprinkle the dry polymer over the surface of the barrel. Watch that clumps are not forming. If clumps form, slow down the addition even further. Keep the polymer agitated, but shut the mixer off periodically so that the motor does not overheat.

Sludge Skimming and Removal

The floating sludge that comes to the surface in the DAF tank has to be skimmed off frequently. Once the floating sludge mat has formed to about ¾ of the length of the DAF tank, it is time to skim. Use a large piece of styrofoam to pull the sludge to the effluent end, up the sludge beach, and into the sludge trough.

Monitor the height of sludge in the totes and pump them out when full. Pumping the contents of the sludge totes to PWSP No. 1 is required approximately once per hour when careful skimming techniques are employed and the water level is not too high in the DAF tank.

Refueling

- When refueling a pump, make sure it is turned off and all safety procedures all followed. If the influent pump is being refueled, turn off the alum and polymer dosing pumps, and close the injection point valves. The DAF recirculation pump should still be left on and can just recirculate in the tank; and
- When refueling the effluent pumps, disconnect the effluent hose from the clear well, and send the effluent to the pond while refueling.

Shut down

If the system is being shut-down for any reason, the following sequence should occur:

- Shut down the final effluent pumps, and disconnect the pumps, allowing the effluent clear-well tanks to empty back to the pond;
- Turn off the alum pump and close the injection valve;
- Turn off the polymer pump and close the injection valve;
- Turn off the influent pump;
- Shut down the DAF recirculation pump as per the Hellbender pump manual;
- Open the air-break (anti-siphon) point at the top of the DAF influent header to prevent siphoning of the DAF tank contents;
- If freezing is a risk, disconnect and drain all lines; and
- Close the DAF pump recirculation valve.

Sampling and Monitoring

- Frequent sampling and monitoring of the system is needed to document consistent operation of the system. Upon start-up, pH measurements should be taken at the influent every 5 minutes for half and hour and adjustments to the alum dose made accordingly; and
- Once the alum addition is confirmed to be stable, take samples from the polymer sampling point to visually confirm good floc formation. Make adjustments to the polymer dosing as required.

Sampling and Performance Monitoring

During operation, the treatment system is attended on a continuous basis. A daily field log was collected for each day of operation of the polishing system during 2009.

The polishing system was controlled using field testing devices for pH and turbidity. Adjustments were made to the aluminum sulphate dosing pump to control the pH and the polymer dosing pump was used to control the turbidity (indicative of total suspended solids-TSS). Physical inspection of the DAF inlet and discharge streams, as well as the consistency of the floated solids layer, indicated to the operators how well the system was operating. In the event of a suspect result a bypass valve was used to redirect effluent back to the PWSP while the system operation was adjusted and retested.

A complete summary of the field, onsite lab, and 3rd party analytical testing is contained in the following

Table 10-2 - Summary of PWSP Polishing MonitoringTable

In House Analysis	Pre Discharge	Middle of Discharge	End of Discharge	Weekly (3rd Party)	Daily (onsite lab)	Hourly (in field)
pH	√	√	√		√	√
Temperature	√	√	√		√	
Turbidity	√	√	√		√	
TP	√	√	√		√	
Ammonia	√	√	√		√	
COD	√	√	√		√	
External Lab Analysis						
BOD	√			√		
COD	√			√		
TSS	√			√		
TP	√			√		
Fecal Coliforms	√			√		
Toxicity		√	√			
O&G	√			√		

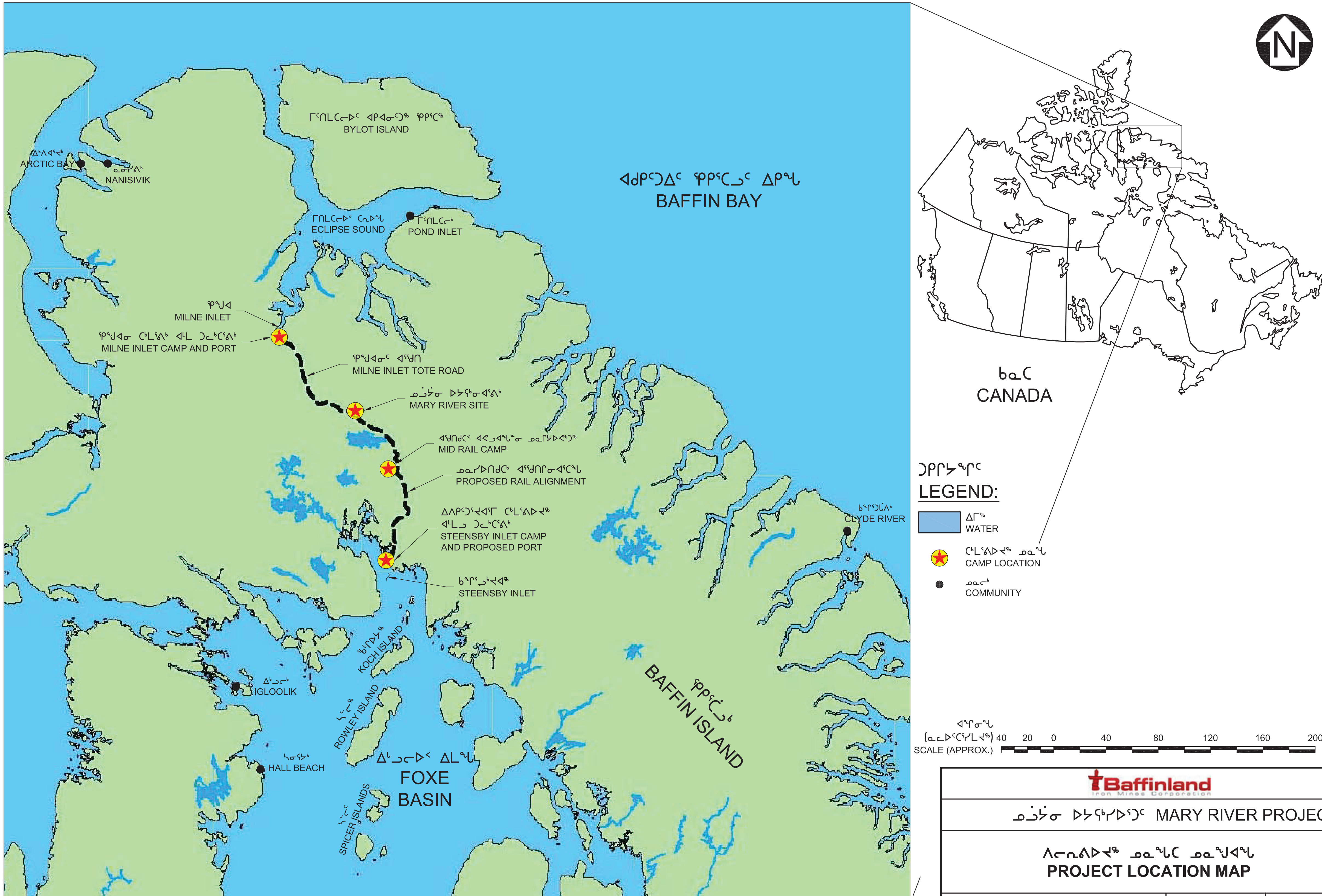
Continuous field monitoring and attendance of the system resulted in 100% compliance during the 2009 operating season. A conservative operating philosophy was adopted during the discharge season which involved using field analytical instruments to test effluent samples for multiple parameters during operation. Daily sample analysis was completed using benchtop analytical equipment available onsite.

