MEADOWBANK
MINING INCORPORATED

MEADOWBANK GOLD PROJECT

WATER USE AND MANAGEMENT PLAN
BAKER LAKE MARSHALLING AREA

OCTOBER 2007

CONTENTS OF THE MEADOWBANK BAKER LAKE FACILITIES – SITE WATER MANAGEMENT PLAN

1. The Licensee shall submit within sixty (60) days of issuance of the Licence, a Site Water Management Plan that is specific to the scope of this Licence and prepared in accordance with the comments of the Parties regarding their review of the Application filed with the Board on April 8, 2007 This Plan shall include, but not be limited to, the following:

i. The name, job title and 24 hour contact number for the person or persons responsible for site operations;

Name: Roy Lindsay
Job Title: Construction Superintendent Baker Lake
Phone No: 867-793-4610

ii. The name and address and telephone number of the employer;

Agnico-Eagle Mines Limited
Meadowbank Project
Suite 375, Two Bentall Centre
Box 209, 555 Burrard Street, Vancouver
V7X 1M8

iii. A detailed description of the facility, including its geographic location, UTM coordinates (map sheet number, Eastings and Northings) and geographic coordinates (Lat/Long);

Latitude: 64°19'2.42"N
Longitude: 96° 1'13.37"O

iv. A site map of sufficient scale to show the location of buildings, contaminants storage areas, sensitive areas such as water bodies, probable pathways of contaminant flow and general topography;

Same as in the license application

v. A detailed description of the site water management procedures to be undertaken, including, but not limited to a full water balance with details on precipitation and evaporation, the location of water diversion and sediment and flow control structures, operational controls for release of water;

Same as in the license application

vi. Steps to be taken to report, contain, clean up and dispose of any spill that may occur, which may be included as a Spill Contingency Plan (as required in Part H, Item 1) appended to the Site Water Management Plan;

Same as in the license application

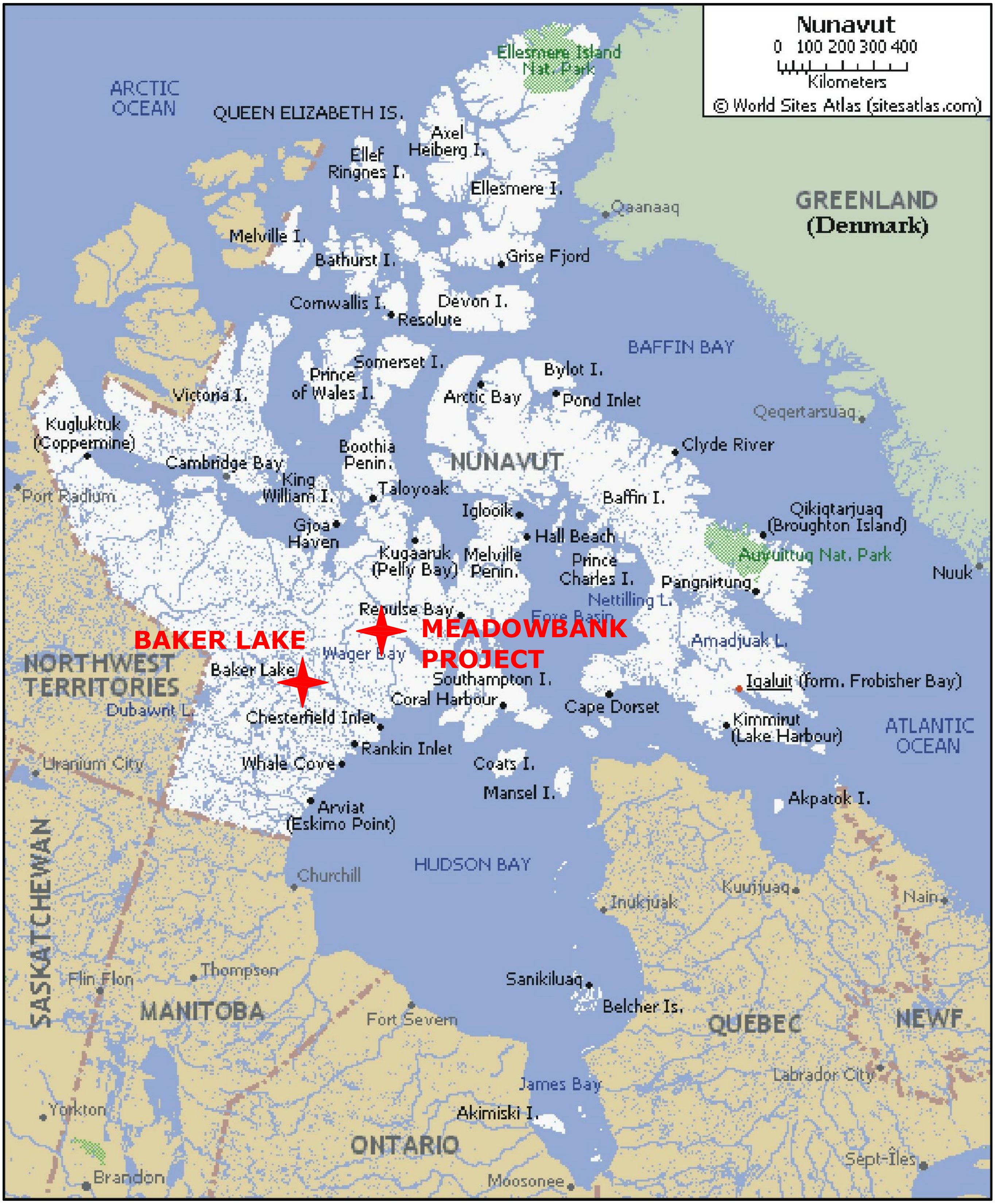
vii. A detailed description of the facility monitoring station locations, as *per* Table 1, Part J, Item 1 for the collection ponds located in the south-east and south-west corners of the lay-down area, the Bulk Fuel Storage Area containment sump, the ammonium nitrate storage area and the explosive storage area, including their geographic location, UTM coordinates (map sheet number, Eastings and Northings) and geographic coordinates (Lat/Long); and

Monitoring locations will be as stated below. Geographic locations and coordinates will be provided following construction.

Monitoring Program Station Number	**Description**	**Status**
MEA-1	Water sample location at Baker Lake in close proximity to the constructed facilities.	Active
MEA-2	East Contact Collection Pond, located in the south-east corner of the lay-down area.	Active
MEA-3	West Contact Collection Pond, located in the south-west corner of the lay-down area	Active
MEA-4	Secondary containment sump at the Bulk Fuel Storage Facility	Active
MEA-5	Water sample location at the ammonium nitrate storage area	Active
MEA-6	Water sample location at the explosive storage area	Active

viii. The date that the Site Water Management Plan was prepared.