Samples were submitted for laboratory analysis on a weekly basis to confirm the screening results and develop a correlation between the two testing methods.

ANNEX B

Drawings and Figures

XREF FILE(S): IMAGE FILE(S): 4 Baffinland logo-big corp Baffinland logo_new logo-big corp NORTH BAFFINLAND



Baffinland
Iron Mines Corporation

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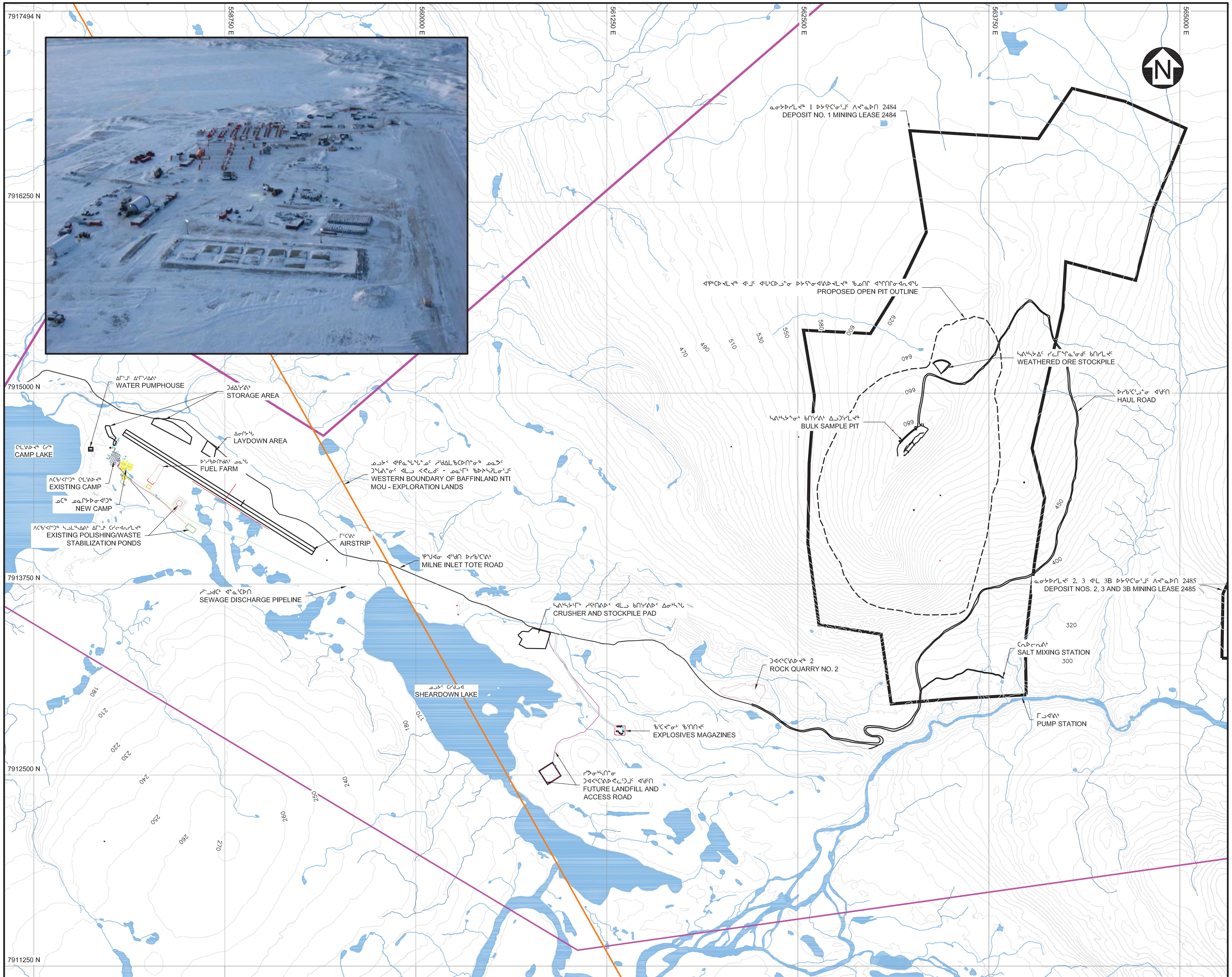
PROJECT LOCATION MAP

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

FIGURE 1

NORTH BAY ON, SAVED: I:\102-00181-15\Assignment\Acad\Figs\A04, 3/13/2009 8:57:10 AM PRINTED: 3/13/2009 9:49:30 AM, A_Landscape, Bpark



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LEGEND:

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WATER

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RIVER/STREAM/DRAINAGE

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BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND

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MINING LEASE BOUNDARY

WESTERN BOUNDARY OF BAFFINLAND NTI MOU - EXPLORATION LANDS

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 10 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
4. MINE SITE INFORMATION PROVIDED BY GENIVAR DECEMBER 9, 2008.
5. REFER TO PHOTO SHEETS FOR ADDITIONAL DETAIL OF CAMP AREA.

ᖃᐅᔨᒪᔭᒃᓴᐃᑦ

1. ᓄᓇᖑᐊᕐ ᑎᑎᕋᒪᓂᖓ ᒪᓕᒃᑐᖅ UTM (NAD83) Zone 17
2. ᑎᑎᕋᒪᔪᑦ ᒥᑕ: ᐊᖑᓂᖓᑦ ᐅᖓᓯᒃᑎᒋᒃᑐᑦ 10 ᒥᑕ
3. ᓄᓇᖑᐊᓕᐅᕐᑦ Eagle Mapping (2005)
4. ᐅᔾᕐᑕᕕᐅᔪᖅ ᑎᑎᖅᐅᔭᕋᒪᓂᖓ Genivar