October 2007



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KEY PLAN	FIGURE 1

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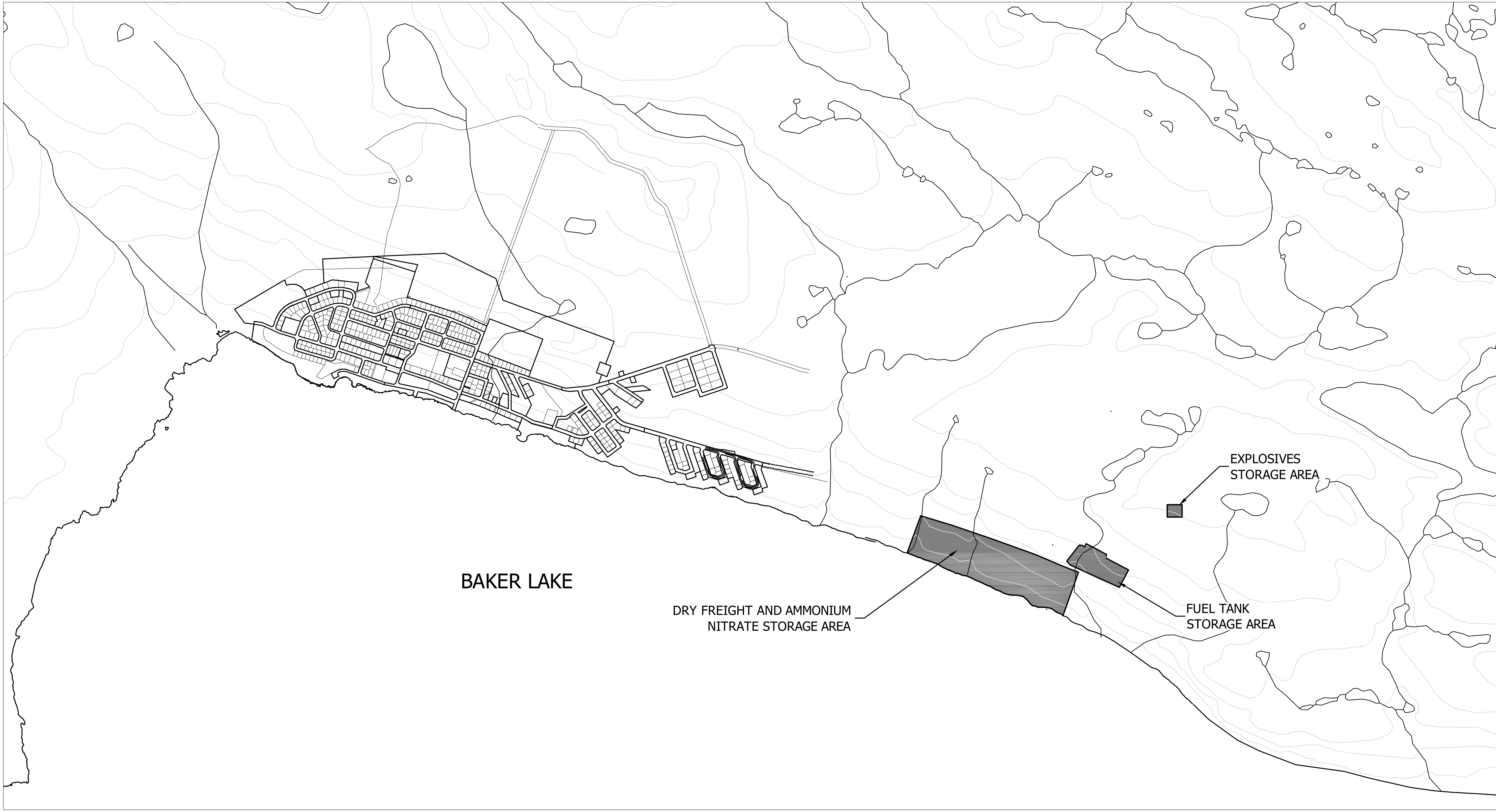

BAKER LAKE MARSHALLING AREA

0 200 400 600 800 1000

Scale in Meters

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BAKER LAKE MARSHALLING AREA LOCATION PLAN	FIGURE 2

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SECTION 1 • INTRODUCTION

This report presents the water use and management plan for the Baker Lake Marshalling Area, a component of Meadowbank Mining Incorporated, Meadowbank Gold Project. Included are:

- A discussion of the available background information;
- A summary of site conditions and of the water management objectives;
- A description of the water use, the management plan and the associated facilities;
- An operations, maintenance and water quality monitoring plan;
- A closure and reclamation plan; and
- An adaptive management strategy.

SECTION 2 • BACKGROUND INFORMATION

Meadowbank Mining Incorporated, formerly Cumberland Resources Ltd. (Cumberland) is developing a mine located in the Kivalliq region (Nunavut, Canada), approximately 70 km north of the hamlet of Baker Lake (Figure 1). Cumberland has been actively exploring the Meadowbank area since 1995. Engineering, environmental baseline studies and community consultations have paralleled these exploration programs and have been integrated to form the basis of this water management plan.

As part of this Project, a site near the hamlet of Baker Lake will be developed as a transfer point for project materials prior to overland shipment to the Meadowbank mine site. It will include facilities for barge off-loading, dry freight storage and marshalling operations, access roads, and storage for bulk fuel, ammonium nitrate and explosives. A fuel tank farm will be constructed to receive bulk shipments of diesel fuel and to provide sufficient above-ground fuel storage capacity required annually to operate the Meadowbank Project.

2.1 MARSHALLING AREA DESIGN LAYOUT

The Baker Lake marshalling area is located approximately 0.75 km east of the Baker Lake hamlet (Figure 2) at latitude 64°19’ North and longitude 96°01’ West. The marshalling area is situated above the highwater mark adjacent to Baker Lake. Fuel tanks will be located in a bermed fuel storage area northeast of the marshalling area. An explosives storage area is located further to the northeast. It is understood that the temporary storage of explosives (primers and detonation supplies) is required in Baker Lake as a transition point between shipment from the south to the Meadowbank site, even if only overnight. Explosives are to be stored in approved magazines for this transition. This proposal was approved in concept by NRCan during the EIS approval process. NRCan is the regulatory body for explosives storage and handling. It is further understood that explosives will be flown directly to the mine site once suitable airport capabilities are available.

SECTION 3 • SITE CONDITIONS

3.1 TOPOGRAPHY AND LAKE BATHYMETRY

The proposed marshalling area is located on a low terrace, parallel to the shoreline of Baker Lake. The topography at the marshalling area and the surrounding area generally has low relief with elevations ranging from 0 to 60 metres above the shoreline of Baker Lake (Figure 2). The area of the dry freight storage is located on a 5 to 10% slope towards Baker Lake. The fuel tank and explosives storage area is located on the upslope terrain, on a gradual slope (2 to 4%) towards Baker Lake. The ground rises from the shoreline at slopes between 5 to 20%. Gently sloping, well-drained, generally uniform blankets of marine gravels and sands (beach deposits) are present along the shore of Baker Lake under most of the proposed site.

The bathymetry of Baker Lake at the marshalling area was previously presented in a Golder report, dated August 25, 2005 (Golder, 2005b). Water depths offshore reach approximately 5 to 10 m within a distance of 100 to 180 m from the shore. The bathymetry indicates that the lake adjacent to the proposed marshalling area slopes gently (at about 3%) away from the shore for the first 50 m to 70 m, and then at about 7% grade to a depth of 15 m.

3.2 GEOLOGY

The regional surficial geology is characterized by sandy till, bedrock outcrops, felsenmeer (ice-shattered bedrock), and shallow lakes; the topography is generally dependent on the bedrock structure. Glacial till is the predominant soil type, although a zone of marine reworking could be present up to an elevation of approximately 100 to 200 masl. Marine beach deposits are commonly found on the north shore of Baker Lake. These deposits manifest themselves as beaches, bars, spits, and ice-pushed ridges.

The marshalling area location is underlain by mineral soil comprising various proportions of silts, sands and gravels and frost-susceptible glacial till overlying weathered bedrock. The mineral soil thickness ranges from less than 1.4 m thick in the fuel tank farm area to more than 2 m in the dry freight storage area. The glacial till comprises a matrix of fine grained soil with coarse angular gravel, cobble and boulder particles.

The ground is generally frozen at shallow depth (less than 2 m) and the bedrock is also generally encountered at shallow depth (less than 2 m).

The area is characterized by the following key features (Golder, 2004; Golder, 2005a):

- Frozen ground is expected at shallow depths (less than 2 m) over the east part of the site, in the area of the proposed fuel tank farm.
- Bedrock is expected at shallow depths (less than 2 m) over the west part of the site, in the area of the proposed dry freight storage, and also to the north, in the area of the proposed explosives storage.
- Approximately 5% of the surface area of the dry freight storage is bedrock outcrop.

- Approximately 60% of the surface area of the proposed fuel tank farm comprises bedrock outcrop.
- A top layer of organic material (primarily green moss), and organic soil covers the site. This top layer is approximately 150 mm thick.
- A layer of grey to black, medium sand has been observed below the organic layer, over most of the site, but not in the area of the push tug barge landing or explosives storage.
- Neither frozen ground nor bedrock was encountered in a test pit excavated in the area of the push tug barge landing.

3.3 FLORA AND FAUNA

The site is covered by low-lying tundra vegetation, primarily a spongy, green moss and organic material. There are no trees or shrubs at the site.

Fish found in Baker Lake include lake cisco, lake trout, lake whitefish and round whitefish. Lake cisco is thought to be the most abundant species in Baker Lake (Cumberland, 2005).

3.4 CLIMATE

There is a long-term Environment Canada climate station at Baker Lake, referred to as Baker Lake A. Climate normals for this station indicate that the daily mean temperature, on an annual basis, varies between -32.2 and 11.4 degrees Celsius. A maximum daily temperature of 16.7 degrees has been recorded in the month of July and a minimum daily temperature of -35.8 degrees has been recorded in the month of January. Average annual precipitation is 268.7 mm. Annual total rainfall is 156.7 mm and annual total snowfall is 130.7 cm.

Hourly precipitation data were obtained for the Baker Lake A station for the period from 1963 to 2006. The data were analyzed and daily rainfall and daily snowfall estimates for the 2, 10, 50, and 100-year wet years were estimated using the following distributions: Three Parameter Lognormal (3P-LN), General Extreme Value (GEV), and the Log Pearson III (LP3). The precipitation estimates from the three distributions were then compared to the measured data. A visual and numerical assessment of the fit of the measured data to each distribution was completed and a best fit distribution was selected. Table 1 presents the results of the data analysis as daily rainfall and snowfall events for the 10-year and 100-year return period.

Table 1: Extreme Daily Rain and Snowfall Data

	10-year	**100-year**
Daily Rainfall (in mm) (1951-2006)	38.7	58.4
Daily Snowfall (in cm) (1951-2006)	17.6	31.3

Hourly wind data were also obtained for the Baker Lake A station for the period from 1963 to 2006. Analysis using the same methods as described above for the precipitation data provided estimates for the 10, 100 and 1000-year hourly wind speed for each major direction. Table 2 presents the hourly wind speed estimates.

Snowmelt is a significant component to consider for the design of water management facilities. Snowmelt occurs primarily during the spring freshet, extending approximately from mid-May through June. During this period, the most rapid melt is from mid-May to mid-June, with an average weekly snowmelt at the Baker Lake snow course station of 20.8 mm water.

Table 2: Hourly Wind Speed Estimates for Baker Lake A (1963-2006)

Wind Direction	10-Year (km/hr)	100-Year (km/hr)	1000-Year (km/hr)
N	72	82	91
NE	54	61	67
E	62	71	77
SE	63	72	83
S	52	65	77
SW	49	64	80
W	68	101	149
NW	77	98	120

3.5 PERMAFROST

The Baker Lake marshalling area lies within the zone of continuous permafrost. Thermistors installed at the Meadowbank mine site indicate that the permafrost is on the order of 400 m to 500 m in thickness. It is expected that the permafrost thickness at the Baker Lake site would be similar to that at the Meadowbank mine site. However, permafrost might not be encountered in some sections of the proposed marshalling area owing to its proximity to the lake. It is likely that the permafrost table will be depressed to some degree beneath and adjacent to Baker Lake.

3.6 SUBSURFACE CONDITIONS

The site is underlain by at least 1.5 m of wet, fine grained soils, typically well above optimum water content conditions, which is consistent with frost–susceptible, ice-rich soils. However, there are isolated areas of non frost-susceptible granular soils and weathered bedrock outcrops within the marshalling area.