ᐊᖏᓂᖓ SCALE 250 125 0 250 500 750 1000 1250 ᒥᑕ m

Baffinland Iron Mines Corporation

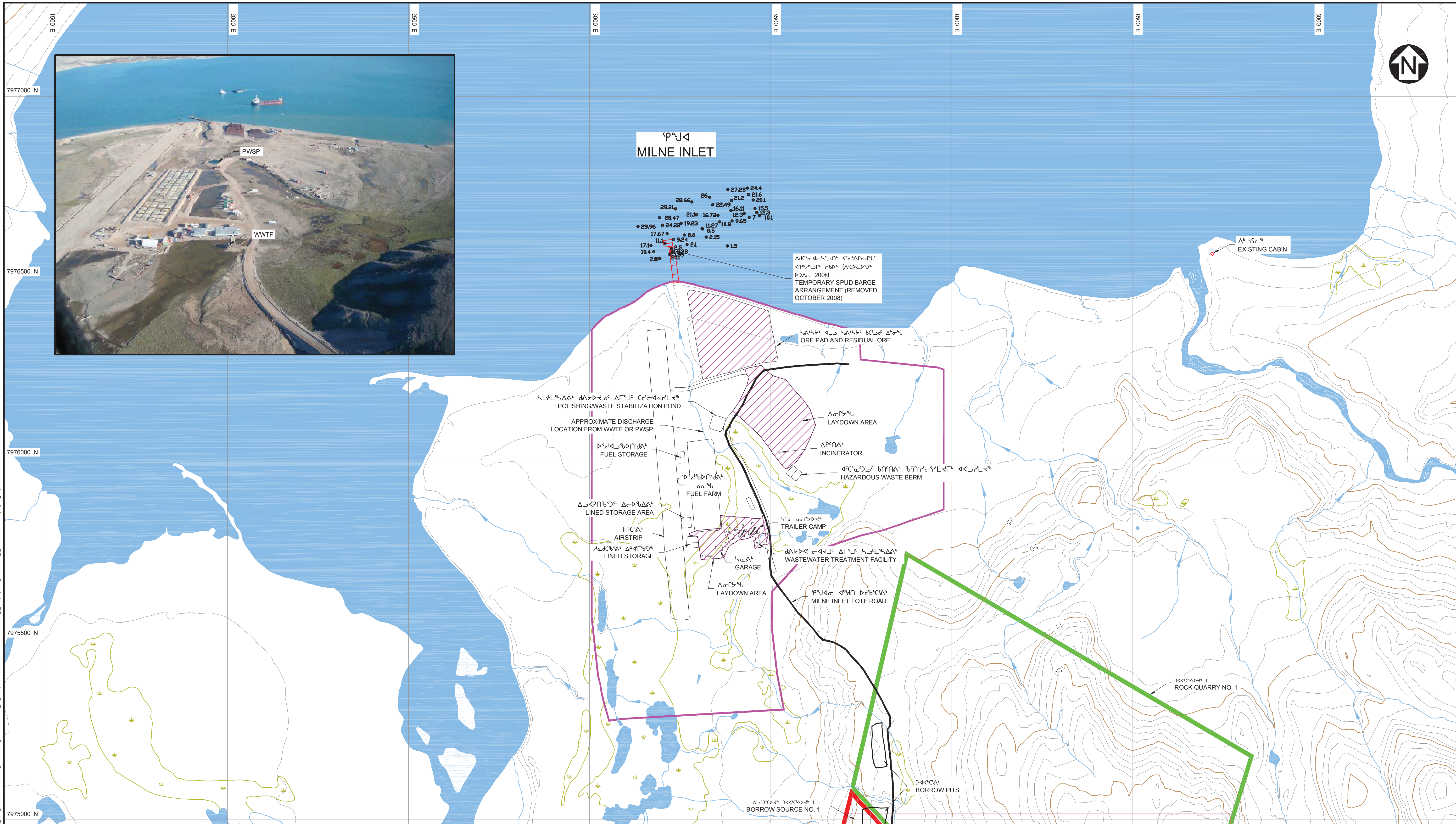
ᓄᓘᔾᓂ ᐅᔾᖅᓯᐅᕐᑐᑦ MARY RIVER PROJECT

ᒫᓇ ᓄᓗᔾᒃ ᖃᓄᐃᓪᓚᖓᓂᖓ

EXISTING SITE LAYOUT AT MARY RIVER

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

ᑎᑎᖅᐅᔭᕐᓯᒪᔪᖅ FIGURE: 2



LEGEND:

- WATER
- WETLAND
- LAYDOWN AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- RIVER/STREAM/DRAINAGE
- DIRECTION OF SURFACE WATER RUNOFF
- MILNE INLET TOTE ROAD
- ROAD
- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)

1. EAGLE MAPPING (2005)
2. UTM (NAD83) ZONE 17
3. 5 ᒥᑕ

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.

SCALE 100 50 0 100 200 300 400 500 m

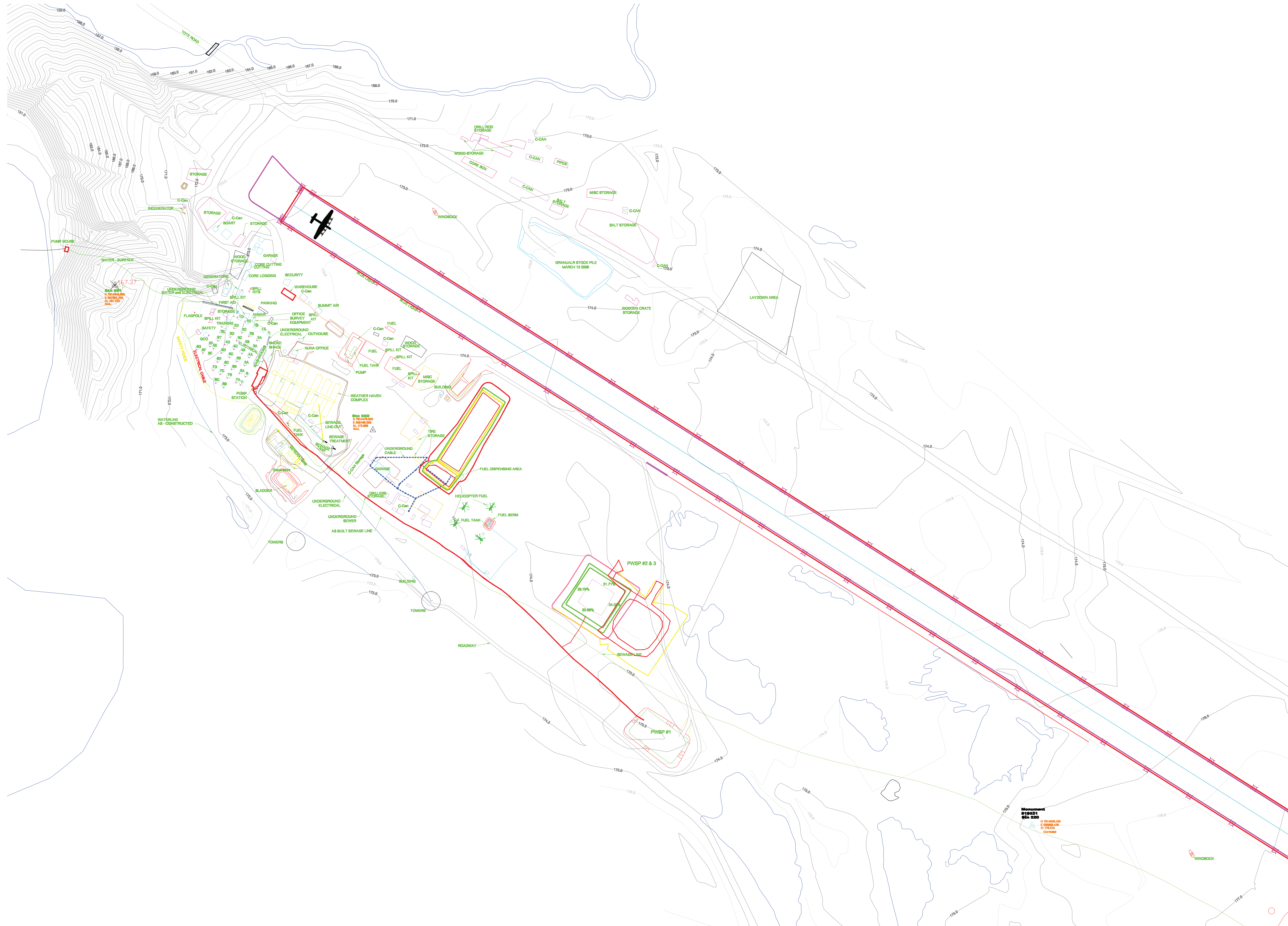
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