Test pits were excavated in the area of the proposed marshalling area (Golder, 2005a). Results indicated that the soil topography is generally composed of:

- a saturated, organic layer up to 0.2 m thick;
- up to 0.7 m thickness of brown sandy gravel; and

- saturated grey brown sand and silt layer up to 1.5 m thick.

Bedrock was encountered in these test pits at a maximum depth of 2 m. Frozen ground was also encountered to a maximum depth of 1.2 m. Seepage was observed in the test pits at the west side of the dry freight storage area. Higher flows were observed in the lower elevations, near the lake shore.

Test pits were also excavated in the area of the proposed fuel tank farm (Golder, 2005a). Results indicated that the soil topography is generally composed of:

- a saturated, organic layer up to 0.2 m thick;
- up to 0.7 m thickness of brown gravely sand; and
- saturated, grey brown, sand and silt layer up to 0.7 m thick.

The site was underlain by bedrock at shallow depths in areas where topsoil and/or overburden soils were encountered. Bedrock was encountered in these test pits to a maximum depth of 1.4 m. No standing water was observed in the test pits, however, seepage flows occurred in some areas.

3.7 WATER QUALITY

Baseline water quality for surface flow at the marshalling area was not known at the time of writing this report.

Information on the water quality of Baker Lake can be found in the baseline aquatic ecosystem report (Cumberland, 2005). The water quality of Baker Lake water closely resembles distilled water, with many conventional water chemistry parameters at or below detection limits[1]. Water chemistry is generally homogenous. The water column is generally well mixed and notable differences in water quality parameters with variance in depth or geographic location were not expected and were not detected. In the summer, some vertical stratification in temperature can be observed because of the deep depth of the lake and the higher salinity in the bottom water. A maximum surface temperature of 15.5°C and high dissolved oxygen concentrations have been recorded in mid-August.

[1] The baseline indicates that the following conventional water chemistry parameters, nutrients, organic parameters and total metals concentrations were below Health Canada drinking water guidelines and/or the CCME (2002) aquatic life guideline: pH, TDS, TSS, hardness, ammonia nitrogen, total phosphorus, total dissolved phosphorus, aluminium, lead, copper, mercury, nickel, zinc, cadmium, chromium and arsenic.

SECTION 4 • WATER MANAGEMENT

The following water management plan has been prepared for the marshalling area, the fuel storage area and the explosives storage area. The following sections present the water management objectives and strategies, standards and design criteria and water usage parameters.

4.1 WATER MANAGEMENT OBJECTIVES AND STRATEGIES

A water management plan for the proposed Baker Lake marshalling area and storage facilities is needed to minimize any potential impacts on the aquatic ecosystem of the adjacent Baker Lake. The primary objectives of the water management plan are to:

1. Minimize impacts of the proposed marshalling area and storage facilities on the quantity of surface water.

2. Minimize impacts of the proposed marshalling area and storage facilities on the quality of surface and groundwater.

A key component to these objectives is the division of surface water into two components, namely contact and non-contact water. Contact water is defined as any water that may be physically or chemically affected by the activities that will take place within the marshalling area and storage facilities. Non-contact water is defined as any water that has not been physically or chemically affected by the marshalling area and storage facilities activities.

The water management strategies to implement these objectives are:

- All contact water will be intercepted, contained, analysed and then would be discharged to the receiving environment provided the water quality meets the discharge criteria limits. If required, the contact water would be treated prior to discharge.
- Implement measures to reduce the quantity of clean runoff water to treat. Namely, non-contact water originating from areas external to the marshalling area and storage facilities activities will be intercepted and directed away from the marshalling area by means of diversion channels and routed to Baker Lake. Non-contact water from within the marshalling area will also be directed to Baker Lake.
- Monitor the quality of contact water discharges to the receiving environment.
- Minimize sediment and pollutant mobilization by implementing best management practices (BMPs) during construction and operation of the facility.
- Adjust water management practices through adaptive management based on the monitoring results of the discharge quality and the discharge criteria.

4.2 WATER MANAGEMENT STANDARDS AND DESIGN CRITERIA

4.2.1 Standards

The minimum standards incorporated into water management planning activities will be developed based on applicable federal and territorial environmental legislation including:

- *Canadian* Environmental *Protection Act*;
- *Fisheries Act*; and
- Canadian Environment Quality Guidelines.

4.2.2 Design Criteria

The various components of the water management system will be designed to meet the design criteria described below.

4.2.3 Water Management Facilities

Table 3 summarizes the preliminary design criteria that will be used in the design of water management facilities:

Table 3: Preliminary Design Criteria for the Water Management Facilities

Aspect	Component	Design Criteria	Comments/Assumptions
Runoff Collection	Channel Capacity for Non-Contact Water	100-year, 1-hour peak storm runoff rate	
	Channel Capacity for Contact Water	100-year, 1-hour peak storm runoff rate	
	Channel Capacity for Internal Contact Water	10-year, 1-hour peak storm runoff	Contact water collection ditch with no chance of overflow outside of the marshalling area
	Channel Freeboard	0.15 m	
	Contact Water Storage Capacity	1:100 year 24-hour rainfall runoff volume in addition to maximum monitoring storage volume (average year climate conditions)	Contact water storage will retain contact water for water quality monitoring and treatment, if necessary, prior to discharging it to Baker Lake. It will also act as a sediment control pond reducing total suspended solids (TSS) levels.
	Contact Water Storage freeboard	0.3 m	
	Contact Water Storage Pumping Capacity	Total contact water storage capacity volume within a one week period	
	Sediment Control	Fisheries and Oceans Land Development Guidelines for the Protection of Aquatic Habitat (1992)	

4.2.4 Water Usage

Table 4 summarizes the preliminary design criteria that will be used to estimate the necessary quantities for various water usages:

Table 4: Preliminary Design Criteria for Water Usage

Aspect	Component	Design Criteria	Comments/Assumptions
Water Usage	Number of people on site	2	Assumed based on discussion with Medowbank Mining Incorporated.
	Potable water usage	negligible (assume 10 L/per capita/day)	Drinking water will come from the Baker Lake hamlet. Domestic wastewater will be collected in portable facilities and trucked offsite for disposal at the Baker Lake hamlet wastewater treatment system
	Truck Wash	None	Truck washing will be completed at the Meadowbank mine site (Cumberland, pers. comm.)
	Dust Control	1000 L/day	Assumed

SECTION 5 • WATER USAGE AND MANAGEMENT SYSTEMS

This section contains a description of the proposed water use and management systems for the operational phase of the Baker Lake marshalling area and storage facilities. The water management systems include the contact water diversion system, the non-contact water diversion system and contact water storage and treatment system.