EXISTING SITE LAYOUT AT MILNE INLET

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

FIGURE 3



AS CONSTRUCTED SITE PLAN

SCALE 1:2000

Description	Date	No.

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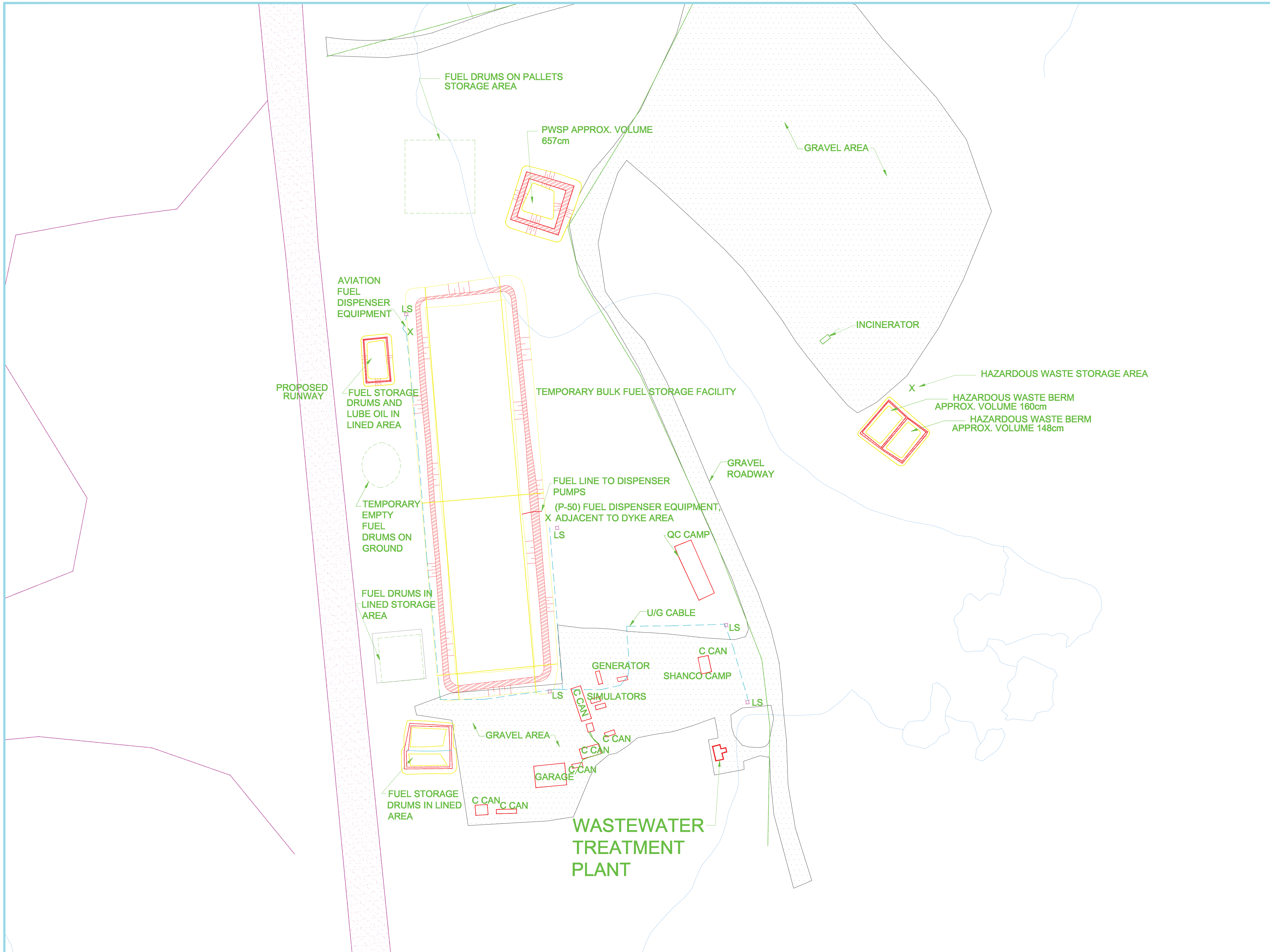
BAFFINLAND IRON
MINES CORPORATION

BAFFIN ISLAND NUNAVUT

Drawing

AS CONSTRUCTED
MARY RIVER
SITE PLAN

Date: MARCH 2009	CADD File Number: REPORT/WWMP DRAWINGS/
Scale: 1:2000	Job Number: 09-058
Drawn: SO	
Checked: MK	Drawing Number: 002
Approved	



LS LIGHT

Description	Date	No.

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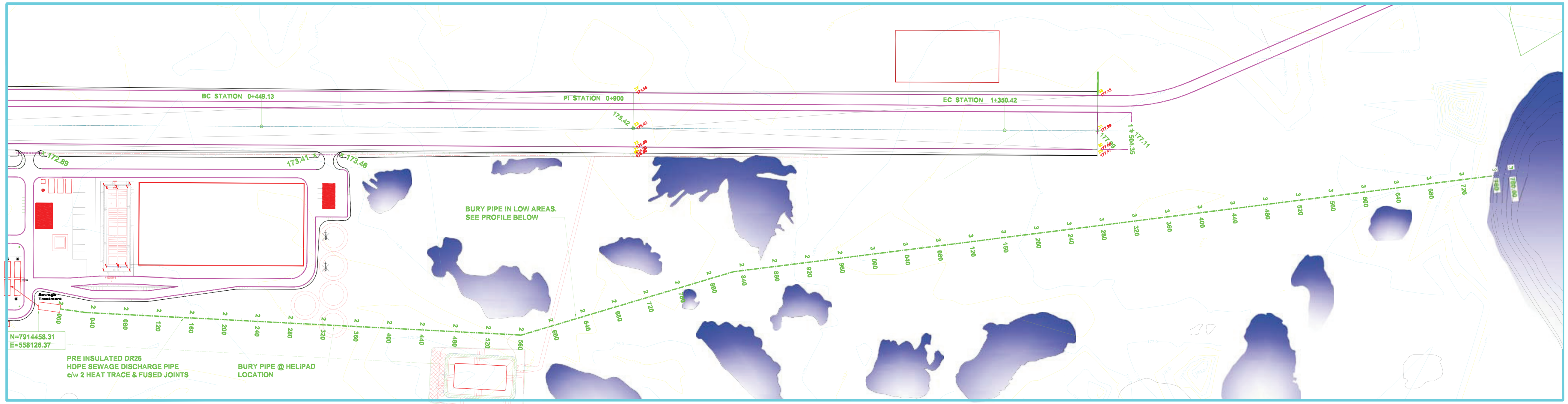
**MARY RIVER PROJECT
BAFFINLAND IRON
MINES CORPORATION**

BAFFIN ISLAND NUNAVUT

Drawing

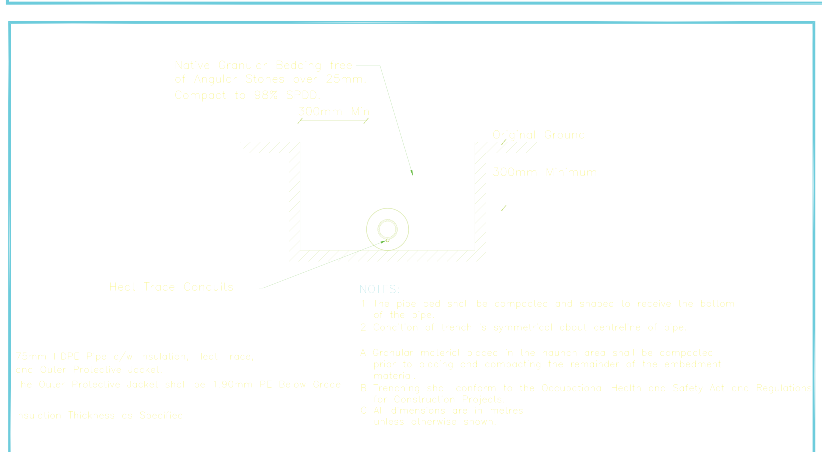
**MILNE INLET
AS CONSTRUCTED
SITE PLAN**

Date MARCH 2009	CADD File Number REPORT/WWMPDRAWINGS/
Scale 1:1000	Job Number 09-058
Drawn AB\SO	
Checked	Drawing Number 003
Approved	

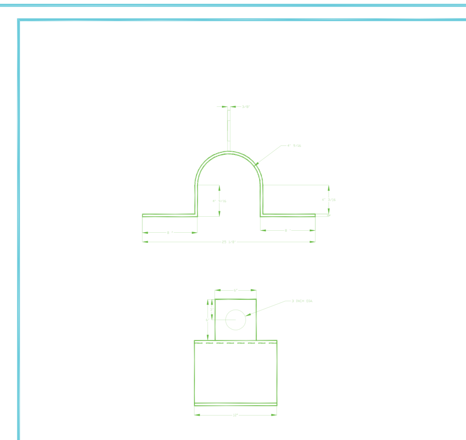


SITE PLAN

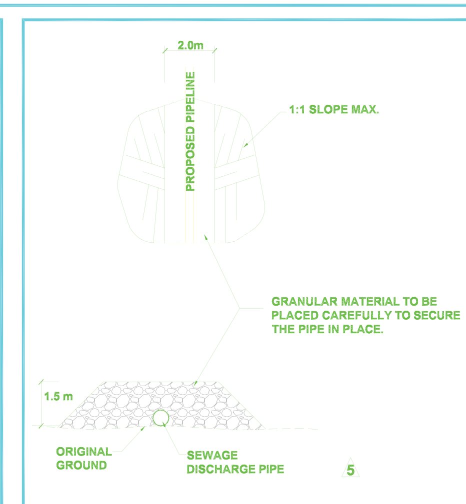
PROFILE THRU SEWAGE DISCHARGE PIPE

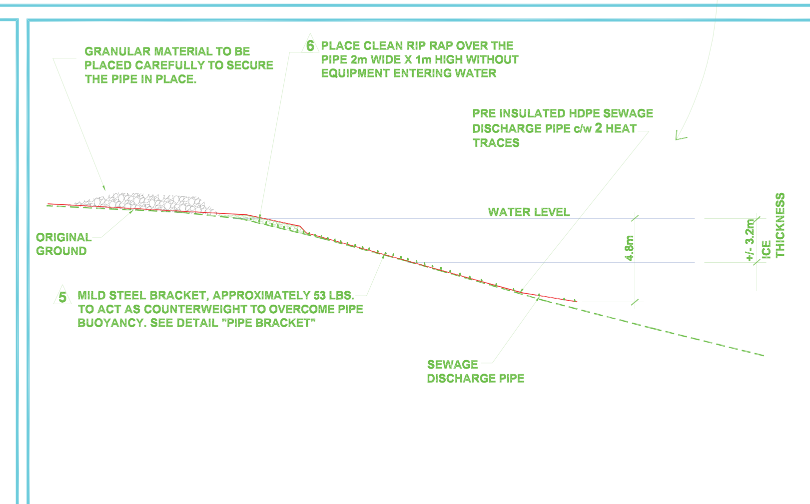


EFFLUENT OUTFALL PIPE DETAIL



PIPE BRACKET





Description	Date	No.
RIP RAP ADDED	Aug. 29/08	6
RIP RAP REMOVED AND BRACKET ADDED	Jul. 29/08	5
NEW DETAIL	Oct. 29/07	4
REVISED PIPE INSTALLATION	Oct. 9/07	3
ISSUED FOR CONSTRUCTION	July 03,2007	1
ISSUED FOR TENDER/REVIEW	May 24,2007	0