The proposed water management systems were developed considering storm drainage design principles for cold regions. Control and prevention of water freezing within and adjacent to drainage structures must be considered in the detailed engineering design.

5.1 WATER USAGE

The primary water usage on site is for dust control measures. Dust control measures are assumed to use approximately 1000 L/day of water to be sourced when possible from the monitoring storage ponds on site, with make-up volumes obtained from Baker Lake. Runoff from dust control applications will be to a contact water monitoring storage pond.

Other water usage requirements are for drinking water. It is assumed that the drinking water consumed at the marshalling area by staff personnel is negligible and will be sourced in the hamlet of Baker Lake and delivered to the marshalling area. The domestic wastewater production from the marshalling area is also assumed to be negligible.

Truck wheel wash will occur at the mine site only. No freshwater requirements for the truck wash will be needed at the marshalling area.

5.2 NON-CONTACT WATER DIVERSION SYSTEM

The water management plan provides for the diversion and discharge of non-contact water directly to Baker Lake.

A non-contact water diversion channel system will collect runoff draining an area north and above the marshalling area, and route it directly to Baker Lake. Channels located on the north side of the various access roads will convey flow westward along the access roads. Culverts will be installed at road crossings. At the west end of the marshalling area, non-contact water will then be routed south directly to Baker Lake.

The following best management practices (BMPs) would be used during construction and operation to prevent sediments from reaching the non-contact water diversion channels:

- Rock sheets: Exposed soils will be covered with a rock sheet as excavations advance.
- Silt Fencing: Silt fencing will be placed along the edges of all areas where soils are disturbed until completion of all construction activities. Silt fences will follow the contour as much as possible.
- Sediment Barriers in Drainage Courses: Sediment barriers constructed of riprap and drain rock will be provided in existing and constructed channels to retain sediment.

- Stabilized Construction Entrances/Exits: All traffic on and off of the site will be restricted to stabilized construction entrances/exits to minimize tracking of sediment onto public roads and right-of-ways. Traffic within the site will also be limited to stabilized construction roads. If any sediment is transported onto a public road surface, the road will be cleaned thoroughly at the end of each day. Sediment will be removed from roads by shovelling or sweeping.
- Waterbars: Waterbars will be used along construction access roads to minimize erosion of the road surface. Waterbars will be provided on all roads with slopes greater than 2%.
- Stockpile Protection: All material stockpiles will be covered in plastic when not in active use. All material stockpiles larger than 10 m^3 in size will also be contained within a silt fence located on the downstream side of the stockpile.

5.3 CONTACT WATER COLLECTION SYSTEM

Contact water will be collected in a system of diversion channels and directed to contact water monitoring storage ponds located in the southeast and southwest corners of the marshalling area.

The east contact water monitoring storage pond, located in the southeast corner of the marshalling area, will receive contact water from the explosives storage area and the portion of the marshalling area east of the access road junction with the dry freight storage area. Water accumulated within the fuel tank storage area will not contribute directly to the pond. A pump system will release the water accumulated within the berms surrounding the fuel tank storage area to the contact water diversion channels reporting to the east monitoring storage pond in a controlled manner when capacity is available in the east monitoring storage pond and water quality is acceptable for discharge. A water balance will be completed during the detailed engineering phase to confirm whether the berm storage capacity and timing of discharge can accommodate the water volumes discussed above and remain in compliance with regulatory storage capacity requirements for emergency fuel spills. If necessary, grading work will be completed upslope (north) of the fuel tank berms to prevent the water accumulation upslope from the berms.

Ditching has been completed above the tank farm area in the northeast corner to divert the runoff away from the tank farm in 2007. No ground disturbance in the marshalling area occurred in the 2007 construction period so there should be no runoff issues in this area during the 2008 freshet.

The west contact water monitoring storage pond, located in the southwest corner of the marshalling area, will receive contact water from the ammonium nitrate storage area and the portion of the dry freight storage area west of the access road junction with the dry freight storage area.

Slope protection will be installed along the southern border of the marshalling area, to protect the main contact water infrastructure (channels, monitoring storage ponds and the marshalling area fill) against ice and wave run-up from Baker Lake. The toe of the fill slope will be located an average 2 m above the high water mark.

The best management practices (BMPs) elaborated above will be used during construction and operations to prevent or minimize sediments reaching the contact water diversion channels.

5.4 CONTACT WATER STORAGE AND TREATMENT SYSTEM

Contact water will be routed to two monitoring storage ponds located on the southeast and southwest corners of the marshalling area. The role of these monitoring storage ponds is to retain the contact water for water quality monitoring and treatment, if necessary, prior to discharging it to Baker Lake. The monitoring storage ponds will also act as sedimentation ponds for the contact water. For water quality monitoring purposes, the monitoring storage ponds will have the capacity to store a volume equivalent to a week of peak snowmelt during an average year plus runoff from the 1:100-year 24-hour peak storm event.

SECTION 6 • INFRASTRUCTURE DESIGN

The design of water management infrastructure will recognize the potential challenges presented by ice-rich ground including icing, localized thawing, local ground instabilities, subsidence and transport of fine-grained soils. The detailed design and maintenance procedures for the water management infrastructure will take into consideration these challenges by incorporating where necessary design features such as adjusting the alignment of channels to take advantage of favourable foundation conditions, oversizing of the drainage infrastructure, provision of training berms instead of, or in combination with, channels, as well as lining and insulation of channels to prevent sedimentation and permafrost degradation.

6.1 CONTACT WATER COLLECTION SYSTEM AND NON-CONTACT WATER DIVERSION SYSTEM

The contact water and non-contact water channels will be sized to accommodate the peak runoff from a 1:100-year 1-hour storm. Although no specific overburden information has been collected along the proposed channel alignments, properly designed excavated channels are considered feasible. The detailed design for these channels will take into consideration items such as ice-rich ground and the presence of bedrock.

Channel alignments will be located, where possible, in favourable ground with a ditch invert at or above existing grade to avoid potential construction and operation constraints associated with channels located in the active layer (found within 2 m of surface). When this is not possible, the channel will be located in-ground with shallow excavation into the overburden soil or rock, which may require the excavation and replacement of ice-rich soils with compacted till materials. The channels will be designed as oversized structures that will allow for the addition of insulated channel lining materials (e.g., blast rock) where required.