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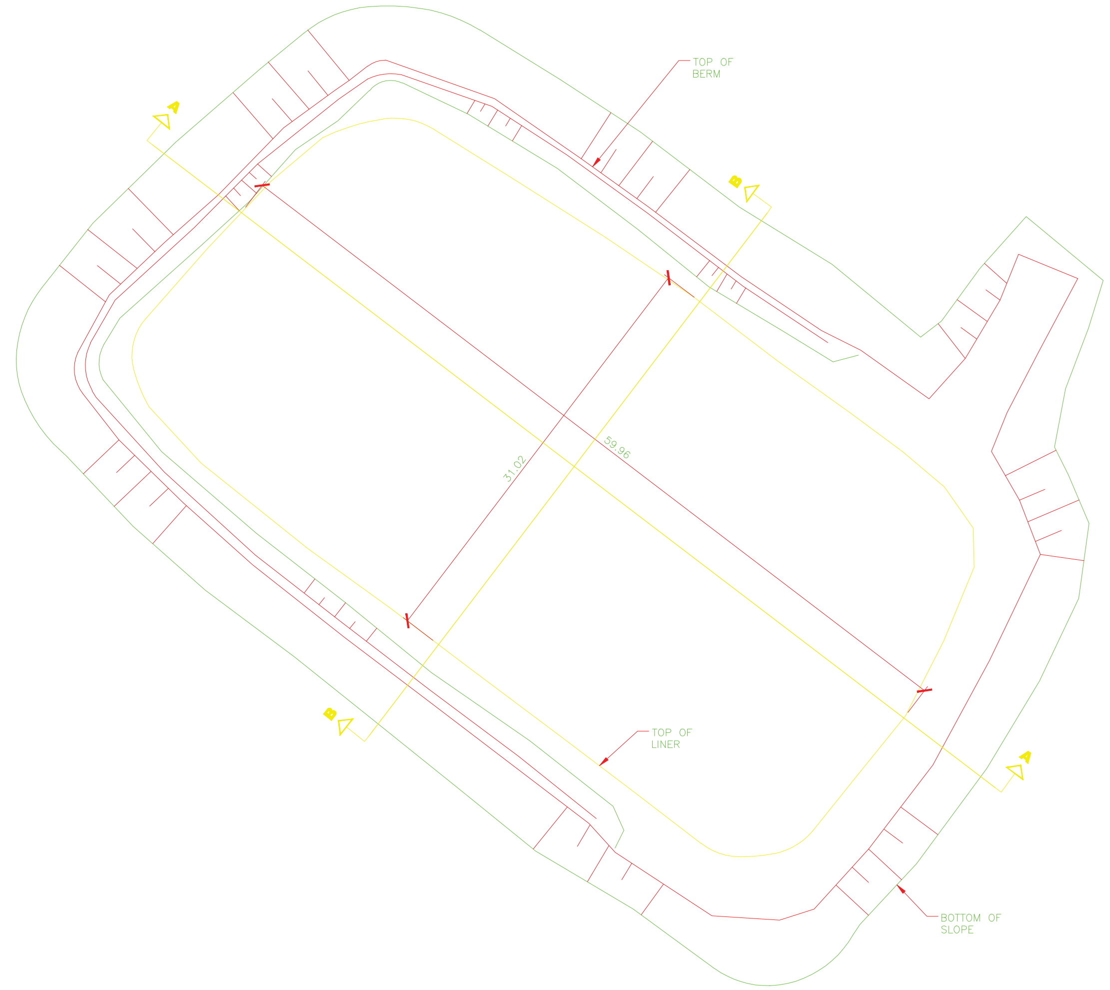
BAFFIN ISLAND, NUNAVUT

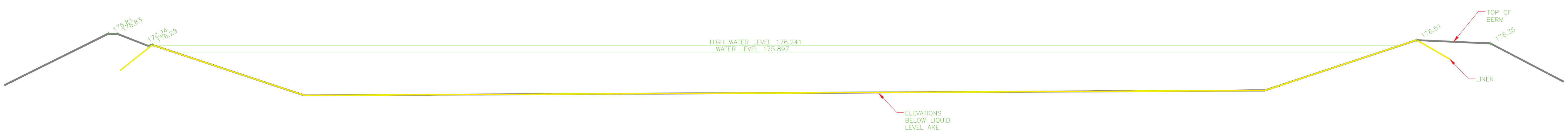
Drawing
MARY RIVER CAMP SEWAGE DISCHARGE PLAN/PROFILE & DETAILS

Date: JULY 2008	CADD File Number
Scale: AS NOTED	Job Number: 09-058
Drawn: rjr/SO	
Checked: BHM	Drawing Number: 004
Approved	

PWSP #1 AS BUILT PLAN VIEW

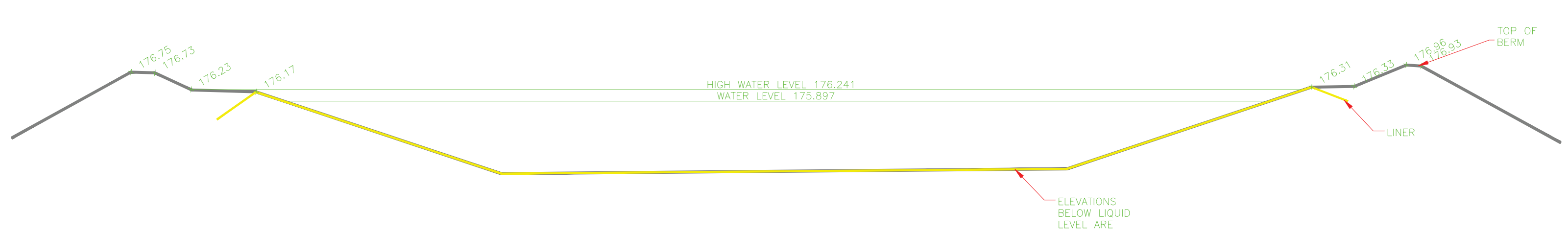
1:250





PWSP SECTION A / C302

1:100



PWSP SECTION B / C302

1:100

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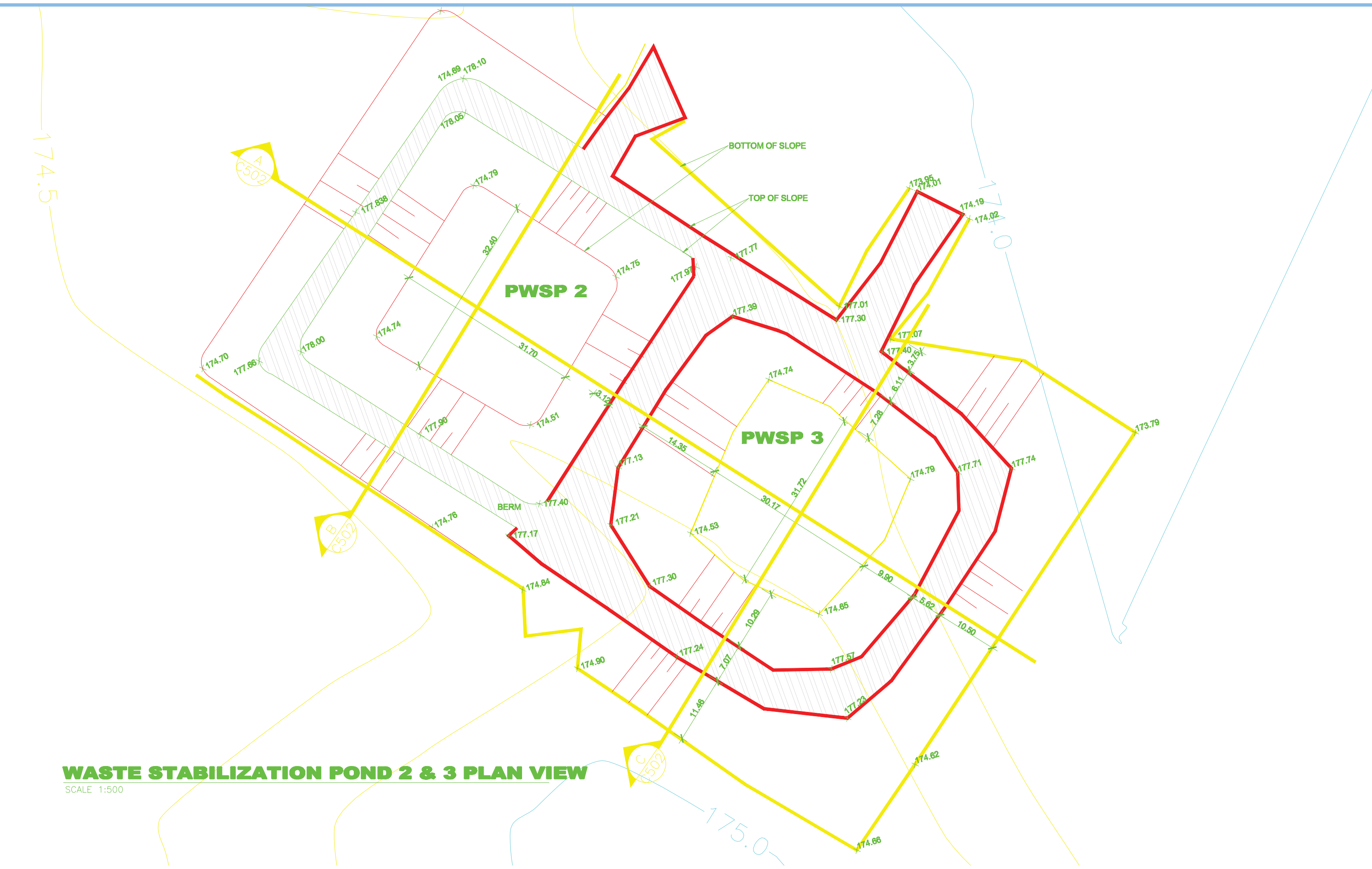
MARY RIVER PROJECT
BAFFINLAND IRON MINES CORPORATION

BAFFIN ISLAND NUNAVUT

Drawing

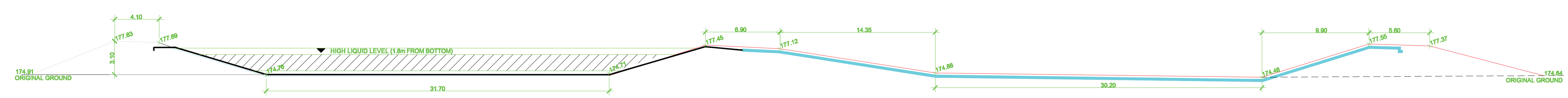
AS CONSTRUCTED
MARY RIVER PWSP 1
PLAN AND SECTIONS

Date: MARCH 2009	CADD File Number: REPORT/WWMPDRAWINGS/
Scale: AS NOTED	Job Number: 09-058
Drawn: AB	
Checked:	Drawing Number: 005
Approved:	



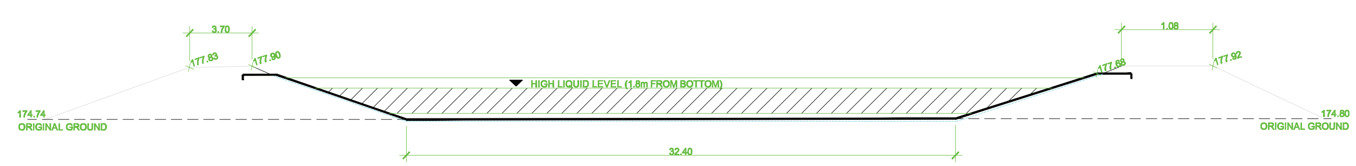
WASTE STABILIZATION POND 2 & 3 PLAN VIEW

SCALE 1:500



SECTION

SCALE 1:200



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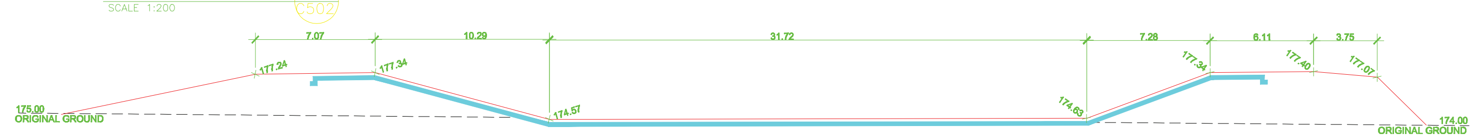
SCALE 1:200



SECTION

SCALE 1:200

Description	Date	No.
2nd Pond	Nov 4_08	1

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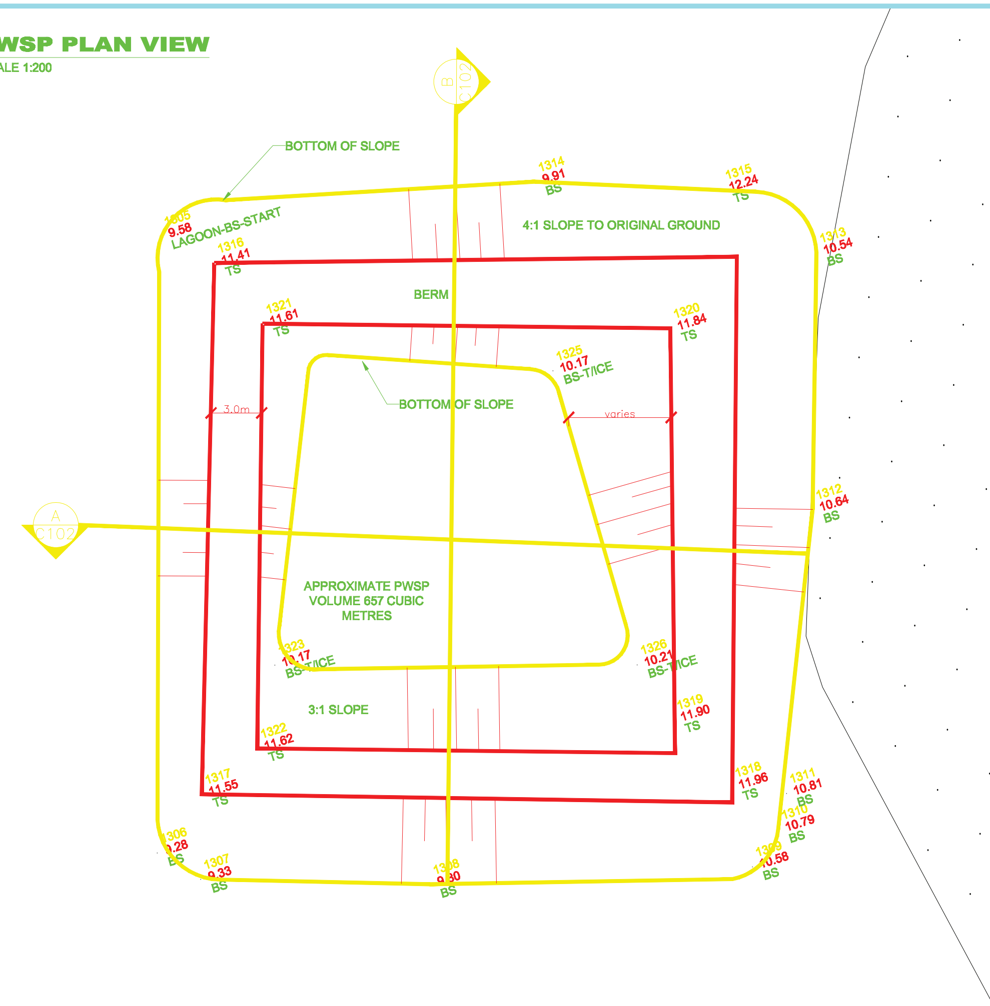
BAFFINLAND IRON MINES CORPORATION
BAFFIN ISLAND NUNAVUT