6.2 CONTACT WATER STORAGE AND TREATMENT SYSTEM

The design of the two contact water monitoring storage ponds will be based on the assumption that all drainage is by gravity. As such, no intermediate sumps will be required for the purpose of pumping water against natural gradient. A commercially available stop log structure will be used for outlet control. If necessary, pumps may also be used to discharge treated contact water from the ponds to Baker Lake.

The contact water monitoring storage ponds will be sized to store the runoff volume from a 1:100-year 24-hour peak storm event (58.4 mm of rain), in addition to the maximum monitoring storage volume from snowmelt for average year conditions (20.8 mm of snowmelt in a week).

6.3 BEACH AND FILL SLOPE PROTECTION

Riprap will be placed as fill slope protection on the lake side of marshalling area fill, running parallel to the shoreline to protect the contact water diversion channel, water monitoring storage ponds and marshalling area fill from wind waves and ice runup. The toe of the fill slope will be located an average 2 m above the high water mark. Specific riprap configurations will be developed during the detailed engineering design.

SECTION 7 • OPERATIONS, MAINTENANCE, AND WATER QUALITY MONITORING PLAN

An operations and maintenance plan for the site is presented in this section. It includes recommendations on the type and frequency of operations and monitoring events. A water quality monitoring plan is also presented to provide a mechanism 1) to track the chemistry of the water contained in the monitoring storage ponds and in the fuel tank storage areas, and 2) to identify if water treatment is required prior to discharge to Baker Lake.

7.1 OPERATIONS AND MAINTENANCE

Operations and maintenance activities are described for each major water management facility in the following sections.

7.1.1 Contact and Non-Contact Water Diversion Channels

The design of the diversion channels will be based on the assumption that all drainage can be achieved by gravity flow. As a result, the diversion channels are considered low maintenance infrastructure. However, they will require regular monitoring to identify any issues with regards to:

- The configuration or structure of the channel etc., due to localized thawing, local ground instabilities, subsidence and transport of fine-grained soils; and
- The free flow of water, due to an accumulation of ice, sediments and other debris.

Monitoring activities will consist of visual inspections to identify sediment or debris accumulation or damage to channel structures. Particular attention to culverts and the inlet and outlet structures will be required.

The regular monitoring program during the snowmelt and ice-free season is based on a schedule of: weekly monitoring during periods of high flow of the freshet (from mid-May through June) and every two weeks (bi-weekly) during the remainder of the summer and fall period (July through October) prior to the fall freeze up. Additional monitoring will be planned after heavy or prolonged rainfall.

Maintenance operations will consist of cleaning accumulated sediments from the channels and culverts, and repair to damaged areas. Removed sediments will be disposed of at a suitable handling facility.

7.1.2 Contact Water Monitoring Storage Ponds

The design of the monitoring storage ponds will be based on the assumption that all inflows to the ponds are achieved by gravity. Pond discharge will be controlled by a commercially available stop log structure. The monitoring storage ponds will be designed to accommodate the total volume from the 1:100-year 24-hour storm runoff in addition to the monitoring storage volume for one week of the peak snowmelt rate during average year climate conditions. The monitoring storage ponds will also be designed to provide storage capacity for accumulated sediments.

Water from the monitoring storage pond will be discharged to Baker Lake provided that water quality monitoring results demonstrate satisfactory water quality.

Monitoring activities will include visual inspections to identify damage to both pond structure on a bi-weekly basis between April and October. Should damage to the structure be found, appropriate repairs will be completed within one week. In early October, or just prior to freeze-up, the ponds will be emptied and sediments cleaned out in preparation for the following year. Removed sediments will be disposed of at a suitable handling facility.

7.1.3 Monitoring Storage Pond Outlet Control System

The outlet control system consisting of a commercially available stop log structure will be designed to provide dewatering capacities for the pond volume within a one week period, provided the discharged water is of suitable quality. A outlet will be operated based on the quality and volume of water accumulated within the pond. Successful operation of the outlet control system is considered critical to the water management plan. If necessary, pumps will also be used to discharge treated contact water from the ponds to maintain storage capacity.

Monitoring activities will consist of visual and mechanical inspections to identify when repairs are required for the outlet control system. If pumps are required, particular attention will be paid to ensure that no water freezes in the pump system. As a result, no water will be allowed to sit in the pumps or piping system when temperatures are near, or below, +1 degrees Celsius.

As noted above just prior to freeze-up, the pond will be emptied. If present, pumps and piping will be drained for the winter to avoid breaks due to water freezing inside the pumps or piping system. The pumps will be stored in a heated enclosure. Prior to the snowmelt period, the pumps will be maintained and repaired when necessary to ensure availability.

7.2 WATER QUALITY MONITORING

All contact water surface runoff from the marshalling area and storage facilities will be directed to the monitoring storage ponds. The water quality within the ponds will be monitored to assure that the water discharged meets water quality standards defined in the water license for the facility. Table 5 summarizes the monitoring frequencies, monitoring method, constituents of potential interest, and action plan outlining contingencies in case of non-compliance.

Runoff water from within the containment area at the fuel tank storage area will be collected in a sump within secondary containment designed to capture petroleum products following spills. Water collected in the sump will be released in a controlled manner to the east monitoring storage pond when capacity is available in the east monitoring storage pond and water quality is acceptable for discharge. Monitoring the water quality at the containment sump will provide capacity for the identification of oil/grease from leaks or spills.

Runoff from the explosive storage area will be be conveyed to the west monitoring storage pond when capcity is available in the west monitoring storage pond. Water quality of all contact water surface runoff from the explosives storage area will be monitored at a water sample location at the explosives storage area to provide for the identification of leakage of explosives and explosive derivatives from the facilites.