Drawing
AS CONSTRUCTED
MARY RIVER PWSP2 & PWSP3
PLAN AND SECTIONS

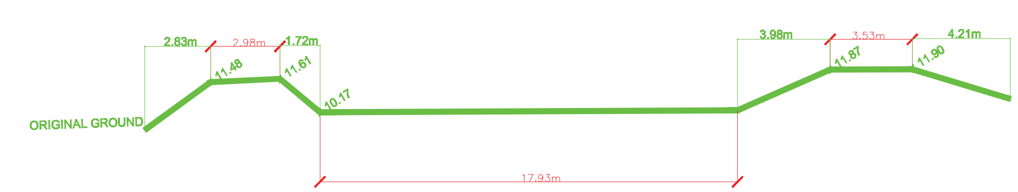
Date: MARCH 2009
CADD File Number: REPORT/WMP DRAWINGS/
Scale: AS NOTED
Job Number: 09-058
Drawn: SS/SO
Checked: M.K
Drawing Number: 006
Approved: M.K

PWSP PLAN VIEW

SCALE 1:200

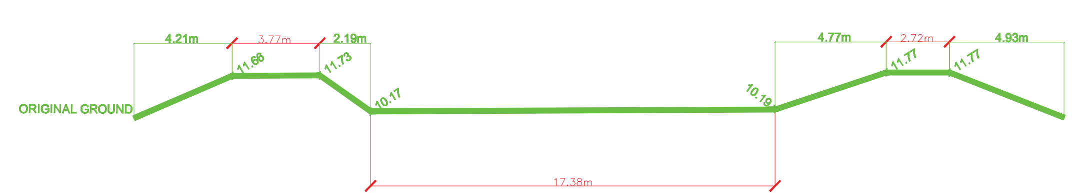


SECTION



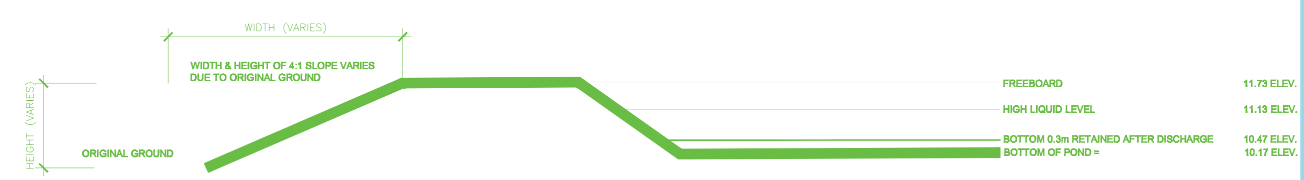
SECTION

SCALE 1:150



TYPICAL BERM

SCALE 1:75



Contractors shall verify and be responsible for all dimensions and conditions on the job and report any discrepancies to the Architect and/ or Engineer before proceeding with the work.

Drawings shall not be scaled.

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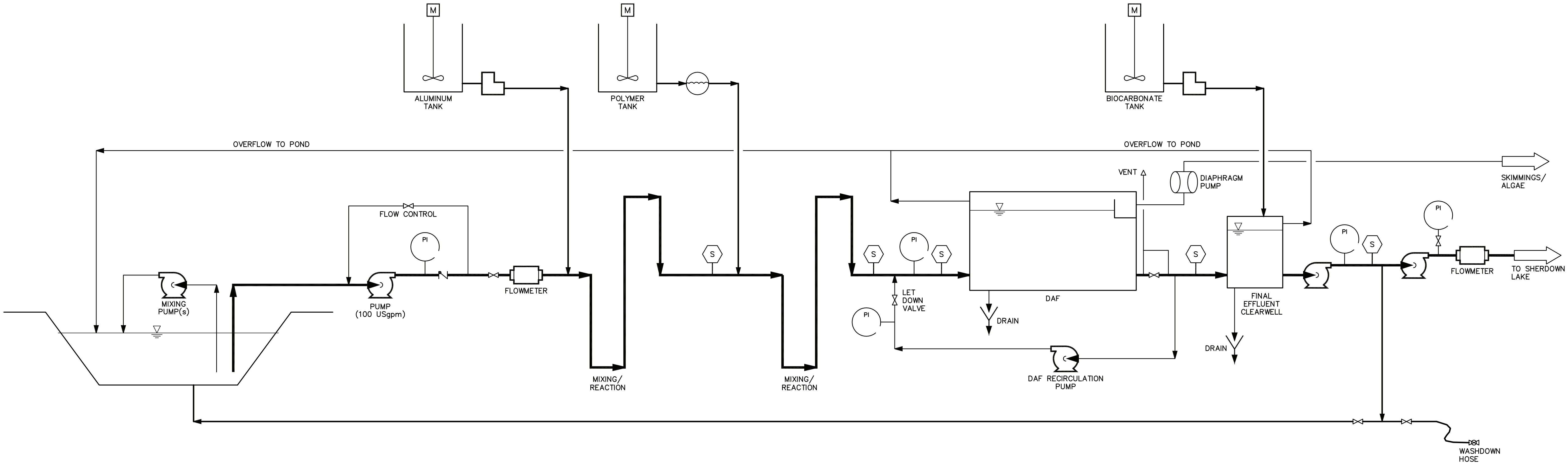
MARY RIVER PROJECT BAFFINLAND IRON MINES CORPORATION

BAFFIN ISLAND NUNAVUT

Drawing

AS CONSTRUCTED MILNE INLET PWSP PLAN AND PROFILES

Date: MARCH 2009	CADD File Number: REPORT/WWMP DRAWINGS/
Scale: AS NOTED	Job Number: 09-058
Drawn: AB	
Checked	Drawing Number: 007
Approved	



CAUTION: THIS PLAN MAY BE REDUCED 0 25mm 50mm ORIGINAL SCALE

NO.	REVISION	DATE	APRVD

DRAWN JR JULY 2009
DESIGNED JW JULY 2009
CHECKED
REVIEWED

AMEC Geomatrix

AMEC Geomatrix Limited
420 Weber Street, North, Unit G
Waterloo, Ontario N2L 4E7
(519) 886-7500

PROCESS FLOW DIAGRAM

BAFFINLAND IRON MINES
POND WASTEWATER TREATMENT

DATE: JULY 2009
SCALE: N.T.S.
SHEET: 1 OF 1 SHEETS
PROJ No: W01446
PFD-01

Filepath: T: Pete Geomatrix 2009 092245-E Baffinland (W01446) W01446-PFD.dwg
Plot Time: Jul 22, 2009 - 12:44pm, Plotted By: Dell Survey2