Table 5: Summary of Monitoring Storage Pond Water Quality Monitoring Plan and Flow Monitoring Plan

Component	Parameters	Monitoring locations	Monitoring frequency	Monitoring methods	Potential Exceedance	Mitigation
Contact water quality	Regular monitoring program: arsenic (total), copper (total), lead (total), nickel (total), zinc (total), TSS, ammonia, total cyanide, benzene, toluene, ethyl benzene, lead, oil & grease and pH ; Event monitoring program: MSDS	All ponds and sampling locations	Regular monitoring program: monitoring during ice-free seasons: weekly mid-May through June, bi-weekly July through October or prior to discharge; Event monitoring program as needed	Regular monitoring program: unfiltered surface grab samples; Event monitoring program: as required	TSS, oil/grease, mill reagents, ammonium nitrate, fuel	Sediment control structures within channels and surface diversions and settling within the pond to reduce TSS; Unintended releases from spills, accidents, and malfunctions mitigation from Spill Contingency Plan, Emergency Response Plan, with monitoring and treatment prior to discharge to Baker Lake
Fuel storage containment sump(s)	Regular monitoring program: arsenic (total), copper (total), lead (total), nickel (total), zinc (total), TSS, ammonia, total cyanide, benzene, toluene, ethyl benzene, lead, oil & grease and pH ; Event monitoring program: MSDS	Containment sump	Monitoring during ice free seasons: bi-weekly mid-May through June, and monthly July through October or prior to discharge	Unfiltered surface grab samples	Fuel, oil/grease	Petroleum products within the sump(s) will be addressed using the spill response procedures including where necessary booms to localize the contamination, absorbant material (spill kit) to collect the contaminant and removal from the sump for disposal. Unintended releases from spills, accidents, and malfunctions at the storage area will use mitigation from Spill Contingency Plan, Emergency Response Plan

Water quality of all contact water surface runoff from the ammonium nitrate storage area and from other constructed facilites in the Baker Lake facilites will be monitored at water sample locations in close proximity to the facilites. The objectives of the water quality monitoring of contact water surface runoff from the ammonium nitrate storage area and other constructed facilities will be for early detection of spills and leachage from each facility.

7.2.1 Monitoring location

The current marshalling area design calls for two monitoring storage ponds located at the southwest and southeast corner of the marshalling area and containment capacity at the fuel tank storage area. The monitoring locations in the ponds will be marked by a highly visible stake that will define the exact location of the collection point. The location of each monitoring point will depend upon access and will be determined in the field following construction of the monitoring storage ponds. Monitoring at the fuel tank storage area is located at the containment sump.

Monitoring at the ammonium nitrate storage area, explosives storage area, and at the constructed facilities at the Baker Lake marshalling area will be in close proximity to the respective facility and will be marked with a highly visible stake to define the exact location of the collection points. Table 6 lists the five monitoring locations and provides a brief description of the sample collection points.

Table 6: Monitoring Program Station Locations

Monitoring Program Station Number	Description
MEA-1	Water sample location at Baker Lake in close proximity to the constructed facilities.
MEA-2	East Contact Collection Pond, located in the south-east corner of the lay-down area.
MEA-3	West Contact Collection Pond, located in the south-west corner of the lay-down area
MEA-4	Secondary containment sump at the Bulk Fuel Storage Facility
MEA-5	Water sample location at the ammonium nitrate storage area

7.2.2 Monitoring frequency

The Baker Lake marshalling area and storage facilities water quality monitoring plan has two primary strategies:

(a) a regular monitoring program to track the normal water chemistry of contact water from the facility prior to discharge; and
(b) an event monitoring program to track the impacts of accidental spills particularly during the period of ice free water.

Table 7 summarizes the ponds monitoring schedule during ice free periods.

Table 7: Regular and Event Based Monitoring Schedule

Regular Monitoring Schedule		**Event Monitoring Schedule**
Mid-May though June	July through October	Following Spill events
Weekly for the contact water monitoring storage ponds, ammonium nitrate storage area, explosive storage area, and constructed facilites Bi-weekly for the fuel storage containment sump	Bi-weekly for the contact water monitoring storage ponds, ammonium nitrate storage area, explosive storage area, and constructed facilites Monthly for the fuel storage containment sump	As required

7.2.2.1 Regular monitoring program

The monitoring storage ponds are sized to accommodate 1:100 year 24-hour storm runoff in addition to the maximum monitoring storage volume for the average year climate conditions. To accommodate the potential of unanticipated storm events and in order to maintain capacity in the pond, water will need to be periodically discharged to Baker Lake. The regular monitoring program is designed to provide systematic monitoring during the ice-free season following a schedule of:

- weekly monitoring during periods of high flow of the freshet (approximately from mid-May through June); and
- bi-weekly monitoring during the remainder of the summer prior to the fall freeze or prior to discharge (approximately from July through October).

The regular monitoring program for the containment sump within the fuel storage area is designed to provide systematic monitoring of oil and grease during the ice-free season following a schedule of:

- bi-weekly monitoring during periods of high flow of the freshet (approximately from mid-May through June); and
- monthly monitoring during the remainder of the summer prior to the fall freeze (approximately from July through October).

7.2.2.2 ***Event monitoring***

It is unlikely that the chemical load derived from the marshalling area and storage facilities, with the possible exception of suspended particulates such as clay and fine grained sediments, will be significant. In the case of any spills, accidents, and potential malfunctions, appropriate remediation responses will be initiated as outlined in the following documents: Spill Contingency Plan and Emergency Response Plan (refer to Section 7.3). The monitoring storage ponds will be sampled following any accidental release and remediation efforts to:

- confirm the effectiveness of the cleanup effort; and

- identify the need, if any, for special handling or treatment of the monitoring storage pond water.

The containment sump at the fuel storage area will be monitored for oil and grease following a release either from leakage from piping or storage vessels or from spills.

7.2.3 Monitoring parameters

Parameters for monitoring are specific for the regular and the event monitoring programs. The parameters of concern for the regular monitoring program for the marshalling area include arsenic (total), copper (total), lead (total), nickel (total), zinc (total), TSS, ammonia, total cyanide, benzene, toluene, ethyl benzene, lead, oil & grease and pH. The choice of TSS and oil/grease is based upon the potential for runoff to erode soil and vehicular traffic to generate a residuum of petroleum products. The choice of ammonia is to address the potential release of ammonium nitrate from the explosives storage area.

The parameters of concern for the event monitoring program include those elements unique to the material discharged and referenced in the Materials Safety Data Sheets (MSDS). The sump within the containment area of the fuel storage area will be monitored for oil/grease.

7.2.4 Monitoring methods

Unfiltered surface water grab samples for the regular monitoring program will be collected from the monitoring locations in the monitoring storage ponds based upon the monitoring schedule outlined in Table 7. Table 8 summarizes the volume, container type, preservation method, and holding time for each analyte.

7.2.5 Action plan outline

Potential exceedences in water quality at the Baker Lake marshalling area monitoring storage ponds could include TSS and oil/grease and/or materials delivered to the marshalling area. Potential exceedences from the fuel tank storage area are TSS, oil/grease, and fuel. Potential exceedences for the explosives storage area are nitrtogen species. The regular and event monitoring programs are designed to identify conditions when when the parameters listed in Table 9 exceed the water quality guidelines identified in the license for the regular monitoring program and trigger contingency plans to reduce the respective concentrations.

Table 8: Summary of Analytes for the Regular Monitoring Program [(1)]

Analyte	Minimum volume	Container	Preservation	Holding Time
Total arsenic	250 mL	Plastic	HNO3 – pH below 2	6 months
Total copper	250 mL	Plastic	HNO3 – pH below 2	6 months
Total lead	250 mL	Plastic	HNO3 – pH below 2	6 months
Total Nickel	250 mL	Plastic	HNO3 – pH below 2	6 months
Total Zinc	250 mL	Plastic	HNO3 – pH below 2	6 months
Total suspended solids	100 mL	Plastic	Cool, 4 ºC	7 days
Ammonia	400 mL	Plastic/glass	Cool, 4 ºC, H_2SO_4 – pH below 2	28 days
Total cyanide [(2)]	500 mL	Plastic	Unfiltered, cooled 4ºC in dark, NaOH over 12	14 days
Benzene (µg/L) [(2)]	2 x 40 mL	Glass/teflon cap	$NaHS0_4$	14 day
Toluene(µg/L) [(2)]	2 x 40 mL	Glass/teflon cap	$NaHS0_4$	14 day
Ethylbenzene(µg/L)	2 x 40 mL	Glass/teflon cap	$NaHSO_4$	14 day
Lead	250 mL	Plastic	Cool, 4 ºC, filter in laboratory	Anlayze immediately
Oil & Grease	1000 mL	Glass	Cool, 4 ºC, H_2SO_4 – pH below 2	28 days
pH	25 mL	Plastic	none	Analyze immediately

[(1)] USEPA Methods for Chemical Analysis of Water and Waste Water, EPA-600/4-79-020.
[(2)]Environmental Sampling Guide, 2004, ALS Environmental, 1988 Triumph Street, Vancouver BC, V5L 1K5.

Table 9: Water Quality Guidelines for Regular Monitoring Parameters

Parameter	Max. Average Concentration (MAC) (mg/L)	Maximum Concentration of any single grab sample (mg/L)
Total arsenic	0.5	1.00
Total copper	0.3	0.6
Total lead	0.05	0.2
Total Nickel	0.5	1.0
Total Zinc	0.5	1.0
Total suspended solids	15	30
Ammonia		
Total cyanide	0.1	0.2
Benzene (µg/L)	370	
Toluene(µg/L)	2	
Ethylbenzene(µg/L)	90	
Lead	1	
Oil & Grease	5 and no visible sheen	
pH between 6 and 9.5		

7.2.5.1 Regular monitoring contingencies

Design criteria for the Baker Lake Marshalling Area include mechanisms to reduce the concentrations of these parameters including:

- Best Management Practices (BMPs) such as silt fences within the channels and other structures designed to intercept sediments prior to the monitoring storage ponds;
- Sediment settling within the ponds; and
- Booms and/or barriers within the ponds to isolate surface oil films for removal and/or treatment. Booms and barriers will be stored on site.

7.2.5.2 *Event monitoring contingencies*

Elements of concern for the event monitoring program include mill reagents (lime, sodium cyanide, acid, flocculants, copper sulphate), fuel, or explosives (ammonium nitrate) from spills, accidents, and potential malfunctions. Each of these accidental releases has specific guidelines that include: mobilization of site equipment to stabilize the release; procedures to contain, neutralize, and dispose of the discharge, and recommendations for monitoring the site following the incident. These guidelines are provided in the:

- Spill Contingency Plan
- Emergency Response Plan

The event monitoring program is the specific monitoring program for the Baker Lake marshalling area and storage facilities and is intended to identify the presence of contaminants in the pond water for treatment prior to any release from the pond. The specific elements of concern will be based upon the type of release and will use the MSDS data to identify the analytes and monitoring program.

The containment sump monitoring program is intended to:

- identify leakage from piping and /or the storage vessels which will trigger diversion of sump water to contact water facilities and emergency response for site remediation; and,
- monitor treatment after mitigation.

7.2.6 Flow monitoring program

The volume of contact water from the Baker Lake Marshalling Area will be monitored through the volume of discharge released from the monitoring storage ponds. The average flow rate, total discharge per event and total cumulative discharge will be recorded and reported annually.

SECTION 8 • CLOSURE AND RECLAMATION CONCEPT

This section summarises a preliminary closure and reclamation concept for the Baker Lake marshalling area and storage facilities. All structures, materials and equipment not required for future use by the local community will be dismantled and demobilized from the site. Non-salvageable buildings and structures will be dismantled or demolished and disposed of offsite. Any site roads and storage pads not required for future use will be decommissioned and all drainage courses will be restored to the original locations where topography and slope stability allows. The water management infrastructure such as diversion channels, monitoring storage ponds, or culverts, will be designed to be dismantled and removed to facilitate restoration of the original drainage.

Water management infrastructure, including the contact and non-contact water diversion channels, the monitoring storage ponds and fill slope protection will be required to remain in place and operational until the marshalling area closure activities are completed and monitoring results demonstrate that water quality conditions are acceptable for discharge of all contact water to the environment without further treatment. It is proposed to maintain operations, monitoring and maintenance activities of the water management infrastructure for five years after closure of the marshalling area. Should water quality monitoring demonstrate that contact water is suitable for direct discharge to Baker Lake, site reclamation could begin earlier than five years.

Once water quality monitoring indicates that the surface runoff is of dischargeable quality, monitoring and treatment of contact water will be discontinued and the marshalling area and storage facilities water management infrastructure will be dismantled.

Assuming no use for the marshalling area and storage facilities infrastructure have been identified by the community of Baker Lake, the proposed closure and reclamation plan for the marshalling area will involve the following key steps:

- Fuel tanks and explosive facilities will be dismantled and removed from site.
- Marshalling area facilities will be dismantled and removed from site.
- Revegetation of the marshalling area, fuel tank storage area, explosive storage area and channels will be completed based on results of field trials during operations.
- Contact and non-contact water diversion channels infrastructure will be filled, and original drainage courses restored where possible once vegetation has been established. Monitoring would continue.
- The pump system, if used, will be dismantled and removed.
- The monitoring storage pond will be decommissioned, filled and re-vegetated.

Throughout the operational period of the marshalling area, the diversion channels will be maintained over a number of seasons. The water management systems for the closure and reclamation phase will be designed based on the performance of water management infrastructure during the marshalling area operations, providing a flexible and adaptive management strategy for the closure of the water management system.

SECTION 9 • REFERENCES

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